19.08.01 (12 of 16)

CONTAMINANT LEVELS IN NORTH PACIFIC KILLER WHALES

Project Number:	~~New project~~ 00461
Restoration Category:	Research
Principle Proposer:	Margaret M. Krahn, Ph. D., Environmental Conservation Division, Northwest Fisheries Science Center, National Marine Fisheries Service
Co-Proposer:	Gina M. Ylitalo, Environmental Conservation Division, Northwest Fisheries Science Center, National Marine Fisheries Service
Co-Proposer:	Marilyn E. Dahlheim, Ph.D., National Marine Mammal Laboratory, Alaska Fisheries Science Center, National Marine Fisheries Service
Lead Trustee Agency:	NOAA
Cooperating Agencies:	None
Alaska SeaLife Center:	No
Duration:	1st year, 1-year project
Cost FY 00:	73.8K
Geographic Area:	No field research proposed
Injured Resource/Service:	Killer whale (AB pod, AT1 pod)

ABSTRACT

Organochlorines (OCs) are widespread and persistent contaminants in the marine environment. By monitoring the level of toxic chemicals in marine mammals, a measure of the health of the ecosystem can be realized. Many compounds can bioaccumulate in top-level, marine predators (e.g., killer whales). Archived blubber samples, obtained from killer whales ranging from California to Alaska, will be analyzed to determine levels of selected organochlorines. Resultant data will be compared to those obtained for Prince William Sound killer whales. A broadscale, geographic index, depicting North Pacific killer whale contaminant levels, will be completed. Linkage of high contaminant levels to killer whale pods with low reproduction (AT1 pod) and population decline (AB pod) will be investigated.

INTRODUCTION

Killer whales (*Orcinus orca*) are the largest species of the Delphinidae family. This species is cosmopolitan in distribution (Heyning and Dahlheim, 1988). In 1971, studies were initiated on killer whales occurring in British Columbia, and Puget Sound, Washington to provide baseline data on abundance, pod structure and population productivity (Balcomb and Goebel, 1976; Bigg, 1982). Two eco-types were identified and termed transient and resident (Bigg, 1982; Bigg *et al.*, 1990). The two types are genetically distinct (Hoelzel *et al.*, 1998) and differ in various aspects of morphology, vocalization patterns, and habitat use (Dahlheim and Heyning, 1998). Diets vary considerably; transient killer whales feed primarily on marine mammals (i.e., harbor seals) whereas the resident animals predominately eat fish, such as salmon (Baird *et al.*, 1992). Similar killer whale studies have been conducted in Prince William Sound, Alaska (Matkin *et al.*, 1994). , Resident and transient pods have also been described from Prince William Sound, AK (Dahlheim and Matkin 1994).

Monitoring for toxic chemical contaminants in marine mammals is necessary to evaluate the risk of deleterious effects to these animals, as well as provide a measure of the health of the ecosystem. Organochlorines (OCs) are widespread and persistent chemical contaminants that are frequently measured in the marine environment. Many of these compounds, including chlorobiphenyls (CBs) and DDT, are highly lipophilic and can bioaccumulate in top level predators of the marine food chain, such as killer whale. Many OCs, [e.g., hexachlorocyclohexanes (HCHs), chlorobiphenyls (CBs) and DDTs] have been detected in remote areas of world even though the production of CBs and the use of DDTs have been banned in the U.S. and other countries for more than 20 years (Barrie *et al.*, 1992; Muir *et al.*, 1992; Iwata *et al.*, 1993). However, many of these compounds are still being used in various parts of the world and are being transported to the subarctic and arctic regions of the northern hemisphere via prevailing global atmospheric circulation (Barrie *et al.*, 1992; Muir *et al.*, 1992; Iwata *et al.*, 1993).

Accumulation of certain OCs in marine mammals is linked to various deleterious biological and physiological effects, including reproductive impairment, immune suppression and pathological lesions (Addison 1986; Beckmen *et al.*, 1997; Reijnders 1986). OC-induced immune suppression may have contributed to the high mortality of striped dolphin from the Western Mediterranean during a recent morbillivirus epizootic (Kannan *et al.*, 1994). Other studies have shown a decrease in immune responses in captive harbor seals fed OC-contaminated fish compared to seals fed fish containing low levels of OCs (Ross *et al.*, 1995; Ross *et al*, 1996). Furthermore, high OC concentrations have been implicated as the cause for low reproduction in a beluga whale population from the St. Lawrence Estuary (Martineau et al., 1987) and in common seals fed contaminated fish from the Dutch Wadden Sea (Reijnders 1986). Exposure to these chemical contaminants may indirectly affect populations of certain marine mammals by increasing susceptibility to opportunistic pathogens at lower exposure levels than are necessary to observe direct toxicity, reproductive failure or dysfunction or death.

Although killer whales have been extensively studied over the years, few chemical contaminant data have been reported. Previous studies have measured OCs in the blubber of killer whales from the eastern North Pacific (Calambokidis *et al.* 1984; Jarman *et al.*, 1996), Japan (Kannan *et al.*, 1989) and Australia (Kemper *et al.*, 1994). In a recent study, selected OCs were measured in whales from the Gulf of Alaska and Prince William Sound, AK (Matkin *et al.*, 1998). A wide range of OC concentrations was reported in these whales. The contaminant levels appear to be

influenced by certain biological factors such as sex, reproductive status and birth order, as well as diet. However, the types and levels of chemical pollutants that can induce deleterious biological effects, as well as the processes by which they affect marine mammal health and survival, are not fully characterized. Such information is needed to assess the relative contribution of toxic environmental contaminants to unusual mortalities, strandings or poor health of marine mammals. An epidemiological approach can give important information on associations between exposure and effects. An important component is such an approach is collecting data on exposure from a range of individuals that have experienced different levels of contaminant exposure.

NEED FOR THE PROJECT

A. Statement of Problem

Killer whales from the resident AB pod of Prince William Sound, Alaska numbered 36 animals prior to the *Exxon Valdez* oil spill (EVOS). During the seven-year period after the oil spill (1989 – 1996), 14 whales were missing from this pod, primarily juveniles and reproductive females (Matkin *et al.*, 1994). However, between 1996–1998, five calves were recruited and only two additional adults were missing. Although these data indicate that the population of the AB pod is increasing, it is too soon to determine if recovery is occurring. In addition, ten animals in the AT1 pod, a transient pod numbering 22, that resides primarily in Prince William Sound, have not been seen in the past eight years. Furthermore, there has been no recruitment of calves in the AT1 group of whales during this time period. The decline of whales in the resident AB pod and lack of recent recruitment in the transient AT1 pod may be due to natural causes or other circumstances (e.g., fishing interactions, opportunistic pathogens). However, these losses may also be associated with exposure to anthropogenic contaminants related to the EVOS or other contaminant sources.

This study will provide critical OC contaminant information that may help explain why the number of whales in the AB pod has fallen from 36 whales to 26 whales from 1988 to 1997. The contaminant levels measured in the killer whales from waters off the coasts of Alaska (Bering Sea, Aleutian Islands, Southeast Alaska), Washington, Oregon, and California will be compared to the OC levels measured previously in whales from the resident AB pod and transient AT1 pod (Matkin *et al.*, 1998).

B. Rationale/Link to Restoration

This study proposes to use archived blubber samples collected between the years 1990-1998 from a wide geographical range of the eastern North Pacific. Additional samples will be collected in 1999. Tissue collection, transport and archiving have been completed and is a part of the National Marine Mammal Laboratory's (NMML's) ongoing killer whale monitoring program. Thus, this project is supported by considerable cost sharing from NOAA. The results of the proposed chemical contaminant analyses will be complemented by NMML's database on killer whale life history data, which are available for the same years when tissues were collected. In addition, the study will be further complemented by a previous EVOS Trustee Council and North Gulf Oceanic Society supported study (Restoration Project No. 97012). The proposed study will determine how contaminant concentrations and profiles in Eastern North Pacific killer whales compare with levels and profiles of contaminants measured in Prince William Sound

killer whales and in other marine mammal studies that have correlated OC levels with deleterious biological effects. Linkage of OC levels to killer whale pods with low reproduction (AT1 pod) and population decline (AB pod) will be investigated.

C. Location

No fieldwork is proposed, as all analyses will be conducted on archived tissue samples. Beginning in 1990, NMML began collecting and archiving blubber samples of killer whales ranging from California to Alaska. These tissues are available for chemical contaminant analysis to answer various questions outlined below about the accumulation of OCs and impacts on killer whales from the eastern North Pacific. These OC concentration data will substantially increase the contaminant database information on killer whales from California to Alaska. Contaminant analyses will be performed at the Northwest Fisheries Science Center, National Marine Fisheries Service, Seattle, Washington.

COMMUNITY INVOLVEMENT AND TRADITIONAL KNOWLEDGE

Samples have already been collected. Analysis results will be posted on the Oil Spill Web Site where the public and members of the local community can easily access the information.

PROJECT DESIGN

A. Objectives

The specific objectives of this investigation are:

1. To determine the levels and profiles of selected organochlorines (OCs) in blubber of killer whales sampled from a wide geographical range of the North Pacific.

2. To compare the OC levels and profiles in blubber of resident and transient killer whales sampled off various sites of the Pacific Coast to OC levels and profiles previously reported in blubber of killer whales from the resident AB pod and transient AT1 pod.

3. To compare the OC levels and profiles in blubber of resident, transient and offshore killer whales from California to Alaska to OC levels and profiles previously reported in marine mammals that had linkages between contaminant exposure and specific biological effects.

B. Methods

1. Sample Collection: Approximately 100 blubber samples were acquired during the 1990–1999 field seasons by scientists from the National Marine Mammal Laboratory, Seattle, WA. Prior to 1994, blubber samples were collected from stranded killer whales. Between 1994-1999, blubber samples were primarily obtained using biopsy darts fired from an air pistol powered by a CO_2 cartridge. The sterilized dart was fired from a range of 8-12m from each whale, hitting the animal in the upper back. The dart was retrieved from

the water by net and the blubber portion of the biopsy sample was excised using a scalpel, placed in a solvent rinsed glass vial and stored at –20°C.

2. Sample Extraction, Cleanup and Analyses: Blubber samples will be analyzed for selected organochlorines, including dioxin-like CBs and other selected CBs and pesticides [e.g., DDTs, hexachlorobenzene (HCB)] using a high-performance liquid chromatography coupled with photodiode array detection (HPLC/PDA) method. This method is a rapid, cost-effective analytical procedure that provides concentrations of individual toxic CBs and other selected organochlorines and total CB and DDT levels. Briefly, the analytes will be extracted from the blubber by homogenization with pentane/hexane (50/50, v/v) and will be separated from interfering compounds on a gravity-flow cleanup column (packed with neutral, basic and acidic silica gels) eluted with methylene chloride/hexane (50/50, v/v). The dioxin-like PCBs (PCBs 77, 105, 118, 156, 157, 169, 170, 180, 189) will be resolved from other selected PCBs (i.e., PCBs 101, 128, 138, 153) and pesticides (o,p'-DDD, p,p'-DDD, p,p'-DDE, o,p'-DDT, p,p'-DDT) by HPLC using a Cosmosil PYE column and will be measured by an ultraviolet photodiode array detector.

3. Quality Assurance: The HPLC system will be calibrated daily. A sample set will consist of 11 – 14 field samples, a method blank and quality assurance samples. Method blanks will contain no more than five analytes that exceed four times the method detection limit (MDL), unless the analyte is not detected in the associated blubber samples of the set. Approximately 10% of the whale blubber samples will be analyzed in duplicate to measure precision of the method and the quality assurance criteria (relative standard deviation $\leq$ 50%) will be met for all analytes detected in the blubber samples. To monitor the accuracy of our HPLC/PDA method, a National Institute of Standards and Technology (NIST) control whale blubber sample will be analyzed with each sample set and concentrations of $\geq$ 70% of selected analytes (CBs 105, 118, 138, 153, 156, 170, 180, o,p'-DDD, p,p'-DDD, p,p'-DDT, hexachlorobenzene) will be within $\pm$ 50% of the published reference values (Wise *et al.* 1993).

4. Lipid Analyses: Total lipids will be determined by thin layer chromatography coupled with flame ionization detection (TLC/FID) using an Iatroscan Mark 5 (Iatron Laboratories, Tokyo, Japan) (Shantha, 1992). The lipid sample extracts will be spotted on Chromarods (Type SIII) and developed in a solvent system containing 60:10:0.02 hexane:diethyl ether:formic acid (v/v/v). Various classes of lipids (i.e., wax esters, triglycerides, free fatty acids, cholesterol and polar lipids) will be separated based on polarity, with the nonpolar compounds (i.e., wax esters) eluting first, followed by the more polar lipids (i.e., phospholipids). Total lipid concentrations will be calculated by adding the concentrations of the five lipid classes for each sample and reported as percent total lipid. The Iatroscan was operated with a hydrogen flow rate of 160 ml/min and air flow of 2000 ml/min. Data was acquired and analyzed on a 386 PC compatible computer using TDatascan software (RSS Inc., Bemis, TN). A four-point linear external calibration was used for quantitation. Total lipid concentrations were calculated by adding the concentrations of the five lipid classes for each sample and were reported as percent total lipid. Duplicate TLC/FID analyses were performed for each sample extract and the mean value reported.

C. Cooperating Agencies, Contracts, and Other Agency Assistance

NOAA/ECD (Krahn/Ylitalo): Perform contaminant and lipid analyses, interpretation, conduct statistical analyses, aid in report preparation, write peer-reviewed manuscript.
NOAA/NMML (Dahlheim): Provide archived tissues and data life history summaries, collect tissues and data life history summaries in 1999, aid in report preparation, write peer-reviewed manuscript.

SCHEDULE

A. Measurable Project Tasks for FY00 (October 1, 1999 to September 30, 2000)

October 31:	NMML provides blubber/biological data to ECD
June 30:	Complete chemical contaminant analyses
August 31:	Complete statistical analyses of contaminant data
April 15:	Submit annual report
September 18:	Submit manuscript to peer-reviewed journal

B. Project Milestones and Endpoints (October 1, 1999 to September 30, 2000)

October 31:	NMML provides blubber/biological data to ECD
June 30:	Complete chemical contaminant analyses
August 31:	Complete statistical analyses of contaminant data
April 15:	Submit annual report
September 18:	Submit manuscript to peer-reviewed journal

C. Completion Date

Project will be completed by September 2000.

PUBLICATIONS AND REPORTS

An annual report will be submitted to the Council by 15 April 2000. Manuscript(s) resulting from this research will be submitted to peer-reviewed journals by September 2000.

PROFESSIONAL CONFERENCES

The project results will be presented by the proposer or co-proposers at numerous scientific conferences to include: 1) Marine Mammal Conference, 2) PICES Conference and 3) EVOS Trustee Council workshop. The topic of the conferences and meetings will be contaminant levels in North Pacific killer whales.

NORMAL AGENCY MANAGEMENT

The National Marine Fisheries Service (NMML) has already provided funding to support field research and data collection associated with this project (1994 - 1999). Biopsy samples (i.e., skin samples) were collected by NMML to investigate genetic diversity of North Pacific killer

whales. The costs associated with the analysis of blubber samples to determine contaminant levels and profiles are outside the scope of NMML's or the NWFSC's funding.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

The Environmental Conservation Division analyzed the killer whale blubber samples reported in Restoration Project No. 97012 (Matkin *et al.*, 1998) and will use the same analytical procedure to analyze the blubber samples proposed in this study. This will facilitate comparing contaminant levels and profiles in killer whale from the Matkin *et al.* (1998) investigation and this study.

PROPOSED PRINCIPAL INVESTIGATOR

Dr. Margaret M. Krahn
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OTHER KEY PERSONNEL

Gina M. Ylitalo
Environmental Conservation Division
Northwest Fisheries Science Center
National Marine Fisheries Service
Seattle, Washington
Task: Perform contaminant and lipid analyses, interpret contaminant data, conduct statistical analyses, aid in report preparation, write peer-reviewed manuscript.

Marilyn E. Dahlheim, Ph.D.
National Marine Fisheries Service
Alaska Fisheries Science Center
National Marine Mammal Laboratory
Seattle, Washington
Task: Provide archived tissues and data life history summaries, collect tissues in 1999, aid in report preparation, write peer-reviewed manuscript.

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Bigg, M. A., Olesiuk, P. F., Ellis, G. M., Ford, J. K. B., and Balcomb, K. C. 1990. Social organization and genealogy of resident killer whales *(Orcinus orca)* in the coastal waters of British Columbia and Washington State. In: *Individual Recognition of Cetaceans: Use of Photo-identification and other Techniques to Estimate Population Parameters*. Eds. P. S. Hammond, S. A. Mizroch, and G. P. Donovan. pp. 383-405. Rept. Int. Whal. Commn. Special Issue 12, Cambridge.

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MARGARET M. KRAHN

Education

Univ. of Washington, Ph.D. (Organic Chemistry) 1968
Univ. of Minnesota, B. Chem. (with honors) (Chemistry) 1964

Research and Professional Experience

Branch Manager, Environmental Chemistry Branch, Environmental Conservation Division, NWFSC, NOAA	1994-present
Leader, Methodology Development Group and Assistant Branch Manager, Environmental Chemistry Branch, Environmental Conservation Division, NWFSC, NOAA	1992-1994
Research Chemist, NOAA National Analytical Facility, Environmental Conservation Division, NWFSC, NOAA	1978-1992
Assistant/Associate Professor of Chemistry, Univ. of Delaware	1972-1978

Honors

Department of Commerce Silver Medal Award	1997
National Science Foundation Fellow	1964-1967

Selected Publications

Krahn, M.M., P.R. Becker, K.L. Tilbury and J.E. Stein. 1997. Organochlorine contaminants in blubber of four seal species: Integrating biomonitoring and specimen banking. Chemosphere. 34:2109-2121.

Krahn, M.M., G.M. Ylitalo, J. Buzitis, C.A. Sloan, D.T. Boyd, S.-L. Chan and U. Varanasi. 1994. Screening for planar chlorobiphenyls in tissues of marine biota by high-performance liquid chromatography with photodiode array detection. Chemosphere. 29:117-139.

Krahn, M.M., G.M. Ylitalo, J. Buzitis, S.-L. Chan, U. Varanasi, T.L. Wade, T.J. Jackson, J.M. Brooks, D.A. Wolfe and C.-A. Manen. 1993. Comparison of high-performance liquid chromatography/fluorescence screening and gas chromatography/mass spectrometry analysis for aromatic compounds in sediments sampled after the *Exxon Valdez* oil spill. Environ. Sci. Technol. 27:699-708.

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GINA M. YLITALO

Education

Western Washington University, Bellingham, WA	M.S.	1990	Chemistry
Western Washington University, Bellingham, WA	B.S.	1981	Biochemistry

Research and Professional Experience

1997-to present	Team Leader – Biomonitoring and Bioremediation Technology
1992-1997	Research Chemist, ECD, NMFS
1989-1992	Chemist, ECD, NMFS

Honors

1992	Dept. of Commerce Bronze Medal
1990, 1991, 1992	Outstanding Performance Award, NMFS, NOAA

Selected Publications

Ylitalo, G. M., J. Buzitis, and M. M. Krahn. (in press). Analyses of tissues of eight marine species for dioxin-like chlorobiphenyls (CBs) and total CBs by high-performance liquid chromatography photodiode array detection (HPLC/PDA). Arch. Environ. Contam. Toxicol.

Ylitalo, G. M., J. Buzitis, S.-L. Chan and M. M. Krahn. 1995. Measuring planar chlorobiphenyl congeners in Puget Sound marine biota by HPLC/PDA. In Proceedings Puget Sound Research '95.

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MARILYN ELAYNE DAHLHEIM

PRESENT POSITION Cetacean Assessment & Ecology Task Leader

EDUCATION

Ph.D. Zoology - University of British Columbia	1987
M.S. Biology - San Diego State University	1980
B.S. Zoology - San Diego State University	1976

EXPERIENCE National Marine Mammal Laboratory 1978-present
(Summary for last 10 years only)

Principal Investigator - IUSS/Marine Mammal Acoustic Investigations (1991-present)
Principal Investigator - Life History/Ecology of Alaskan killer whales (1989-present)
Principal Investigator - Abundance/distribution of Alaskan harbor porpoise (1991-1993)
Principal Investigator - Impact of Exxon Valdez Oil Spill on Prince William Sound Cetaceans (1989-1994)

PROFESSIONAL SOCIETIES
Society for Marine Mammalogy (Charter Member)
Acoustical Society of America

HONORS AND AWARDS
Department of Commerce - Bronze Medal Award (November 1997) - group award for contribution to delisting eastern North Pacific stock of gray whales from List of Endangered & Threatened Wildlife (June 1994).
Certificate of Recognition (June 1993) for marine mammal contributions made during Exxon Valdez Oil Spill scientific investigations.
Outstanding Performance Ratings in last five years: FY92, FY93, FY97.

Selected Publications (since 1994 only)

Dahlheim, M. E., A. York. R. Towell, J. Waite, and J. Breiwick. 1999. Harbor porpoise (*Phocoena phocoena*) abundance in Alaska: Bristol Bay to Southeast Alaska, 1991-1993. *Accepted Marine Mammal Science.*

Waite, J. M., **M. E. Dahlheim**, R. C. Hobbs, S. A. Mizroch, L. M. Herman, J. Jacobsen, J. M. Straley, O. von Ziegesar. 1999. Evidence of a Feeding Aggregation of Humpback Whales (*Megaptera novaeangliae*) Around Kodiak Island, Alaska. *Marine Mammal Science* 15(1):210-220.

Dahlheim, M. E. and J. E. Heyning. 1998. Killer Whale *Orcinus orca* (Linnaeus, 1758). In: Handbook of Marine Mammals, Vol. 6. Ed. S. Ridgway and R. Harrison, pp. 281-822.

Hoelzel, A. R., **M. Dahlheim**, and S. J. Stern. 1998. Low Genetic Variation Among Killer Whales *Orcinus orca* in the Eastern North Pacific and Genetic Differentiation Between Foraging Specialists. *Journal of Heredity* 89:121-128.

Moore, S. E., K. M. Stafford, **M. E. Dahlheim**, C. G. Fox, H. W. Braham, J. J. Polovina and D. E. Bain. 1998. Seasonal variation in reception of fin whale calls at five geographic areas in the North Pacific. *Marine Mammal Science* 14(3):217-225.

Dahlheim, M. E. 1997. A Photographic Catalog of Killer Whales, *Orcinus orca*, from the Central Gulf of Alaska to the Southeastern Bering Sea. NOAA Technical Report NMFS 131, 54 pages.

Dahlheim, M. E., D. K. Ellifrit, and J. D. Swenson. 1997. Killer Whales of Southeast Alaska: A Catalogue of Photo-Identified Individuals. Published by the National Marine Mammal Laboratory. Day Moon Press, Inc., Seattle, Washington. 79 pages.

Yano, K. and **M. E. Dahlheim**. 1995. Behavior of Killer Whales *Orcinus orca* during Longline Fishery Interactions in the Southeastern Bering Sea and Adjacent Waters. *Fishery Science* 61(4):584-589.

Bain, D. E. and **M. E. Dahlheim**. 1994. Effects of masking noise on detection thresholds of killer whales. In: Impacts of the Exxon Valdez Oil Spill on Marine Mammals. (Ed. T. R. Loughlin). Pp. 243-256. Academic Press, San Diego, Ca.

Dahlheim, M. E. and C. O. Matkin. 1994. Assessment of injuries to Prince William Sound killer whales. In: Impacts of the Exxon Valdez Oil Spill on Marine Mammals. (Ed. T. R. Loughlin). Pp. 163-171. Academic Press, San Diego, Ca.

Dahlheim, M. E. and R. T. Towell. 1994. Occurrence and distribution of Pacific white-sided dolphins (*Lagenorhynchus obliquidens*) in southeastern Alaska, with notes on an attack by killer whales (*Orcinus orca*). *Marine Mammal Science* 10:458-464.

Harvey, J. T. and **M. E. Dahlheim**. 1994. Cetaceans in Oil. In: Impacts of the Exxon Valdez Oil Spill on Marine Mammals. (Ed. T. R. Loughlin). Pp. 257-264. Academic Press, San Diego, Ca.

Matkin, C. O., G. M. Ellis, **M. E. Dahlheim**, and J. Zeh. 1994. Status of killer whales in Prince William Sound (1985-1992). In: Impacts of the Exxon Valdez Oil Spill on Marine Mammals. (Ed. T. R. Loughlin). Pp. 141-162. Academic Press, San Diego, Ca.

von Ziegesar, O., E. Miller, and **M. E. Dahlheim**. 1994. Impacts on Humpback Whales in Prince William Sound. In: Impacts of the Exxon Valdez Oil Spill on Marine Mammals. (Ed. T. R. Loughlin). Pp. 173-191. Academic Press, San Diego, Ca.

Yano, K. and **M. E. Dahlheim**. 1994. Killer Whale, *Orcinus orca*, depredation on longline catches of bottomfish in the southeastern Bering Sea and adjacent waters. *Fishery Bulletin* 93:355-372.

2000 EXXON VALDEZ TRUS COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 2000

Budget Category:	Authorized FY 1999	Proposed FY 2000
Personnel		$50.8
Travel		$3.8
Contractual		$0.0
Commodities		$11.6
Equipment		$0.0
Subtotal	$0.0	$66.2
General Administration		$7.6
Project Total	$0.0	$73.8
Full-time Equivalents (FTE)		0.6
Other Resources		

LONG RANGE FUNDING REQUIREMENTS

Estimated FY 2001	Estimated FY 2002
$3.9	

Dollar amounts are shown in thousands of dollars.

Comments: The estimated budget for FY2001 contains costs for report and manuscript preparation.

FY00

Prepared: 04/09/99

Project Number: ~~New project~~ 00461
Project Title: Contaminant levels in North Pacific killer whales
Agency: NOAA

FORM 3A
TRUSTEE
AGENCY
SUMMARY

2000 EXXON VALDEZ TRUS COUNCIL PROJECT BUDGET
October 1, 1999 - September 30, 2000

2000 EXXON VALDEZ TRUS COUNCIL PROJECT BUDGET
October 1, 1999 - September 30, 2000

Personnel Costs*:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 2000
M. Krahn - NOAA/ECD	Supervisory Research Chemist	GS14/5	0.5	10.7	0.0	5.4
M. Dahlheim - NOAA/NMML	Oceanographer	GS13/4	2.0	8.8	0.0	17.6
G. Ylitalo - NOAA/ECD	Research Chemist	GS12/1	1.5	6.7	0.0	10.1
J. Buzitis - NOAA/ECD	Research Chemist	GS11/4	1.5	6.2	0.0	9.3
L. Hufnagle - NOAA/ECD	Research Chemist	GS11/1	1.5	5.6	0.0	8.4
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
*See DPD Section Other Key Personnel for details						0.0
	Subtotal		7.0	38.0	0.0	
					Personnel Total	$50.8

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 2000
M. Krahn, EVOS Trustee Council workshop, Anchorage, AK	0.8	1	4	0.1	1.2
M. Dahlheim, PICES conference	0.8	1	5	0.1	1.3
G. Ylitalo, Marine mammal conference, Honolulu, HI	0.8	1	5	0.1	1.3
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$3.8

FY00

Prepared: 04/09/99

Project Number: New project
Project Title: Contaminant levels in North Pacific killer whales
Agency: NOAA

FORM 3B
Personnel
& Travel
DETAIL

2000 EXXON VALDEZ TRU COUNCIL PROJECT BUDGET
October 1, 1999 - September 30, 2000

Contractual Costs:	Proposed FY 2000
Description	
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$0.0

Commodities Costs:	Proposed FY 2000
Description	
Chemical reagents - NOAA/ECD	4.8
Glassware/laboratory supplies - NOAA/ECD	5.7
Laboratory/office supplies - NOAA/NMML	1.1
Commodities Total	$11.6

FY00

Prepared: 04/09/99

Project Number: New project
Project Title: Contaminant levels in North Pacific killer whales
Agency: NOAA

FORM 3B
Contractual & Commodities DETAIL

2000 EXXON VALDEZ TRUS COUNCIL PROJECT BUDGET
October 1, 1999 - September 30, 2000

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed 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: Description	Number of Units	Inventory Agency
HPLC/PDA system - NOAA/ECD	1	NOAA/ECD

FY00

Prepared: 04/09/99

Project Number: New project
Project Title: Contaminant levels in North Pacific killer whales
Agency: NOAA

FORM 3B
Equipment
DETAIL

Effect of Disease on Pacific Herring Population Recovery in Prince William Sound

Project Number:	00462
Restoration Category:	Research and Monitoring
Proposer:	University of California, Davis
Lead Trustee Agency:	ADFG
Cooperating Agencies:	None
Alaska SeaLife Center:	no
Duration:	2nd year, 3-year project
Cost FY00:	$24.9 (UCD) + 49.7 (ADFG) = $74.6
Cost FY01:	$29.5 (UCD) + 52.2 (ADFG) = $81.7
Cost FY02:	none
Geographic Area:	Prince William Sound
Injured Resource/Service:	Pacific herring, commercial fishing, subsistence

ABSTRACT

The Pacific herring population of Prince William Sound has not recovered from severe population decline in 1993. Viral hemorrhagic septicemia virus and the fungus *Ichthyophonus hoferi* were identified as the two main diseases in these fish. Prevalence of *Ichthyophonus* decreased after 1995, but increased prevalence of viral hemorrhagic septicemia virus in 1997 and 1998 has been associated with delayed recovery. To determine if disease continues to impair recovery, and to document recovery when it occurs, we propose to continue to monitor the prevalence of the two major diseases in Pacific herring in Prince William Sound in November 2000 and April 2001.

INTRODUCTION

The population of Pacific herring (*Clupea pallasi*) in Prince William Sound (PWS), Alaska has not recovered since the estimated spawning biomass decreased precipitously from over 100,000 tons in 1992 to less than 20,000 tons in 1994 (Figure 1). Study of the population since 1993 has revealed that viral hemorrhagic septicemia virus (VHSV) and the fungus *Ichthyophonus hoferi* are the two major diseases in Pacific herring, and that VHSV probably contributed most to population decline in 1993 (Meyers et al. 1994; Marty et al. 1998). Prince William Sound Pacific herring fisheries were severely curtailed in 1993, and were never opened in 1994 or 1995. The population began to recover in 1996, and a small bait fishery was opened in November of 1996. All fisheries were opened in 1997, but an unexpected increase in prevalence of VHSV in spring samples (15% in 1997 vs. 0% in 1996) was associated with abnormal spawning activity. In the fist year of this project (99462), the prevalence of virus was again high (14% in 1998).

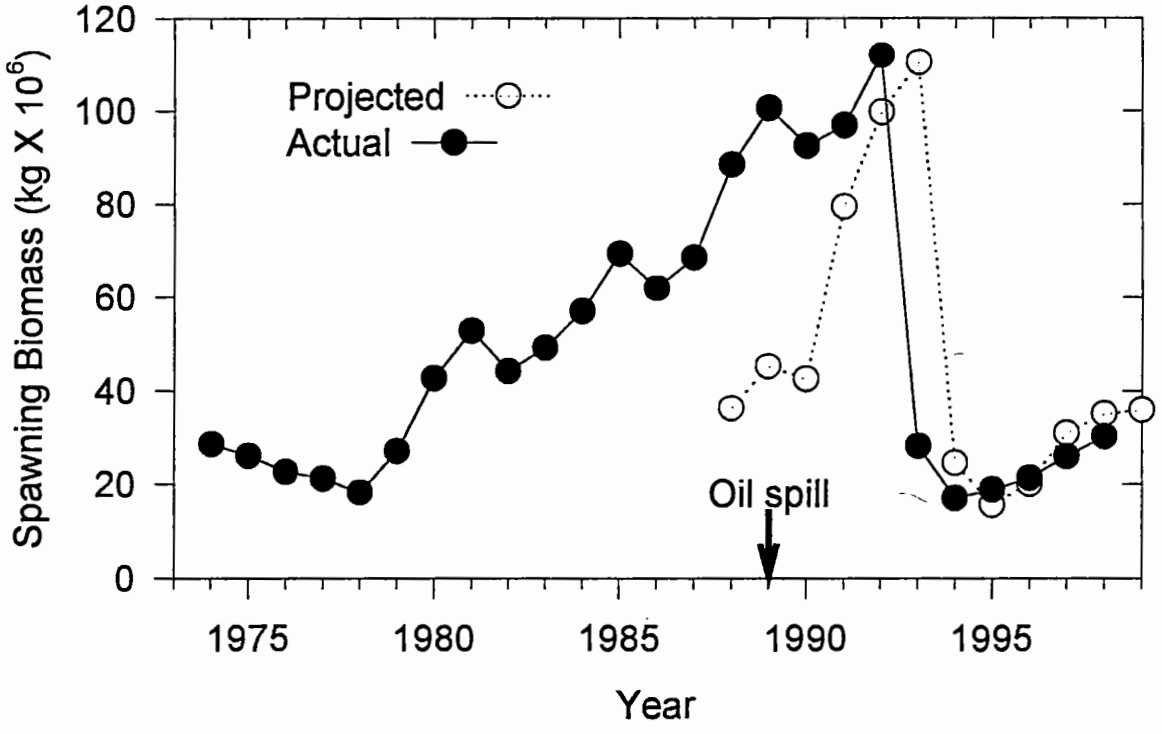

Figure 1. Biomass estimates of mature Pacific herring in Prince William Sound, Alaska. Unexploited spawning biomass is estimated using an age-structured assessment model.

After the major crash of 1993, the Pacific herring population continued to decline in 1994 and project 94320-S was initiated under emergency conditions to determine causes of herring morbidity (sickness), with particular emphasis on the role of VHSV. Beginning in 1995, a 4-year multidisciplinary project was initiated to explore the role of VHSV, *Ichthyophonus hoferi*, and other parasites on population change (95320-S, 96162, 97162, and 98162). Study in 1995 and 1996 included examination of fish from a reference site, Sitka Sound, in which the herring fishery was strong and there was no history of a large oil spill.

It soon became obvious that the results from this study had broad significance beyond the two populations being studied. We were beginning to answer basic questions about how disease contributes to mortality of free-ranging, pelagic, schooling fish. To more fully answer these basic questions, the U.S. National Science Foundation (Biological Oceanography) funded a 3-year project to continue disease research in PWS. The NSF project is closely linked to this project (00462). This proposal asks the Trustee Council to continue to fund fish necropsy, tissue sampling, and virus analysis. NSF has committed to fund analysis of blood and tissues (histopathology) as well as a modeling component through Dr. Terrance Quinn of the University of Alaska, Fairbanks. Both organizations benefit from high quality, multiyear research, but at a fraction of the cost of supporting the entire project. The NSF component of the project cannot continue unless the Trustee Council continues to fund sample collection. In funding the sampling and virus analysis components of the study, the Trustee Council will have access to the same types of data generated from 1994-1998, with the addition of a modeling component to determine the role of disease in stock assessment. We propose to continue monitoring the health of the Pacific herring population in PWS through spring of 2001.

Preliminary surveys suggested that the 1994 or 1995 year-classes were the most likely to recruit at numbers large enough for population recovery by 1999 or 2000. Unfortunately, the prevalence of VHSV increased to 15% among all Pacific herring sampled in spring 1997 (Figure 2), and 23% of the 71 fish that were from 1994 year-class had VHSV. In 1998, the prevalence of VHSV remained high (14%), and 28% of the 64 fish from 1995 year-class had VHSV (Figure 3). The effect of the VHSV outbreak on population biomass in 1997 and 1998 does not appear to be as severe as in 1993, but the viral outbreak will limit the contribution of the 1994 and 1995 year-classes to population recovery. This project is most closely linked to other Pacific herring projects, and details are given in the dedicated section below.

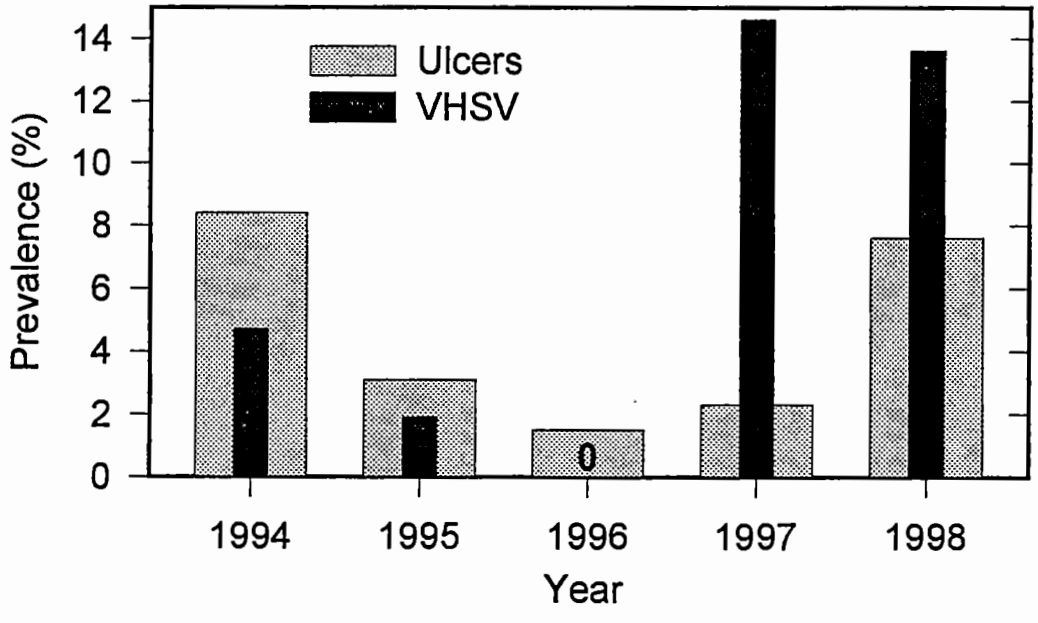

Figure 2. Prevalence of severe focal skin reddening (ulcers) and VHSV in adult Pacific herring sampled from Prince William Sound, Alaska.

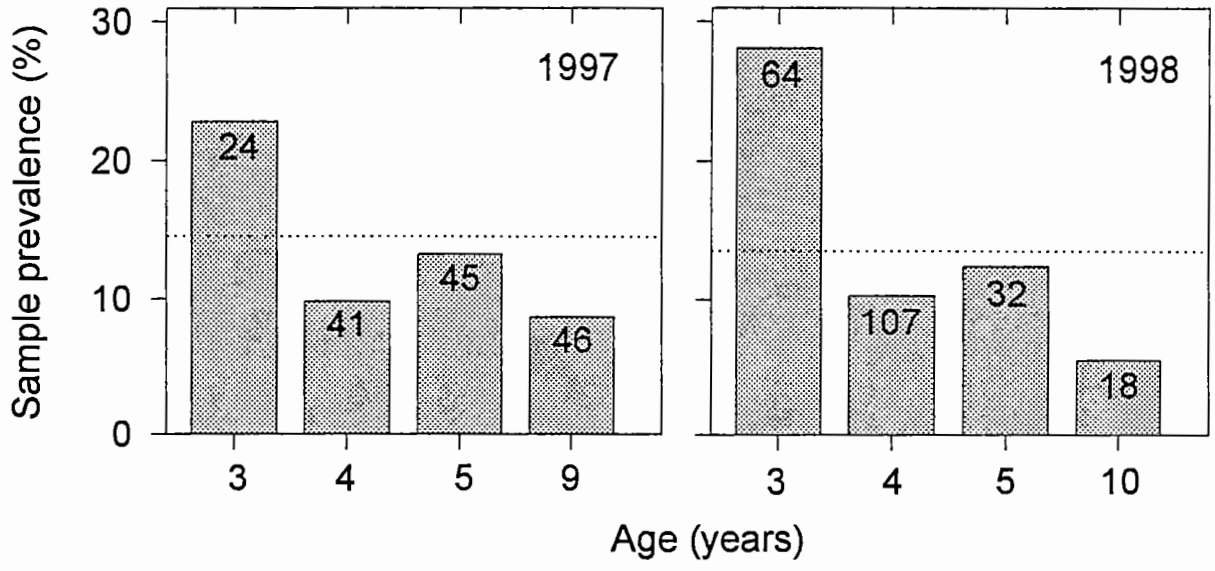

Figure 3. VHSV prevalence in Prince William Sound Pacific herring.
Reference line = overall sample VHSV prevalence.
Numbers within bars = sample size for each age.

NEED FOR THE PROJECT

A. Statement of Problem

Pacific herring are an injured biological resource in Prince William Sound (PWS) classified as recovering. Although commercial fishing for herring started again in 1996, after being closed for three years, population recovery has been very slow, resulting in lost services. Also, several thousand pounds of herring and herring spawn on kelp are harvested annually for subsistence purposes and form an important part of the local native culture of Chenega and Tatitlek. Delay in recovery of herring populations results in lost resources for subsistence use. Continued study is needed to examine how disease may be limiting recovery and to document when recovery has occurred.

B. Rationale/Link to Restoration

This project should be done because it will provide information on what might be limiting population recovery and it will monitor when fish are healthy and recovery has occurred. Continued sampling fish twice a year is needed to determine the dynamics of disease in the population. During the first 6 years of disease research already funded by the Trustee Council, we established that VHSV and *Ichthyophonus hoferi* were the most significant causes of disease. Prevalence of VHSV can be determined by virus isolation and prevalence of *Ichthyophonus hoferi* can now be estimated fairly closely by gross examination.

C. Location

Study will be done in Prince William Sound, Alaska. Information will benefit fisheries managers as they consider alternatives for managing Pacific herring fisheries. As the resource is enhanced, users throughout PWS could potentially benefit.

COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE

Dr. Marty has a solid record of local contact and dissemination of information, and continued collaboration with local users is proposed for FY 00. For example, Dr. Marty will be leading a herring dissection and necropsy demonstration for the Youth Area Watch in Cordova on April 19, 1999. Contact with fishers and ADFG managers occurs through participation in conference telephone calls, personal contact while in Anchorage and Cordova, and via e-mail.

To aid in dissemination of information, project personnel are available by phone for interviews and will respond quickly to requests from the Restoration Office for general information and articles for newsletters. The project's principal investigator is based in California, but Dr. Kathy Burek of Alaska Veterinary Pathology Services (one of only two board-certified veterinary pathologists residing in Alaska) has been contracted as a necropsy pathologist in 1995, and 1996, and 1999, and she has indicated her interest to serve as the second pathologist in April 2000. Alaska residents will be hired by ADFG for sampling logistics and recording data, and ADFG will charter vessels from local residents for collecting and processing fish.

PROJECT DESIGN

A. Objectives

The restoration objective states that "Pacific herring will have recovered when the next highly successful year class is recruited into the fishery and when other indicators of population health are sustained within normal bounds in PWS." The population cannot be classified as healthy until individuals within that population are healthy. Continued high prevalence of VHSV in spring 1998 samples was consistent with a population at risk. Field sampling to determine the ongoing disease status is a high priority of this project. Objectives include:

1. Determine the prevalence of major diseases in Pacific herring.

2. Determine the interaction of gender, age, and season on disease prevalence.

3. Determine if disease prevalence correlates with population trends.

B. Methods

Pacific herring will be randomly sampled from PWS in November (at the end of the feeding season, n = 100) and in April (near the time of spawning, n = 300). Each fish will be examined for abnormalities (e.g., *Ichthyophonus hoferi*), and tissues from each fish will be assayed for VHSV.

This proposal has two specific hypotheses to test:

1. Prevalence of external lesions, VHSV, or *Ichthyophonus hoferi* is different from previous years.
2. Gross lesions, VHSV, or *Ichthyophonus hoferi* are related season, age, or gender.

To test the hypothesis that reproductive stage affects the development of disease, sampling is needed during the spawning season (spring) and during the period of gonadal development and peak condition (fall). Nearly 80% of the PWS Pacific herring biomass schools in the waters on the northern and western edge of Montague Island during November, and the fish remain in this area until after they spawn in April. All fish will be sampled from this region. During the summer, fish disperse throughout the Sound. The other 20% of the PWS Pacific herring biomass overwinters and spawns in the Northeast region of PWS; these fish were sampled for disease study on as part of the spawn-on-kelp investigations, and trends in viral prevalence were similar to fish in the Montague area (Hershberger In press). To provide a minimum number of fish from which at least the dominant year class can be analyzed in detail, we propose sampling 300 fish in April. Fish are easier to capture in the spring, and the age distribution in the spring is most consistent with data used in the historical age-structured assessment model. With a sample size of 300, diseases with a prevalence as low as 1% can be detected with 95% confidence, and a 6% difference in sample prevalence (e.g., 10 vs. 16%) can be detected with a statistical power of 0.80 (Becker and Grieb 1987). To test hypotheses of age differences, the dominant year class--often >40% of the sampled population--will be compared with combined groups of smaller year classes. To detect seasonal differences, and minimize costs, 100 fish will be sampled in the fall. A sample size of 100 is sufficient to have 95% confidence that disease with a prevalence of 3% will be detected in at least one fish sampled (Becker and Grieb 1987).

Proposed study is designed to minimize bias associated with gear type, capture, and holding (Holst 1996). All fish will be sampled using commercial purse seines. In the event that large numbers of fish begin to spawn in areas too shallow for commercial seines, fish will be captured using cast nets. All necropsies will be completed < 4 hours after the seine is pursed around the fish.

To best characterize the condition of herring in Prince William Sound, herring will be subjected to complete necropsy using the following sampling schedule (as field conditions allow) during the three years of proposed study:

Dates	Reproductive Stage	Number of Fish
FY00: Oct./Nov., 1999 (2 nights)	peak condition/ gonadal development	100
mid-late April, 2000 (4 days)	Spawning/post-spawning	300
	Total Fish, FY00:	400

Dates	Reproductive Stage	Number of Fish
FY01: Oct./Nov., 2000 (2 nights)	peak condition/ gonadal development	100
mid-late April, 2001 (4 days)	spawning/post-spawning	300
	Total Fish, FY01:	400

Fish for necropsy will be anesthetized in tricaine methane sulfonate (Finquel®) and visually screened for external lesions (Marty et al. 1998), which are ranked as none (0), mild (1), moderate (2), or severe (3). Prevalence of *Ichthyophonus* will be estimated by gross examination of internal organs, especially the heart. With funding from NSF, histopathological analysis will be done on 10 organs to determine *Ichthyophonus* prevalence.

Measurements on each fish include body weight, standard length, age (from scales), liver weight, and gonad weight. Otoliths are archived for later use if information on annual growth rates is desired. This study is designed to diagnose gross lesions and the two major diseases: VHSV and *Ichthyophonus hoferi*. Results will be compared with previous years of study. Several samples will be collected, but only selected samples will be analyzed:

a. Virus isolation - To assay fish for virus, anterior kidney, spleen, and any severe skin lesions will be put into individually labeled plastic bags and stored on ice (for each fish, one bag will hold kidney and spleen, and a separate bag will be used for skin lesions). Samples will be shipped by air to the ADFG fish pathology laboratory in Juneau (under the direction of Dr. Ted Meyers) for analysis every 48 to 72 hours. Isolation using EPC cell lines will be as previously described (Meyers et al. 1994). The application of polymerase chain reaction (PCR) techniques for primary diagnosis of VHSV has been explored (R.M. Kocan and J.R. Winton, personal communication); to date, PCR has not proved more useful than virus isolation, but work is still underway.

b. Bacteriology - for each fish with severe gross lesions, a sterile loop is stabbed into the anterior kidney and then streaked on Trypticase Soy Agar (TSA) and Marine agar for bacterial isolation. Ulcers will be preserved for histopathology or virology, but they will not be cultured for bacteria (superficial bacteria can be diagnosed on histopathology).

Other samples will be collected and analysis will be done using funding from NSF:

a. Histopathology (fix in 10% neutral buffered formalin) - gill, spleen, liver, gonad, heart, stomach, intestinal tract, exocrine pancreas, trunk kidney, skeletal muscle, skin, brain, and other gross lesions. Also, a touch prep of kidney from each fish is made on a glass slide.

b. Hematology - blood will be drawn from the caudal vein into a Lithium-heparinized syringe and stored on ice. Packed cell volume (PCV) is determined on site. A blood smear is made on a glass slide, dried, and archived. Plasma is separated by centrifugation (3,000 *g* for 7 min) and frozen within 3 h of collection.

c. Immunology - plasma for IgM determination and a blood smear for leukocyte differential counts will be collected.

In previous study, spring samples from PWS had several other parasites, but these did not seem to be significant on the population level. Gross lesions and other observations will be scored as in previous years. Although all lesions are described in a "comments" section on our data sheet, only the most common gross findings are scored for statistical analysis: caudal fin fraying, caudal fin reddening, fin base reddening, focal skin reddening, diffuse skin reddening, iris reddening, branchial copepods, number of 0.5-mm-diameter white foci on gills, number of peritoneal Anisakidae, and gonadal fullness. Parasites requiring histopathology for diagnosis will be scored using NSF funds.

The ADFG fisheries laboratory in Cordova, Alaska, will handle logistics for sampling fish for necropsy, collecting age and length data, preparing formalin and containers for tissue fixation, providing a data recorder for one pathologist on site, and ship all samples. Results from virus isolation will be reported as a VHSV titer.

Quality control and quality assurance are part of all examinations. For necropsy examination, the senior pathologist (Dr. Marty) is on site at all times; when questionable or difficult lesions are encountered, the second pathologist can consult with Dr. Marty. In the event that Dr. Marty is unavailable for necropsy, five other pathologists have experience on the herring necropsy team, and services of these pathologists would be secured.

Statistical analysis in this study will focus on determining changes in disease prevalence over time. The association of selected categorical variables (e.g., VHSV status versus external lesion scores) will be evaluated using chi-square methods for categorical data analysis; comparisons will be considered valid only if individual expected cell frequencies are >1 and no more than 20% of the cells have expected cell frequency <5. Odds ratios will be calculated only for standard (2x2) two-way contingency tables. Significance of changes in disease prevalence will be tested using chi-square or Fisher's Exact test. For all analyses, comparisons will be considered significant when $P<0.05$ and highly significant when $P<0.01$.

C. Cooperating Agencies, Contracts, and Other Agency Assistance

This proposal includes significant contributions from ADFG as the lead agency. The project is being run through ADFG because Dr. Marty has worked closely with ADFG on several Trustee Council-funded projects during this decade. ADFG has unique local knowledge on Pacific herring in PWS, including the necessary experience and expertise to secure all necessary charters and ship hazardous materials from Cordova to Davis. Close collaboration with ADFG allows for seamless transfer of disease information to fishery managers, and rapid transfer of disease information to commercial and subsistence fishers. No other agencies are requesting funds for this section of the project, and no other agencies or universities will be contracted for this work. Note, however, that Dr. Richard Kocan, University of Washington, is submitting a proposal to study disease in juvenile Pacific herring and determine if other forage fishes in PWS carry VHSV. Dr. Marty and Dr. Kocan worked closely on the initial multiyear herring disease project (98162 et al.), and they

will continue to share information on these new projects.

SCHEDULE

A. Measurable Project Tasks for FY00

DATES (results due on final date)	ACTIVITY
Fall Samples:	
Oct. 1 - Nov. 30, 1999:	Collect samples; Person in charge: Gary D. Marty, UC Davis
Nov. 1 - Dec. 31, 1999:	Scale analysis (age); Person in charge: Greg Carpenter, ADFG, Cordova, AK
Nov. 1, 1999 – Feb. 28, 2000:	Virology and bacteriology; Person in charge: Ted Meyers, ADFG, Juneau, AK
March 1- Aug. 1, 2000:	Statistical analysis; Person in charge: Gary D. Marty
January, 2000 (5 days):	Attend Restoration Science Workshop (Gary D. Marty)
Spring Samples	
April 1 - April 30, 2000:	Collect samples; Person in charge: Gary D. Marty
April - July 31, 2000:	Scale analysis (age); Person in charge: Greg Carpenter, ADFG, Cordova, AK
April - Sept. 30, 2000:	Virology and bacteriology; Person in charge: Ted Meyers, ADFG, Juneau, AK
Oct. 2000 - Feb. 1, 2001:	Statistical analysis; Person in charge: Gary D. Marty
Jan. 11, 2000 –April 15, 2000:	Annual report writing; Person in charge: Gary D. Marty
open:	Opportunities for public comment

B. Project Milestones and Endpoints

Review of Objectives:

1. Determine the prevalence of major diseases in Pacific herring.
2. Determine the interaction of gender, age, and season on disease prevalence.
3. Determine the effect of disease on population trends.

Objectives will be met when each year of results is reported in the annual report, but the most complete information will be available when the multi-year study is completed and the final synthesis report is submitted April 15, 2002.

D. Completion Date

Basic project objectives will be met at the end of the third year of proposed study. Note, however, that each additional year of disease study in Prince William Sound provides more information on the recovery of the Pacific herring population. The first year of this project (99462) found continued evidence of viral expression in the population. High viral prevalence among recruiting populations of both the 1994 and 1995 year-classes seems to have severely limited the capacity of these year classes to contribute to population recovery. Preliminary evidence indicates that the 1996 year-class is small, but the 1997 year-class may be larger. Even if the 1997 year class is as large as the last major year class (1988), recovery cannot be fully documented until that year class is 5 years old: in 2002 (a year after the current project ends). Therefore, termination of study in 2001 is not likely to be sufficient to document population recovery. Comments from reviewers of my NSF proposal were favorable, but most reviewers agreed that following the population through a full cycle—probably 16 to 20 years—would be needed to understand how disease and population size are linked. Currently funded study through 2001 will provide us with 8 years of disease information, and this is already the most comprehensive study ever conducted on disease in a wild fish population. However, 8 years of study will provide information on no more than ½ of a population cycle. Extending this project (__462) another 5 years through the Restoration Reserve cost sharing with NSF will greatly enhance our understanding of how and when the Pacific herring population recovers. Such an extension is not being proposed now, but possibility of a long-term extension will be discussed with the chief scientists as details of the restoration reserve become known.

PUBLICATIONS AND REPORTS

No publications are anticipated from this work in FY00. Because the study is primarily monitoring, and proposed for three years, publication will be most beneficial to the scientific community after all three years of data are collected and analyzed. Results from fall 1998 samples (project 99462) will be incorporated into manuscripts being prepared as part of the final report for the field component of project 98162, but funds needed for that work have already been appropriated.

PROFESSIONAL CONFERENCES - No funds are requested.

NORMAL AGENCY MANAGEMENT - Not applicable.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

Continuation of proposed disease research in PWS is critical for obtaining other funding. In late 1998, the National Science Foundation's Division of Biological Oceanography funded an unsolicited proposal to continue complete analysis of the samples collected as part of project __462. The three-year $286.4K NSF project has no funds for sample collection, and depends

entirely on Trustee Council funds for sample collection. The NSF project includes collaboration with ADFG (through John Wilcock) and the University of Alaska, Fairbanks (Dr. Terrance J. Quinn). Using Dr. Quinn's expertise, the NSF project includes a modeling component to mathematically determine the relation of disease and changes in population biomass. Trustee Council-funded studies of herring disease since 1994 were highlighted in the NSF proposal as a significant source of matching funds (about $2.2 million over the life of the project). NSF normally does not fund unsolicited proposals for more than $150K per year. Because the Trustee Council funded the first year of this project (99462), and committed to an additional 2 years of funding, NSF saved about $207K on its project. At the same time, the Trustee Council will benefit from $286.4K worth of analysis funded entirely by NSF.

This project is designed to provide the same types of data that were generated during detailed disease study since 1994 (94320S, 95320S, 96162, 97162, 98162, 99462). Each year of research produces some new findings, but with each year the significance of the project becomes greater than its individual parts. The addition of two more years of data on the most important diseases will only add to the significance of this work. Proposed study has two specific interactions: 1) fish captured at the same time as disease samples will be available for, but not replace, age-weight-length studies conducted under normal ADFG management or research studies; 2) Dr. Marty will continue to share information with Dr. Kocan as he proposes separate but related research on VHSV in PWS.

EXPLANATION OF CHANGES IN CONTINUING PROJECTS – no changes other than minor adjustments in the budget.

PROPOSED PRINCIPAL INVESTIGATOR (Field Component)

Gary D. Marty
Department of Anatomy, Physiology, and Cell Biology
School of Veterinary Medicine
University of California
1 Shields Ave.
Davis, CA 95616
Phone: 530-754-8062
FAX: 530-752-7690
e-mail: gdmarty@ucdavis.edu

PERSONNEL

Project Leader:

Gary D. Marty, DVM, Ph.D., and Diplomate, American College of Veterinary Pathologists, will be responsible for design of pathology studies, on-site necropsy evaluation, and final report writing. Dr. Marty has the required fisheries background (BS and MS in fisheries biology) to integrate the many parts of this study, and he has performed these duties on a similar project since 1994.

Other Key Personnel (Field Component):

Greg Carpenter, BS, is in charge of chartering a commercial seiner for capturing fish and a laboratory vessel for fish necropsy. Mr. Carpenter is also in charge labeling sample vials, mixing 10% neutral buffered formalin, and for shipping hazardous materials (e.g., formalin) to UC Davis.

Theodore R. Meyers, Ph.D., is certified as a Fish Pathologist by the Fish Health Section of the American Fisheries Society. Dr. Meyers has been Principal Pathologist for the AK Dept. of Fish and Game since 1985. Dr. Meyers and the laboratories he supervises have been involved in the detection and diagnosis of VHSV in Alaskan fisheries since 1990, detecting the virus in cod and herring from PWS and in herring from other parts of Alaska. Dr. Meyers will oversee the diagnostic virology and bacteriology parts of this project.

LITERATURE CITED and RELEVANT PUBLICATIONS:

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Davis, C.R., **G.D. Marty**, M.A. Adkison, E.F. Freiberg, and R.P. Hedrick. In review. Association of plasma IgM with body size, histopathologic changes, and plasma chemistries in adult Pacific herring Clupea pallasi. Dis. Aquat. Org.

Hauck, A.K., and E.B. May. 1977. Histopathologic alterations associated with *Anisakis* larvae in Pacific herring from Oregon. J. Wildl. Dis. 13:290-293.

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morphological, cytogenetic, and histopathological assessments, 1989-1991. Can. J. Fish. Aquat. Sci. 53:2355-2365.

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Kocan, R., M. Bradley, N. Elder, T. Meyers, W. Batts, and J. Winton. 1997. The North American strain of viral hemorrhagic septicemia virus is highly pathogenic for laboratory reared Pacific herring. J. Aquat. Anim. Health 9:279-290.

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Marty, G.D., E.F. Freiberg, T.R. Meyers, J. Wilcock, T.B. Farver, and **D.E. Hinton**. 1998. Viral hemorrhagic septicemia virus, Ichthyophonus hoferi, and other causes of morbidity in Pacific herring Clupea pallasi spawning in Prince William Sound, Alaska, USA. Dis. Aquat. Org. 32(1):15-40.

Marty, G.D., R.A. Heintz, and **D.E. Hinton**. 1997. Histology and teratology of pink salmon larvae near the time of emergence from gravel substrate in the laboratory. Can. J. Zool. 75:978-988.

Marty, G.D., J.E. Hose, M.D. McGurk, E.D. Brown, and **D.E. Hinton**. 1997. Histopathology and cytogenetic evaluation of Pacific herring larvae exposed to petroleum hydrocarbons in the laboratory or in Prince William Sound, Alaska, after the Exxon Valdez oil spill. Can. J. Fish. Aquat. Sci. 54:1846-1857.

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Meyers, T.R., J. Sullivan, E. Emmenegger, J. Follet, S. Short, W.N. Batts, and J.R. Winton;

1992. Identification of viral hemorrhagic septicemia virus isolated from Pacific cod *Gadus macrocephalus* in Prince William Sound, USA. Dis. Aquat. Org. 12:167-175.

Meyers, T.R., and J.R. Winton. 1995. Viral hemorrhagic septicemia virus in North America. Ann. Rev. Fish Dis. 5:3-24.

Moser, M., and J. Hsieh. 1992. Biological tags for stock separation in Pacific herring *Clupea harengus pallasi* in California. J. Parasitol. 78(1):54-60.

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1998 EXXON VALDEZ TR[illegible] E COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

Budget Category:	Authorized FFY 1999	Proposed FFY 2000
Personnel	$16.1	$12.9
Travel	$0.0	$0.0
Contractual	$44.5	$47.4
Commodities	$9.0	$9.0
Equipment	$0.0	$0.0
Subtotal	$69.6	$69.3
General Administration	$5.5	$5.3
Project Total	$75.1	$74.6
Full-time Equivalents (FTE)	0.4	0.4
Other Resources		

LONG RANGE FUNDING REQUIREMENTS

Estimated FFY 2001	Estimated FFY 2002	Estimated FFY 2003			
$81.7					

Dollar amounts are shown in thousands of dollars.

Comments:

This project proposal includes two components:

1. University of California, Davis: Fish necrospsy
   a. Funds for writing the annual report in FY01 are included in the FY00 request.

2. Alaska Department of Fish and Game: Logistical and analytical support (costs are less than last year because one technician in the budget in FY99 has been eliminated from the budget).

2000

Project Number: 00462
Project Title: **Effect of Disease on Pacific Herring Population Recovery in Prince William Sound**
Agency: AK Dept. of Fish & Game

FORM 3A
AGENCY
PROJECT
DETAIL

Prepared:
summarized WJH 2Ap99

4/12/99

1998 EXXON VALDEZ TRI[illegible]E COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

Personnel Costs:			GS/Range/	Months	Monthly		Proposed
PM	Name	Position Description	Step	Budgeted	Costs	Overtime	FFY 2000
	G. Carpenter	Fishery Biologist II	16D	1.5	5,817		8.7
	Vacant	Fish & Wildlife Technician II	9A	0.5	3,229	2,614	4.2
			Subtotal	2.0	9,046	2,614	
Those costs associated with program management should be indicated by placement of an *.						**Personnel Total**	$12.9

Travel Costs:		Ticket	Round	Total	Daily	Proposed
PM		Price	Trips	Days	Per Diem	FFY 2000
	Description					
Those costs associated with program management should be indicated by placement of an *.					**Travel Total**	$0.0

2000

Project Number: 00462
Project Title: **Effect of Disease on Pacific Herring Population Recovery in Prince William Sound**
Agency: AK Dept. of Fish & Game

FORM 3B
Personnel
& Travel
DETAIL

1998 EXXON VALDEZ TR E COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

Contractual Costs:		Proposed
Description		FFY 2000
PWS Fall Sampling	Vessel Charter (hotel boat/sampling platform 4d @ 900/d)	3.6
	Vessel Charter (seiner to locate fish, 4d @ 1100/d)	4.4
	Shipping	0.2
PWS Spring Sampling	Vessel Charter (hotel boat/sampling platform, 7d @ 900/d)	6.3
	Vessel Charter (seiner to locate fish, 7d @ 1100/d)	7.7
	Shipping	0.3
Contract with Univ. of California Davis for analyses and report writing		24.9
When a non-trustee organization is used, the form 4A is required.	**Contractual Total**	$47.4

Commodities Costs:	Proposed
Description	FFY 2000
Misc. sampling supplies (tubes, jars, preservative, coolers, totes etc.) (approximately $500/sample event - 2 events)	1.0
Pathology Laboratory - Virology/Bacteriology Supplies (400 samples @ $20/sample)	8.0
Commodities Total	$9.0

2000

Project Number: 00462

Project Title: **Effect of Disease on Pacific Herring Population Recovery in Prince William Sound**

Agency: AK Dept. of Fish & Game

FORM 3B
Contractual & Commodities DETAIL

4/12/99

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FFY 2000
Those purchases assoc. with replacement equipment should be indicated an "R."		**New Equipment Total**	$0.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency

2000

Project Number: 00462
Project Title: Effect of Disease on Pacific Herring Population Recovery in Prince William Sound
Agency: AK Dept. of Fish & Game

FORM 3B
Equipment
DETAIL

1998 EXXON VALDEZ TR E COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

Budget Category:	Authorized FY 1999	Proposed FY 2000
Personnel		$10.4
Travel		$5.8
Contractual		$2.4
Commodities		$2.3
Equipment		$0.0
Subtotal	$0.0	$20.9
Indirect		$4.0
Project Total	$0.0	$24.9
Full-time Equivalents (FTE)		0.2
Other Resources		

LONG RANGE FUNDING REQUIREMENTS

Estimated FY 2001	Estimated FY 2002
$29.5	$0.0

Dollar amounts are shown in thousands of dollars.

Comments: Indirect Costs include the standard overhead rates and applications for the Institute of Toxicology and Environmental Health (ITEH) at the University of California, Davis (18.9%).

Other funds - A 3-year $286.4K grant was funded by the National Science Foundation (NSF), 2-1-99 through 1-31-02, with Dr. Gary D. Marty as principal investigator. The NSF grant includes complete blood analysis, histopathology, and population modeling not included in this proposal. This proposal (00462) can stand on its own, but completion of the NSF grant is entirely dependent on access to samples collected as part of this project. The Trustee Council benefits by getting complete analysis of all samples collected, including population modeling, at no additional cost.

Proposal includes funds (here, direct costs) for report writing (0.5 month time for G. Marty, $400 of the supply budget), community involvement (0.2 month time for G. Marty, $50 for long distance phone calls), the annual workshop and a technical review session (travel and per diem). The proposal does not include funds for NEPA compliance, publications, or professional conferences (the NSF grant provides funds for publication and for Dr. Marty to attend one professional meeting per year). Increased cost for the final year covers extra time by Dr. Marty (0.5 month) for final report writing.

FY00

Project Number: 00462
Project Title: Effect of Disease on Pacific Herring Population Recovery in Prince William Sound
Name: University of California, Davis
Agency: ADFG

FORM 4A
Non-Trustee
SUMMARY

Prepared:
GDM; entered WJH - 2Ap99

4/12/99

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

Personnel Costs:			Months	Monthly		Proposed
	Name	Position Description	Budgeted	Costs	Overtime	FY 2000
	Marty, G.	Assistant Researcher IV	1.5	5.8	0.0	8.7
	Teh, C.	Laboratory Assistant III	0.5	3.3	0.0	1.7
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
		Subtotal	2.0	9.1	0.0	
					Personnel Total	$10.4

Travel Costs:		Ticket	Round	Total	Daily	Proposed
	Description	Price	Trips	Days	Per Diem	FY 2000
	airfare to Cordova for sample collection (1 fall, 3 spring)*	0.6	4	16	0.1	4.0
	airfare to Anchorage for annual workshop and tech. rev. session	0.5	2	8	0.1	1.8
						0.0
	*There are actually 32 days per diem rather than 16 on these trips,					0.0
	but the field rate is $45/day which these formulas will not					0.0
	accommodate. Thus the number of days were halved and the					0.0
	rate doubled.					0.0
						0.0
						0.0
						0.0
						0.0
						0.0
					Travel Total	$5.8

FY00

Prepared:

Project Number: 00462
Project Title: Effect of Disease on Pacific Herring Population Recovery in Prince William Sound
Name: University of California, Davis
Agency: ADFG

FORM 4B
Personnel
& Travel
DETAIL

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

Contractual Costs:	Proposed FY 2000
Description	
150 fish necropsies @ $15.75/fish (professional services of consulting pathologist)	2.4
Contractual Total	$2.4

Commodities Costs:	Proposed FY 2000
Description	
Materials and supplies (for sampling supplies, report writing, long distance phone, film, computer disks)	1.7
statistical analysis	0.4
ITEH supplies	0.2
Commodities Total	$2.3

FY00

Prepared:

Project Number: 00462
Project Title: Effect of Disease on Pacific Herring Population Recovery in Prince William Sound
Name: University of California, Davis
Agency: ADFG

FORM 4B
Contractual & Commodities DETAIL

4/12/99

1998 EXXON VALDEZ TR E COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

New Equipment Purchases:	Number	Unit	Proposed
Description	of Units	Price	FY 2000
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 an "R."		**New Equipment Total**	$0.0

Existing Equipment Usage:	Number	
Description	of Units	
IEC clinical centrifuge equipped with rotors for on site plasma separation and packed cell vol. determination	1	
Revco -80° freezer for archiving plasma	1	
YSI Model 55 hand-held dissolved oxygen meter for checking fish holding conditions before necropsy	1	
For report writing and correspondence:		
Pentium 90 IBM-PC desktop computer with 64Mb RAM, Ethernet card, and internal 14,400 baud modem	1	
486-100 IBM-PC color notebook computer with 16MB RAM and internal 14,400 baud modem	1	
HP4L LaserJet printer	1	
Codonics NP-1600 Color Photographic Network Printer, for publication grade printing of digital images	1	

FY00

Prepared:

Project Number: 00462
Project Title: Effect of Disease on Pacific Herring Population Recovery in Prince William Sound
Name: University of California, Davis
Agency: ADFG

FORM 4B
Equipment
DETAIL

4/12/99

IMMAGE: Integrated Monitoring of Mechanisms Affecting the Gulf (of Alaska) Ecosystem

Project Number:	~~New Project~~ 00493
Restoration Category:	Monitoring and Research (Trawl Surveys)
Proposer:	National Oceanographic and Atomospheric Agency (NOAA) and Alaska Department of Fish and Game (ADFG)
Lead Trustee Agency:	NOAA
Cooperating Agencies:	ADF&G, NMFS, PMEL, DOI
Alaska SeaLife Center:	No
Duration:	1st year, 3 year project.
Cost FY 00:	$178,000
Cost FY 01:	$83,000
Cost FY02:	$85,000
Geographic Area:	Gulf of Alaska – Kodiak Is. Region (Chiniak Bay)/Lower Cook I.
Injured Resource/Service:	Subtidal communities, seabirds including: Marbled Murrelet, Common Murre, cormorants, Harlequin Duck, Pigeon Guillemont, Kittlitz's Murrelet. Marine mammals including: harbor seal, Steller sea lion, sea otter, killer whale. Services including: commercial fishing, recreational fishing and tourism, subsistence.

ABSTRACT

This project is an integrated study of mechanisms controlling changes in community structure in the Gulf of Alaska (GOA) ecosystem. Three major components include (1)small-mesh trawl sampling of benthic and epi-benthic megafauna in representative areas of the GOA, (2) , deployment of a moored buoy array to provide "real-time" oceanographic data in the coastal region, and (3) associated plankton sampling to quantify phyto- and zooplankton dynamics in the water column during critical periods of life history. These components should lead to a more comprehensive understanding of biological-physical coupling and dynamics of the GOA ecosystem.

INTRODUCTION

Research results from EVOS sponsored studies of past trawl surveys have shown the Gulf of Alaska underwent a reorganization in the forage and benthic communities following a climatic change in 1977(Anderson and Piatt, 1999). The mechanism of how the change occurred is poorly understood although it is clearly related to the increase in temperature observed in the later part of the 1970s. It is important to understand how changes are either related to the mechanism, or are an integral part of the driving force of ecological change. This study proposes to "immage" the ecosystem and produce data that will help us understand the mechanisms that lead to changes in the composition of forage and benthic communities. This understanding is the key framework from which to judge the adequacy of recovery for injured species

NEED FOR THE PROJECT

A. Statement of Problem

There is an urgent need to maintain the small-mesh trawl survey data series. NOAA through its NMFS currently funds an annual survey at one site in the Gulf of Alaska. Additionally ADFG funds a triennial survey of several bays in the Gulf of Alaska. Providing funding of this project would allow ADFG and NMFS to cooperate in a modest program to expand annual surveys to three sites in the Gulf of Alaska from the current single site. Analysis of past data suggest that this would give a fairly complete picture of changes, if any, over a broad area from Lower Cook Inlet, Kodiak, and the south side of the Alaska peninsula on a annual basis. This data will become more important as a basis for understanding the dynamics coastal processes in the future.

Additionally it is important to understand the underlying mechanisms for forage species abundance changes in the Gulf of Alaska ecosystem in order to conserve and manage Alaska's fish, seabird, and marine mammal resources. To accomplish this degree of understanding, we must initiate programs that integrate both biological and physical aspects of the ecosystem. The effects of human induced changes from activities such as commercial fishing and oil spills will not be clear until we can establish the magnitude and form of natural response to climate change and its underlying mechanisms. In order to accomplish this goal we propose to establish a permanent "real-time" oceanographic station in the near-shore Gulf of Alaska habitat.

B. Rationale/Link to Restoration

It is difficult to judge the adequacy of restoration efforts without knowledge of the degree and magnitude of change that has occurred due to climate change or other factors. Understanding these changes and the underlying mechanism, that drive variation in the marine ecosystem is critical in determining higher trophic level response. Continuing the trawl survey data collection is an important first step in getting the knowledge base for this better understanding.

C. Location

Gulf of Alaska, Kodiak Island Region, primarily Chiniak Bay and surrounding area and trawl

sampling in Kachemak Bay and Cook Inlet.

COMMUNITY INVOLVEMENT AND TRADITIONAL KNOWLEDGE

Community involvement will play a large initial role in this project. To assist in improving sampling efforts, information on timing of capelin spawning activity will be collected from fishers who harvested subsistence capelin from Chiniak and Marmot Bays (1970-1995). Such information is critical to determine optimal timing of surveys in order to gather representative samples from subsequent larval surveys.

PROJECT DESIGN

A. Objectives

1. Conduct late-summer small-mesh trawl surveys in the standard sampling strata with standard gear as used since the early 1970's in Chiniak Bay and Kachemak Bay sampling stratum.

2. Collect "real-time" oceanographic observations in the important near-shore habitat zone in Chiniak Bay.

3. Collect retrospective data for greater Chiniak Bay, Kodiak Island region Kachemak Bay. Capelin subsistance use history (timing and areas), historic temperature data from near-shore zone (from Kodiak tide station and ADF&G station starting about 1970), assemble all pertinent Osmerid Ichthyoplankton data collected since early 1970's in the Kodiak region, assemble historic plankton samples that have not yet been sorted for Osmerid larvae, assemble and compile all trawl survey and especially small-mesh survey data for this area.

4. Conduct plankton sampling concentrating on capelin larvae in Chiniak and Kalsin Bays and adjacent offshore areas.

B. Methods

1. Trawl surveys to monitor the benthic and epi-benthic components of the ecosystem will be conducted in Chiniak and Kachemak Bay, occupying stations that have been sampled since the early 1970s. Chiniak bay has been closed to on-bottom trawling by commercial vessels since 1986. The lack of commercial fishing effort would enhance interpretation of survey results. Late summer or early fall is the preferred period of sampling. We will continue sampling in areas that have been sampled for at least the last twenty years with small-mesh high-opening nets. All species in a haul will be weighed and enumerated. Size frequency will be collected on selected species. All data will be quality checked and added to legacy databases. In addition to bottom trawling, we will use a modified Herring mid-water trawl net to sample forage fishes, in particular capelin, in lower Cook Inlet, where intensive sampling has occurred during the past five years in association with the APEX project.

2. Physical oceanographic observations will be collected continuously by the OSKAR buoy array

(see appendix A. for further information and operational details). This information will be served to the internet by the main PMEL servers off a T-1 line from Seattle, WA. Data from buoys will provide an opportunity to examine how the physical properties of the in-shore area change relative to off-shore collected data. Physical forcing factors in the Gulf of Alaska will be integrated with information from the trawl/plankton surveys, and compared with data from ongoing breeding bird surveys in the same vicinity. All biological and physical oceanographic data will be entered into standard databases at PMEL and made available as requested.

3. Most of the retrospective data is available from various sources. There has not been an integrated compilation of this data except for part of the trawl data. A GIS will be used to compile this information and a database containing this information will be developed. Preliminary analysis of this data would guide the direction for future research..

4. Plankton sampling will be conducted with standard sampling methodology that has been used in previous surveys of Chiniak Bay. We will concentrate on sampling the appropriate time periods for main species of interest: Mid-spring to early summer for decapod crustaceans and pollock larvae and mid to late summer for capelin larvae. Sorting will be accomplished through the long-term arrangement that NMFS has with the Polish sorting center or through contracts with local businesses. Data of relative abundance for selected species will be stored in the Alaska Fisheries Science Center plankton database.

C. Cooperating Agencies, Contracts, and Other Agency Assistance

Pacific Environmental Marine Laboratory (PMEL)-(NOAA) will be responsible for assembly, testing, calibration, deployment and maintenance of the buoy array and instrumentation. Oceanographic data will be made available through "real-time" and database access through the internet.

Alaska Department of Fish and Game (ADFG) would oversee and conduct the trawl survey and would be responsible for data quality and control.

NMFS Alaska Fisheries Science Center at the Kodiak Fisheries Research Center would coordinate retrospective data collection and analysis, oversee with ADFG the trawl and plankton sampling, and would oversee contract personnel assigned to sorting samples for quality control. Databases would be maintained in cooperation with ADFG.

Project data synthesis and report and manuscript preparation would be shared by all of the participating agencies.

SCHEDULE

A. Measurable Project Tasks for FY 00 (October 1, 1999 - September 30, 2000)

October - January	Assemble Retrospective IMMAGE Database
November - December	Purchase and Assembly of OSKAR array
November - June	Assemble historic plankton samples and start sorting for Osmerid larvae collected from Chiniak Bay
January	Attend Annual Restoration Workshop
March	Deploy OSKAR mooring
March - April	Prepare Report on Initial Results
March - September	Prepare manuscript on early life history of capelin
July	Develop trawl and plankton sampling protocol
Late Summer	Conduct trawl survey

B. Project Milestones and Endpoints

Establish OSKAR and direct link to disseminate data real-time via the internet.(FY00)

Publish historic discription of the various early life history stages of capelin in the Kodiak region of the Gulf of Alaska.(FY00)

Maintenance and replacement of OSKAR (FY01-?)

Update long-term trawl survey database as data is collected, quality checked and entered.

C. Completion Date

Monitoring ongoing, if successful, at providing data needed by researchers.

PUBLICATION AND REPORTS

Publish report on retrospective sysnthesis from data sources (FY00)

Publish manuscript describing long-term changes from the trawl survey data (FY00)

Publish paper on shrimp as indicators of climatic shift (FY00)

Prepare manuscript for presentation at Pacific Salmon Conference dealing with food webs, based on trawl survey data analysis.(FY00)

Prepare manuscript on early life history of capelin in the vicinity of Kodiak Island (FY00-01)

Present early research results at Pacific Climate Variability symposium.(FY00)

PROFESSIONAL CONFERENCES

Possible tie in with GOLBEC sponsored inshore process studies may lead to attendance at GLOBEC meetings.

Beyond El Niño: Conference on Pacific Climate Variability March 23 - 26, 2000.

NORMAL AGENCY MANAGEMENT

The funds to conduct this project are not available from NMFS, ADFG, PMEL, or DOI. Any funds to conduct this project will however be extremely well leveraged since many of the cooperating agencies will be providing equipment that is already in hand to conduct the research and monitoring project proposed. As an example, the OSKAR buoy array will be constructed from equipment and some sensors that PMEL has in house. This will speed deployment of the project, and will be efficient due to staff familiarity with the gear and recovery of data.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

This project will take direction from already council funded projects such as APEX and SEA. We will not duplicate their fine past efforts, but rather build on the knowledge from those studies to further the understanding of two highly significant species associated with climate change in the Gulf of Alaska.

EXPLANATION OF CHANGES IN CONTINUING PROJECTS

None, new project.

PROPOSED PRINCIPAL INVESTIGATORS

Bruce Wright, project coordination
John Piatt, Ph.D. seabird data and analysis,
Paul Anderson, trawl and plankton sample coordination
Kevin Bailey, Ph.D., ichthyoplankton specialist
Jim Blackburn, trawl survey and database coordinator
Bradley Stevens, Ph.D., larval crustacean specialist
Phyllis Stabeno, Ph.D., biological oceanographer

PRINCIPLE INVESTIGATOR

At this time, a PI for this project has not been designated contact:
Paul J. Anderson
Kodiak Laboratory, NMFS
301 Research Court
Kodiak, AK 99615
(907)481-1723
paul.j.anderson@noaa.gov

OTHER KEY PERSONNEL

Sharon Loy, GIS
Bill Parker, OSKAR assembly and maintenance
Eric Munk, plankton specialist
Bill Bechtol, trawl surveys, Kachemak Bay

LITERATURE CITED

Anderson, Paul J. and John F. Piatt, 1999. Community Reorganization in the Gulf of Alaska Following Ocean Climate Regime Shift. Marine Ecol. Prog. Series (Accepted).

Appendix A

Project OSKAR

Ocean Station - Kodiak, Alaska Region

National Marine Fisheries Service
Kodiak Laboratory
P.O. Box 1638
Kodiak, AK 99615
(907) 481-1700

April 13, 1999

1. PROJECT SUMMARY

1.A Abstract

Over the past few decades, large scale oceanographic changes have occurred in the North Pacific Ocean. This regime shift is associated with major declines in the abundance of crab, shrimp, small pelagic fish, seabirds and marine mammals, and increases in groundfish, as well as major economic shifts in the human communities which harvest these resources. Past and future regime shifts cannot be studied without long-term, real-time oceanographic data. Such data does not now exist for the North Pacific Ocean due to the absence of in-situ instrumentation. We propose to solve this problem by developing OSKAR: Ocean Station Kodiak Alaska Region, a moored instrument array on the continental shelf in the Gulf of Alaska, to collect long-term oceanographic data, and make it available to scientists via the internet. It would become the hub of all future marine research in the GOA.

1.B. Background

Over the past few decades, large scale changes have occurred in the climatic, oceanographic, physical and biological characteristics of the North Pacific Ocean (Royer, 1989, Trenberth and Hurrell 1995). Most notable was a major increase in temperature in 1977 with subsequent precipitous declines in abundance of crab, shrimp, and small pelagic fish, and increases in gadids and flatfishes (Anderson et al., 1997). This change was seen only in retrospect, and is now called the North Pacific Decadal Oscillation (NPDO). It is an example of a regime shift, which occurs when a long period of semi-stable ecological conditions suddenly gives way to a new set of entirely different conditions. These ecological changes have led to major economic shifts in the character of coastal communities in Alaska. On a smaller scale, the El Nino/ Southern Oscillation (ENSO) occurs at intervals of 3-7 years, and also causes short term (months to years) changes in oceanographic conditions in the North Pacific. Major changes in the abundance of seabirds (Piatt and Anderson 1996), plankton (Brodeur et al., 1996), and marine mammals, particularly the now endangered Steller sea lion, over recent decades are also likely linked to either the ENSO or NPDO.

A major problem in marine science is that large scale changes like NPDO have never been observed in real time, i.e., as it occurred, and have only been detected by analyzing historical data sets, which are often quite patchy. Real time observation, and prediction of such major ecological changes requires the development of a set of comprehensive leading ecological indicators; at present there is no such data set. Furthermore, most scientists and managers are only concerned about one or a few species and lack a large scale view which incorporates ecosytem wide variability. Major changes in the Bering Sea ecosystem prompted a review by The National Research Council, which concluded that

> "The biggest single impediment to understanding the causes of change in the Bering Sea ecosystem ... is the absence of an ecosystem viewpoint... Previous research has focused on ... narrow ecological and temporal... subsets of resources...Such partitioning... does not allow the broad synthesis of information ...required to properly interpret the dynamics of the system. The most significant research recommendation... is to adopt a broader ecosystem perspective in both science and management..."

Despite the importance of the North Pacific Ocean, and the Gulf of Alaska (GOA) in particular, as a resource for fishing and other marine related activities, there has been no long term collection of oceanographic data in the nearshore coastal region. Without such data, it is impossible to observe oceanographic trends, or to understand how the biology of fishery

resources responds to such changes. Year-round temperature data is available from only a few locations, and even now, it is only available once yearly. Given that such regime shifts have occurred every few decades, another shift is inevitable and may already be underway. Without real-time oceanographic data, it is impossible to observe, study or predict the occurrence of the next regime shift.

The only way to observe oceanographic changes, and study their effects, is to establish oceanographic observatories. These consist of a moored array, essentially a buoy from which is suspended a suite of instruments to measure and record water conditions. All the instruments are proven technology; a large number of similar moorings are present along the equator for monitoring ENSO. The only similar device in the Gulf of Alaska is in Resurrection Bay, which is not typical of the Kodiak regional environment. Prior to 1998, it was only in use during May-October, and was not functioning during spring plankton blooms.

Ocean Station - Kodiak, Alaska Region (OSKAR)

We propose to establish such an observatory, called OSKAR, Ocean Station Kodiak Alaska Region. OSKAR is designed to provide real-time data on the oceanographic conditions over the continental shelf near Kodiak. It will be the only data buoy on the West Coast of the US which is placed in a nearshore region of productive fisheries. The Kodiak Fishery Research Center (KFRC) will provide a home for the equipment associated with OSKAR, such as the computers and telecommunications equipment necessary to provide real-time data access via the internet. The name OSKAR also honors the late Oscar Dyson, one of the pioneers of the Kodiak fishing industry. KFRC houses the National Marine Fisheries Service (NMFS) Kodiak Laboratory, and will bring Kodiak to the forefront of marine research in Alaska; adjacent facilities include the University of Alaska (UA) Fishery Industrial Technology Center, and the Alaska Dept. of Fish and Game (ADFG) Western Region headquarters. The development of this research center makes access to real-time local oceanographic data a necessity, and such data will become an integral focus of marine research in the GOA. OSKAR is the key component to any further research on the marine environment of the Gulf of Alaska.

2. PROJECT DESCRIPTION

The project consists of two distinct units, (1) a moored oceanographic buoy array (OSKAR), and (2) associated laboratory and computer equipment.

A. Existing Facility

The Kodiak Fisheries Research Center (KFRC) is a new facility which is jointly used by NMFS, the University of Alaska, ADFG, and the National Park Service. KFRC contains 2500 square feet of wet laboratory as well as numerous other office and laboratory spaces. It is adjacent to the UA Fishery Industrial Technology Center (FITC), and will be linked with FITC for communications and internet access. The KFRC contains laboratories with running filtered and raw seawater (the first such facility in Kodiak), microscope/equipment labs, three controlled temperature rooms, an electron microscope lab, a scuba compressor station and dive locker, a video analysis and editing lab, various preparation labs, as well as a complete scientific library and offices.

Currently, there is no source for real-time, long-term acquisition of oceanographic data in the nearby region. The only current option available for collection of water temperature data are

in-situ recorders which must be collected by scuba annually, so that the data is retrospective, and not available in real time, nor in water deeper than scuba depths (about 30 m).

B. Project Proposal: **OSKAR** - Ocean Station - Kodiak, Alaska Region.

1. Purpose - The purpose of OSKAR is to provide real-time, long term, in-situ observations of oceanographic conditions over the continental shelf in the region of Kodiak, Alaska. The data will be made available to multiple users in real time to scientists and others around the world by internet access via WWW. Data will be used to observe short and long term changes in oceanographic conditions, to develop leading indicators of such changes, and to develop biophysical models of large and small scale oceanographic parameters. Data will also be used in local research on reproduction, recruitment and population dynamics of marine species. Examples of such biological research include long-term studies on reproduction and recruitment of Tanner crabs in Chiniak Bay, population dynamics of nearshore flatfish species, timing of the phytoplankton bloom and linkages with crab and fish spawning cycles, changes is abundance of small pelagic fish, seabird and marine mammal studies. None of this can be accomplished without real-time information on oceanographic conditions. Long-term retrospective studies on the biodiversity of the GOA (Anderson et al. 1997) would have been, and continuation of this research will be, much more comprehensive with associated in-situ oceanographic data. Ultimately, the data would be used to create models for improved understanding of recruitment fluctuations in Gulf of Alaska marine organisms.

2. Data Management - Data from OSKAR would be sent via satellite or cell phone (depending on distance from shore) to a shoreside station at the new KFRC, or to PMEL in Seattle. There, the data would be examined for integrity, post-processed, calibrated, and stored in a database which could be accessed at any time via the internet. Since NMFS already has the computer and internet infrastructure to handle data acquisition and distribution, this represents a considerable leveraging of assets. NMFS staff would maintain the computer equipment and database integrity.

3. Structure - The station would consist of two moored arrays, anchored to the seabottom in approx 150-200 m of water, with a bouy at the surface. Attached to the array would be instruments for determination of:

   Temperature - Surface (5 m), midwater (50 m), and bottom (150-200 m)
   Salinity - same depths as temperature
   Chlorophyll - To estmate phytoplankton abundance, at 5 m.
   Currents - An acoustic doppler current profiler (ADCP) will be placed on the second mooring, near the bottom.

   The main mooring would have a floating instrument platform at the surface, which would contain instrumentation for power (photocells) and data transmission, whereas the ADCP would be attached to a retrievable subsurface mooring. Data would be transmitted either by satellite or cell phone to a shoreside computer, where it would be made available on

the internet. OSKAR would be deployed from ship by personnel from PMEL (who have successfully deployed temporary moorings in up to 120 m depth at other locations). OSKAR would be serviced annually, at which time instruments would be calibrated or replaced as necessary.

4. Benefits - Oceanographic data provided by OSKAR will be usable by local and distant scientists studying the oceanography and marine resources of the Gulf of Alaska, including scientists from the NMFS, ADFG, and UAF. It will also be used by students in Kodiak High School biology and fisheries classes, as well as by UA students, either in residence at Kodiak, or on the main campuses. Visiting scientists and students will have access to real-time oceanographic data for use in conjunction with field studies, in-situ observations or collections. The data would facilitate new collaborations between personnel of NMFS, UA, ADFG, and other agencies for long-term research. It would allow comparisons of oceanographic events on the outer continental shelf to those observed at other locations, thus fostering larger scale research activities than are currently possible. The data will support complex research activities by multiple investigators concerning long-term, large-scale ecological changes and processes, which are necessary to understand the demographic shifts currently occurring in sensitive populations, such as endangered Steller sea lions in the Gulf of Alaska. OSKAR will become the central hub for a variety of oceanographic and marine research projects which will be connected to it like spokes of a wheel.

5. Placement of OSKAR - Long term studies of Tanner crab mating and aggregation have been conducted at one site in Chiniak bay since 1991. Over 100,000 crabs release larvae at this site annually. For this reason, Chiniak bay is the first choice for placement of OSKAR. However, local ship traffic and fishing intensity may dictate selection of an alternate site further out on the continental shelf where water conditions may be more representative of the wider GOA shelf region.

C. Principal Investigators

Dr. Bradley G. Stevens.

Dr. Stevens has been studying the reproduction and behavioral ecology of Tanner crabs (Chionoecetes bairdi) using submersibles and ROV's (Stevens et al. 1993, 1996). In 1991, he discovered that Tanner crabs form high density aggregations each spring associated with mating (Stevens et al. 1994). Recent findings (Stevens et al. In press) suggest that aggregation is associated with larval release, and is cued to local tidal cycles, a potential mechanism decoupling it from annual oceanographic variations. He spent most of 1996 in Japan, studying settlement behavior and substrate use by king crab postlarvae and juveniles, with Dr. Jiro Kittaka of Tokyo Science University (Stevens and Kittaka 1998).

Mr. Paul Anderson

Mr. Anderson has spent much of his career studying the biology of Pandalid shrimps. Recently he has been the PI on a retrospective study of a long time series of small mesh trawl surveys in the GOA (Anderson et al., 1997). The results are the best documentation of the

changes in abundance of benthic invertebrates and small pelagic fish which resulted from the 1977 regime shift.

Dr. Phyllis Stabeno

Dr. Stabeno is a biological oceanographer with the Pacific Marine Environmental Laboraotory (PMEL), of NOAA, in Seattle. She has been a PI on the FOCI (Fisheries Oceanography Coordinated Investigations) project for several years. Her interest is oceanography of the northern Pacific ocean and its relationship to fisheries production (Stabeno et al. 1998).

Mr. Bill Parker

Mr. Parker works for PMEL, and is primarily responsible for assembling and maintaining oceanographic research equipment, including the components of OSKAR.

Additional Investigators

Dr. Brenda Norcross

Dr Norcross specializes in fisheries oceanography, fisheries ecology and habitat characterization, and early life history of marine fish. Research projects have included defining habitats and developing models for nursery areas of five species of flatfishes in Alaskan waters.

Mr. Jim Blackburn

Mr. Blackburn is a fishery biologist and research scientist with the ADFG, and has been a co-investigator on the time series analysis of GOA fish and invertebrates.

3. Bibliography

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4. BUDGET

Initial cost to build and deploy the array would be in the range of $150-250 K, and annual maintenance could cost from $10,000 - 25,000. However, newer, cheaper alternatives are available, and will be explored.

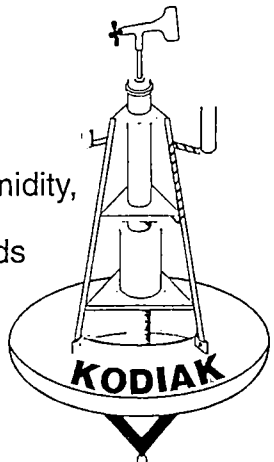
5. Schematic diagram of OSKAR

see attached figure..

Alaska Fisheries Science Center
and
Pacific Marine Environmental Laboratory

FOCI-FATE-CRAB Cooperative Program

Kodiak Surface Mooring
Weather and Thermistor Data



. .eal-time weather: humidity,
rainfall, AT, SST,
solar radiation, winds

10 meters Seacat with fluorometer

15 meters **REAL-TIME 90 METER THERMISTOR CHAIN**

25 meters

thermistor every 10 meters

95 meters

105 meters

110 meters Microcat

release

Depth is 120 Meters

anchor

30" float

250 KHz ADP

release

anchor

2000 EXXON VALDEZ TRU . COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 2000

Budget Category:	Authorized FY 1999	Proposed FY 2000	PROPOSED FY 2000 TRUSTEE AGENCIES TOTALS					
			ADEC	ADF&G	ADNR	USFS	DOI	NOAA
				$45,000.0				$134,000.0
Personnel	$0.0	$36,220.0						
Travel	$0.0	$810.0						
Contractual	$0.0	$31,275.0						
Commodities	$0.0	$2,500.0						
Equipment	$0.0	$101,395.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	$0.0	$172,200.0			Estimated FY 2001	Estimated FY 2002		
General Administration	$0.0	$6,083.5						
Project Total	$0.0	$178,283.5			$83,000.0	$85,000.0		
Full-time Equivalents (FTE)	0.0	0.5						
	Dollar amounts are shown in thousands of dollars.							
Other Resources	$0.0	$0.0			$0.0	$0.0		

Comments:This proposed study "IMMAGE" will deploy a marine data collection buoy system "OSKAR" at Chiniak Bay , Alaska. Annual small-mesh trawl surveys in this area will be resumed if the project is funded. This area is thought to be representative of the productive inshore marine system in the Gulf of Alaska. The area has been closed to on-bottom trawl fisheries since 1986. Long-term data sets for a variety of different species from top predators to plankton is available and will be assembled into a coherent product along with the monitoring data that will be collected from this project.

FY00

Prepared:

Project Number: New Project 00493
Project Title: IMMAGE: Integrated Monitoring of Mechanisms Affecting the Gulf (of Alaska) Ecosystem
Lead Agency: NOAA

FORM 2A
MULTI-TRUSTEE
AGENCY
SUMMARY

2000 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 2000

Budget Category:	Authorized FY 1999	Proposed FY 2000
Personnel		$23,920.0
Travel		$810.0
Contractual		$4,000.0
Commodities		$0.0
Equipment		$101,395.0
Subtotal	$0.0	$130,125.0
General Administration		$3,680.5
Project Total	$0.0	$133,805.5
Full-time Equivalents (FTE)		0.3
Other Resources		

LONG RANGE FUNDING REQUIREMENTS

		Estimated FY 2001	Estimated FY 2002		
		$37,000.0	$38000		

Dollar amounts are shown in thousands of dollars.

Comments:NOAA with participation of its Pacific Marine Environmental Laboratory (PMEL) and National Marine Fisheries Service (NMFS) will coordinate most of this project. PMEL and appropriate staff will be responsible for deployment of the OSKAR data collection buoy system and will provide real-time data through their data services link to the internet. Dr Stabeno will be responsible for scientific data collection quality and interpretation of results. Various PMEL staff will be responsible for assembly, testing, and calibration of data gathering sensors in the array. NMFS Kodiak Laboratory staff will be responsible for overseeing assembly of various biological databases into one location for the IMMAGE project. Dr. Stevens will be responsible for coordinating this part of the project with assistance from Paul Anderson,who will also oversee direction of monitoring/survey data collection and analysis.

Long-range funding requests are substantially lower due to the first year investment costs associated with deploying the oceanographic data collection buoy system

FY00

red:

Project Number: New Project
Project Title: MMAGE: Integrated Monitoring of Mechanisms Affecting the Gulf (of Alaska) Ecosystem
Agency: NOAA

FORM 3A
TRUSTEE
AGENCY
SUMMARY

2000 EXXON VALDEZ TRU[illegible] COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 2000

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 2000
Bill Parker (PMEL)	Oceanographic Survey Technician	GS12/7	0.2	5800.0		1,160.0
Dr. Stabeno	Biological Oceanographer	GS14/5	0.3	7800.0		2,340.0
Dr. Stevens	Fisheries Biologist	GS13/8	1.0	8400.0		8,400.0
Paul Anderson	Fisheries Biologist	GS12/7	1.0	6700.0		6,700.0
Eric Munk	Fisheries Biologist	GS11/4	0.3	5400.0		1,620.0
USGS	Fisheries Biologist	GS9/2	1.0	3700.0		3,700.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		3.8	37800.0	0.0	
					Personnel Total	$23,920.0

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 2000
PMEL and NMFS will donate travel to and from Seattle for deployment					0.0
of the OSKAR Buoy Array					0.0
					0.0
Annual EVOS Workshop	300.0	1	3	170.0	810.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$810.0

FY00

Prepared:

Project Number: New Project
Project Title: MMAGE: Integrated Monitoring of Mechanisms Affecting the Gulf (of Alaska) Ecosystem
Agency: NOAA

FORM 3B
Personnel
& Travel
DETAIL

2000 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1999 - September 30, 2000

Contractual Costs:	Proposed
Description	FY 2000
Sort plankton samples from 1981 and 1982 for Osmerid larvae $8 per sample for 500 (approx.) samples	4,000.0
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$4,000.0

Commodities Costs:	Proposed
Description	FY 2000
PMEL and NMFS will donate Ship time and consumables to aid in deployment of the OSKAR Buoy Array NMFS will donate workspace and laboratory consumables for Plankton sorting and collection	
Commodities Total	$0.0

FY00

Project Number: New Project
Project Title: MMAGE: Integrated Monitoring of Mechanisms Affecting the Gulf (of Alaska) Ecosystem
Agency: NOAA

FORM 3B
Contractual & Commodities DETAIL

Prepared:

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FY 2000
Components for OSKAR Buoy Array			0.0
Weather package	1	15000.0	15,000.0
Buoy	1	11000.0	11,000.0
ADP	1	30000.0	30,000.0
ADP Bracket	1	1495.0	1,495.0
SEACAT (FL mod/WETStar/pump)	1	16500.0	16,500.0
Microcat	1	3900.0	3,900.0
Thermistors	10	100.0	1,000.0
Releases	2	9000.0	18,000.0
Argos Satelite Transponder Package Plus one year communication maintenance and Internet Link	1	4500.0	4,500.0
			0.0
			0.0
			0.0
Those purchases associated with replacement equipment should be indicated by placement of an R.		**New Equipment Total**	$101,395.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency
Ship time and off-the-shelf equiptment will be donated for OSKAR buoy system		
Binocular scopes		
Plankton splitting and sorting equiptment		
NMFS sampling gear and accessories, including nets, plankton bongo frames, sample collection containers and preservatives		
Computer systems and Network and Internet Access		

FY00

Project Number: New Project
Project Title: MMAGE: Integrated Monitoring of Mechanisms Affecting the Gulf (of Alaska) Ecosystem
Agency: ADFG

FORM 3B
Equipment
DETAIL

Prepared:

2000 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 2000

Budget Category:	Authorized FY 1999	Proposed FY 2000
Personnel		$12,300.0
Travel		$0.0
Contractual		$27,275.0
Commodities		$2,500.0
Equipment		$0.0
Subtotal	$0.0	$42,075.0
General Administration		$2,403.0
Project Total	$0.0	$44,478.0
Full-time Equivalents (FTE)		0.2
Other Resources		

LONG RANGE FUNDING REQUIREMENTS

Estimated FY 2001	Estimated FY 2002
$46,000.0	$47,000.0

Dollar amounts are shown in thousands of dollars.

Comments: ADFG will be responsible for conduct of the annual trawl survey within the selected study area: Chiniak Bay in the Gulf of Alaska. The contractual amounts shown cover the cost of the R/V Resolution for the time needed to survey this defined area.

FY00

ıred:

Project Number: New Project
Project Title: MMAGE: Integrated Monitoring of Mechanisms Affecting the Gulf (of Alaska) Ecosystem
Agency: ADFG

FORM 3A
TRUSTEE
AGENCY
SUMMARY

2000 EXXON VALDEZ TRU COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 2000

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 2000
Fisheries Biologist II	Trawl Survey Leader		0.2			1,750.0
3 Fisheries Tech. I	Trawl survey technicians		1.5			6,700.0
Fisheries Biologist III	Database Manager / Quality Control		0.5			3,850.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		2.2	0.0	0.0	
					Personnel Total	$12,300.0

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 2000
NONE					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$0.0

FY00

Prepared:

Project Number: New Project
Project Title: MMAGE: Integrated Monitoring of Mechanisms Affecting the Gulf (of Alaska) Ecosystem
Agency: ADFG

FORM 3B
Personnel
& Travel
DETAIL

2000 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 2000

Contractual Costs:	Proposed FY 2000
Description	
R/V Resolution to conduct small-mesh trawl survey in the Chiniak Bay region of the Gulf of Alaska 5 days at $2755 per day (Internal Agency)	13,775.0
R/V Pandalus to conduct trawl survey in Kachemak Bay /Lower Cook Inlet Region 10 days at $1,350/d	13,500.0
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$27,275.0

Commodities Costs:	Proposed FY 2000
Description	
Repair and supplies for trawl net and hardware	2,500.0
Commodities Total	$2,500.0

FY00

Project Number: New Project
Project Title: MMAGE: Integrated Monitoring of Mechanisms Affecting the Gulf (of Alaska) Ecosystem
Agency: ADFG

FORM 3B
Contractual & Commodities DETAIL

ared:

New Equipment Purchases:	Number of Units	Unit Price	Proposed FY 2000
Description			
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
			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	Inventory Agency
Description		
All shipboard sampling equiptment		ADFG
Trawl Sampling Nets and associated hardware	3	ADFG

FY00

Project Number: New Project
Project Title: MMAGE: Integrated Monitoring of Mechanisms Affecting the Gulf (of Alaska) Ecosystem
Agency: ADFG

FORM 3B
Equipment
DETAIL

Prepared:

Project Title: Recovery Status of Barrow's Goldeneyes

Project Number:	00466
Restoration Category:	Research
Proposer:	Dan Esler Alaska Biological Science Center USGS-Biological Resources Division 1011 E. Tudor Rd. Anchorage, Alaska 99503
Lead Trustee Agency:	DOI
Cooperating Agencies:	
Alaska SeaLife Center:	No
Project Duration:	2nd year, 2-year project
Cost FY 00:	$15,800
Geographic Area:	Prince William Sound
Injured Resource/Service:	Barrow's goldeneye

ABSTRACT

Data available at the onset of this project (population trends and indices of contaminant exposure) raised concern that Barrow's goldeneye populations may have been injured by the *Exxon Valdez* oil spill, may not be fully recovered, and, further, may continue to suffer deleterious effects of the spill. The work under this proposal is designed to critically assess the recovery status of Barrow's goldeneye populations through assemblage and analysis of all existent, relevant data. This work will lead to definition of recovery status, identification of any data gaps limiting our understanding of recovery status or impediments to recovery, and, if warranted, proposal of directed research to fill those gaps in subsequent years. Most data analyses were conducted during FY99; FY00 funds are requested for final data analyses and compilation of analysis results and other information into a final report and manuscripts.

INTRODUCTION

Barrow's goldeneyes (*Bucephala islandica*) occur in nearshore habitats of Prince William Sound (PWS), the environment that received about 40% of the oil spilled after the *Exxon Valdez* ran aground (Galt et al. 1991). PWS is almost exclusively a wintering area for Barrow's goldeneyes. Estimates of sound-wide goldeneye numbers (which include a small proportion of common goldeneyes [*B. clangula*]) during 1996 were approximately 36,000 in winter and 400 in summer (Agler and Kendall 1997). Although concerns about nearshore recovery and restoration have resulted in a suite of studies sponsored by the Exxon Valdez Oil Spill Trustee Council (EVOSTC), assessments of Barrow's goldeneye recovery status and constraints to recovery had not been conducted prior to the onset of this project.

Barrow's goldeneyes may be particularly susceptible to injury and constraints to recovery from the oil spill. Because of their close affiliation with intertidal habitats, which still contain oil in some areas, Barrow's goldeneyes may continue to be exposed. Data from the first year of this study demonstrate that Barrow's goldeneyes preferred areas of mixed substrate over rocky substrate and they preferred unexposed areas over exposed; the types of habitats preferred by Barrow's goldeneyes have been shown to be the most likely to hold residual oil. Further, winter diets of Barrow's goldeneyes consist almost entirely of mussels (*Mytilus trossulus*; Koehl et al. 1982, Vermeer 1982), which have been demonstrated to contain hydrocarbon residues as recently as 1995 (Babcock et al. 1997). Also, Barrow's goldeneyes, like other sea ducks, are long-lived with relatively low annual productivity. Population dynamics of species with these life history characteristics have relatively low rates of potential population growth (Goudie et al. 1994, Schmutz et al. 1997). Thus, recovery of Barrow's goldeneye populations (if injured by the oil spill) would be expected to take many years, even in the absence of long-term, chronic effects.

This species warrants concern not only for population recovery, but also because Barrow's goldeneyes are an important subsistence resource for local residents. For example, in Chenega goldeneyes were harvested by over 25% of households and constituted the majority of harvested waterfowl (Scott et al. 1996). PWS residents have expressed concern over recovery of populations of harvested waterfowl species, including Barrow's goldeneyes (Dan Rosenberg, ADFG, pers. comm.).

This project capitalizes on data collected during NVP studies on the primary study sites of northern Knight Island (oiled) and Montague Island (unoiled). These data were collected during efforts addressing sea otter (*Enhydra lutris*) and harlequin duck (*Histrionicus histrionicus*) recovery. However, they also can be used to critically assess Barrow's goldeneye recovery. This project does not propose work that is already funded under NVP, but rather proposes to either (1) reanalyze data used to assess sea otter or harlequin duck recovery to address questions specific to goldeneyes or (2) analyze data specific to Barrow's goldeneyes that were collected as an aside when conducting NVP field studies. Data collected during NVP that will be used to assess goldeneye recovery include: mussel size class and abundance (collected to assess sea otter recovery), goldeneye abundance and distribution (collected during harlequin duck surveys), goldeneye body condition and diet (from birds collected for NVP copredator studies), and cytochrome P4501A induction of goldeneyes (from collected birds).

Other data that will be assessed with regard to Barrow's goldeneye recovery status include survey data from USFWS, Migratory Bird Management, mussel contaminant level data from NOAA, Auke Bay Lab, and immediate post-spill data collected during ADFG harlequin duck studies. All analyzed and compiled data will be incorporated into the NVP recovery assessment framework as described in Methods.

Based on results from analyses and compilation of available data, the proposed work will lead to conclusions regarding the status of recovery and will generate recommendations for specific research to fill any remaining data gaps. If necessary, additional research would be recommended following the logic and organization of the NVP project, which addressed potential demographic, trophic, and health constraints to recovery of nearshore vertebrate predators, and the nearshore environment generally. Along with addressing questions specific to Barrow's goldeneye recovery, the work conducted under this proposal, as well as any additional research, will serve as another window into recovery of the nearshore system (Holland-Bartels 1995).

NEED FOR THE PROJECT

A. Statement of Problem

At the onset of this project, several pieces of evidence were available that suggested that Barrow's goldeneyes suffered injury from the oil spill and that recovery had not occurred. Sound-wide population surveys have suggested divergent population trends between oiled and unoiled areas (Agler and Kendall 1997; Brian Lance, USFWS, pers. comm.), as of March 1998. Further, comparisons of pre- and post-spill data suggest population reductions in oiled versus unoiled areas at several geographic scales of analysis (David Irons, USFWS, pers. comm.). Also, levels of P4501A expression in goldeneyes were significantly higher on oiled Knight Island than unoiled Montague Island (Esler, unpubl. data). These data, along with the life history characteristics that indicate susceptibility of Barrow's goldeneyes to oil spill effects, strongly suggest that a more complete evaluation of the status of recovery, and potential impediments to recovery, is an important restoration objective.

B. Rationale/Link to Restoration

Barrow's goldeneye restoration requires assessment of recovery status and definition of impediments to recovery (demographic, trophic, or health/oil exposure). This proposed work represents a comprehensive approach to understanding the factors that affect population dynamics and definition of critical bottlenecks to recovery. Without an understanding of the underlying processes that dictate population change, we can not prescribe specific activities to enhance recovery.

C. Location

Data to be compiled will come from throughout Prince William Sound. NVP data that will be used to assess Barrow's goldeneye recovery were collected on northern Knight Island (Bay of Isles and Herring Bay) and Montague Island. There is no field component for proposed work.

COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE

All efforts will be made throughout the restoration process to participate in and provide public involvement in the implementation of this project. Project staff will be available to present information to local communities or prepare articles or photographs for Trustee Council publications.

PROJECT DESIGN

A. Objectives

1. Analyze data collected during NVP studies and report on results regarding:

    a. Foraging ecology of Barrow's goldeneyes, including body composition, diet composition, and mussel size class selection.

    b. Factors influencing distribution and abundance of Barrow's goldeneyes, including mussel abundance, habitat characteristics, and oiling history.

2. Summarize data from other sources relevant to assessment of Barrow's goldeneye recovery status and impediments to recovery.

3. Generate conclusions regarding recovery status, identify impediments to recovery (if any), and recommend research needed to fill in data gaps to fully evaluate recovery status or impediments to recovery (if necessary).

B. Methods

Following the NVP framework, the proposed work will ask the questions: "Is there evidence for lack of recovery or continued injury from the oil spill?" and "If so, is recovery limited by trophic, demographic, or health constraints?".

Trophic Interactions

Data collected during NVP studies will prove valuable for understanding potential limiting effects of prey availability. Mussel availability and abundance data for NVP study sites will be used to assess food limitation. Lower biomass of mussels (in size classes consumed by goldeneyes) per goldeneye on the oiled study area would be consistent with a hypothesis of potential food limitation of recovery. Preliminary analyses conducted during FY99

demonstrated that abundance and density of mussels was comparable or higher on oiled Knight Island than unoiled Montague Island, suggesting that food is not limiting population recovery.

Waterfowl body mass and condition have been shown to be related to both contaminant exposure (see below) and food availability. Further, body mass and condition have been shown to affect subsequent survival (Conroy et al. 1989, Longcore et al. 1991, Bergan and Smith 1993) and productivity (Esler and Grand 1994). Lab analyses of lipid and protein levels were conducted for each Barrow's goldeneye collected for NVP copredator studies. Under this proposal, these data will be analyzed to assess variation in body condition related to sex, age, season, and oiling history (i.e., study area). Poorer body condition in oiled areas than unoiled areas, in conjunction with lower food availability, would be consistent with a hypothesis of food limitation of recovery. Analyses conducted in FY99 found that body mass, after accounting for effects of age, sex, and season, did not differ between areas, further suggesting that food is not limiting population recovery. Condition data are still being analyzed.

Demography

Data regarding goldeneye distribution and abundance were collected during NVP harlequin duck surveys. These data were analyzed to assess variation in goldeneye density related to mussel abundance, habitat characteristics, and oiling history. This will assess recovery status by determining whether densities of goldeneyes on oiled study areas are comparable to those on unoiled areas after accounting for intrinsic differences in habitat and food. Preliminary analyses conducted in FY99 demonstrate that Barrow's goldeneye densities were not lower on oiled than unoiled areas after accounting for intrinsic differences area differences.

Migratory Bird Management, USFWS, has conducted surveys throughout Prince William Sound following the spill. This project proposes interpretation of data through the most recent (March 1998) survey, in light of other data regarding Barrow's goldeneye population health.

Survival and movements data are not available for Barrow's goldeneyes. These parameters have proven critical for understanding the progress and process of harlequin duck recovery status and may be appropriate for future research on Barrow's goldeneye recovery.

Indices to Health/Oil Exposure

Oil exposure of collected Barrow's goldeneyes was evaluated by measurements of cytochrome P4501A. Results from harlequin duck work strongly indicate that induction of P4501A reflects continued exposure to *Exxon Valdez* oil. For many nearshore predators, including Barrow's goldeneyes, elevated cytochrome P4501A was expressed in oiled sites. These data will be interpreted in light of other results.

Because Barrow's goldeneye diets consist almost exclusively of mussels during winter, mussel hydrocarbon contamination data from NOAA, Auke Bay Lab, will be reviewed to determine whether foraging represents a potential pathway of continued oil exposure. Mussel bed sampling will be conducted during summer 1999 (Pat Harris, pers. comm.); this information will be

incorporated into considerations of goldeneye recovery.

Waterfowl body mass has been demonstrated to be related to contaminants (Hohman et al. 1990). Body mass and condition data were interpreted in light of measures of oil exposure. Lowered body mass, in conjunction with differences in P450 induction, would be consistent with a hypothesis of health related constraints to recovery. However, analyses conducted during FY99 found that body mass was not related to P450 induction, after accounting for sex, age, and season differences.

C. Cooperating Agencies, Contracts, and Other Agency Assistance

This proposal relies on data collected by a number of researchers funded by the EVOSTC, including the principal investigator, Chuck O'Clair (NOAA), Pat Harris (NOAA), David Irons (USFWS), and Dan Rosenberg (ADFG).

SCHEDULE

A. Measurable Project Tasks for FY 00

Throughout: Analyze and summarize data regarding Barrow's goldeneye recovery status and impediments to recovery.

April 15: Submit final report, as described below.

B. Project Milestones and Endpoints

This project will be completed upon submission of the final report prior to 15 April 2000.

C. Completion Date

All project objectives will be met during FY2000.

PUBLICATIONS AND REPORTS

A final report of activities will be submitted to the Restoration Office before 15 April 2000. The report will consist of 3 documents:

1. A report on status and constraints to recovery of Barrow's goldeneyes based on all available data.

2. A draft manuscript regarding foraging ecology of Barrow's goldeneyes, including diet and body composition variation within and between oiled and unoiled study areas.

3. A draft manuscript addressing factors related to density of Barrow's goldeneyes, including habitat variables, mussel biomass, and oiling history.

PROFESSIONAL CONFERENCES

None in FY 00.

NORMAL AGENCY MANAGEMENT

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

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

As described above, this research relies on incorporation of data from other Trustee sponsored research. The major objectives of this work require interaction with other investigators and integration of all available data that are relevant to the question of Barrow's goldeneye recovery status. Also, this proposal relies on data collected during NVP studies by the principal investigator.

PROPOSED PRINCIPAL INVESTIGATOR

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PERSONNEL QUALIFICATIONS

Dan Esler is a Wildlife Research Biologist with the Alaska Science Center, USGS Biological Resources Division. He has conducted waterfowl research in arctic and subarctic regions of Alaska and Russia for the past 10 years. Since 1995 he has served as project leader for harlequin duck studies as part of the EVOSTC-sponsored Nearshore Vertebrate Predator project. He earned a M.S. from Texas A & M University in 1988 and is currently enrolled as a doctoral candidate at Oregon State University. He has authored 17 peer-reviewed journal publications

and numerous reports and presentations addressing research and issues in waterbird conservation.

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LITERATURE CITED

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2000 EXXON VALDEZ TRI E COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 2000

Budget Category:	Authorized FY 1999	Proposed FY 2000
Personnel	$10.6	$12.0
Travel		$0.0
Contractual		$0.0
Commodities		$2.0
Equipment		$0.0
Subtotal	$10.6	$14.0
General Administration	$1.6	$1.8
Project Total	$12.2	$15.8
Full-time Equivalents (FTE)		0.2

LONG RANGE FUNDING REQUIREMENTS					
		Estimated FY 2001	Estimated FY 2002		
		$0.0	$0.0		

Dollar amounts are shown in thousands of dollars.

Other Resources

Comments: Submitted FY00 budget is $1.6K higher than projected in FY99 proposal, due to higher than anticipated salary costs.

FY00

Prepared:

Project Number: 00466
Project Title: Recovery Status of Barrow's Goldeneyes
Agency: DOI-U.S. Geological Survey

FORM 3A
TRUSTEE
AGENCY
SUMMARY

2000 EXXON VALDEZ TRI E COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 2000

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 2000
D. Esler	Wildlife Research Biologist	GS12/02	2.0	6.0		12.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		2.0	6.0	0.0	
					Personnel Total	$12.0

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
					0.0
				Travel Total	$0.0

FY00

Prepared:

Project Number: 00466
Project Title: Recovery Status of Barrow's Goldeneyes
Agency: DOI--U.S. Geological Survey

FORM 3B
Personnel
& Travel
DETAIL

2000 EXXON VALDEZ TR :E COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 2000

Contractual Costs:	Proposed FY 2000
Description	
4A Linkage	0.0
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$0.0

Commodities Costs:	Proposed FY 2000
Description	
Manuscript Publication Costs (Barrow's Goldeneye Foraging Ecology and Body Condition Variation)	1.0
Manuscript Publication Costs (Factors Related to Distribution and Abundance of Barrow's Goldeneyes)	1.0
Commodities Total	$2.0

FY00

Prepared:

Project Number:00466
Project Title: Recovery Status of Barrow's Goldeneyes
Agency: DOI--U.S. Geological Survey

FORM 3B
Contractual & Commodities
DETAIL

2000 EXXON VALDEZ TR :E COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 2000

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

FY00

Project Number: 00466
Project Title: Recovery Status of Barrow's Goldeneyes
Agency: DOI-U.S. Geological Survey

FORM 3B
Equipment
DETAIL

Prepared:

2000 EXXON VALDEZ TR EE COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 2000

Budget Category:	Authorized FY 1999	Proposed FY 2000
Personnel		$0.0
Travel		$0.0
Contractual		$0.0
Commodities		$0.0
Equipment		$0.0
Subtotal	$0.0	$0.0
Indirect		
Project Total	$0.0	$0.0
Full-time Equivalents (FTE)		0.0
Other Resources		

LONG RANGE FUNDING REQUIREMENTS

		Estimated FY 2001	Estimated FY 2002		

Dollar amounts are shown in thousands of dollars.

Comments:

FY00

Prepared:

Project Number:
Project Title:
Name:

FORM 4A
Non-Trustee
SUMMARY

2000 EXXON VALDEZ TR :E COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 2000

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
						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
						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

FY00

Prepared:

Project Number:
Project Title:
Name:

FORM 4B
Personnel
& Travel
DETAIL

2000 EXXON VALDEZ TR :E COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 2000

Contractual Costs:	Proposed FY 2000
Description	
Contractual Total	$0.0

Commodities Costs:	Proposed FY 2000
Description	
Commodities Total	$0.0

FY00

Prepared:

Project Number:
Project Title:
Name:

FORM 4B
Contractual & Commodities DETAIL

2000 EXXON VALDEZ TR EE COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 2000

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
			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		

FY00

Project Number:
Project Title:
Name:

FORM 4B
Equipment
DETAIL

Prepared:

Project Title: Sea Otter Baseline Population Surveys

Project Number:	00469
Restoration Category:	Monitoring
Proposers:	Angela Doroff and Jim Bodkin
Lead Trustee Agency:	DOI
Cooperating Agencies:	
Alaska Sea Life Center:	No
Project Duration:	1st year, 2-year project
Cost FY 00:	$
Cost FY 01:	$
Geographic Area:	Kodiak, Kenai Peninsula
Injured Resource/Service:	Sea otter

ABSTRACT

The current status of sea otter populations affected by the Exxon Valdez oil spill (EVOS) outside Prince William Sound are unknown. Although sea otter oiling and mortality was widespread along the Kenai Peninsula and Kodiak Archipelago, only one sea otter survey has been conducted in this area since 1990 (USFWS unpub. data). In addition, large-scale declines in sea otter populations across the western and central Aleutians have been observed in recent years (Estes et al. 1998). The declines in sea otters may be a result of predation by killer whales (*Orcinus orca*), in response to declines in other pinniped species in the Bering Sea and Gulf of Alaska. The geographic extent of the decline in otter populations is unknown, however, large declines in Steller sea lions (*Eumatopias jubatus)* and harbor seals *(Phoca vitulina*) are reported east to at least Prince William Sound. If the decline in sea otters is related to pinniped declines through prey switching, the phenomenon may extend into the spill area. Previous research supported by the EVOS trustee council resulted in the design, testing and implementation of an aerial survey method for sea otters (Bodkin and Udevitz 1999). This method has been employed in Prince William Sound since 1993. The results of these surveys are providing estimates of abundance with improved accuracy over skiff surveys and

proportional standard errors of 10-15%. We propose to conduct aerial surveys of the Kenai Peninsula and Kodiak Archipelago during fiscal years 2000 and 2001. Costs of surveys will be shared with USGS and USFWS.

INTRODUCTION

One of the major factors contributing to our lack of understanding about the effects of the Exxon Valdez oil spill (EVOS) is the lack of baseline pre-spill data. This "data gap" continues to constrain our ability to identify recovery of injured resources. Sea otters (*Enhydra lutris),* a conspicuous casualty of the spill, inhabit shorelines throughout the entire spill area, including Prince William Sound, the Kenai Peninsula and Kodiak Archipelago. Although surveys of sea otters are conducted regularly in Prince William Sound, no EVOS Trustee Council (EVOSTC) support has gone toward estimating sea otter population size outside Prince William Sound.

In the decade since the spill, there has been a dramatic decline in sea otter abundance in the western and central Aleutian Islands. The geographic extent of the decline is unknown. The series of events leading to the otter decline began with large-scale oceanic changes in the north Pacific/Bering sea that led to reductions in Steller sea lions (*Eumatopias jubatus*) and harbor seals (*Phoca vitulina).* Both species are principal food items of killer whales *(Orcinus orca).* In response to the decline in pinnipeds, it is possible that killer whale predation has shifted to sea otters. Since the pinniped decline extends to Kodiak and Prince William Sound, it is conceivable that cascading effects, including predation on sea otters, may extend into the spill area.

In the absence of data on the distribution and abundance of sea otter populations outside Prince William Sound, we are neither prepared for another EVOS-like event, nor able to interpret the potential cascading effects of large-scale ecological events. We propose to survey sea otters in the Kodiak Archipelago and Kenai Peninsula over a two-year period, using an EVOSTC supported aerial survey method. The survey results will provide baseline data on sea otter population distribution and abundance as well as provide an evaluation of the geographic extent of the decline in otter populations observed in the

Aleutian Islands. The cost of the surveys will be shared among the EVOSTC, USGS and USFWS.

NEED FOR THE PROJECT

A. Statement of Problem

Sea otter populations in Prince William Sound and the Gulf of Alaska were injured as a result of the EVOS (Ballachey et al 1994), with nearly 400 carcasses recovered from the Kenai and Kodiak areas. Bodkin and Udevitz (1994) estimated the mortality of sea otters along the Kenai coast may have ranged from 494 to 706 otters. While extensive surveys of sea otter populations in Prince William Sound have been completed annually since 1993, the current status of Kenai Peninsula and Kodiak Archipelago sea otter populations are unknown.

The Kenai Peninsula was last surveyed in 1989, using line and strip protocols from a helicopter (DeGange et al. 1994). The area surveyed included 2,423 km of shoreline from Cape Puget to Anchor Pt. and included coastal and offshore sampling to the 50m isobath. Population estimates were adjusted for group size bias and detection bias. Detection bias was estimated by comparing strip counts to "hover" counts, compensating for animals not detected on strip counts. Estimates of abundance were 2,330 (se=279) and 2,146 (se=194) for the spring and fall of 1989 respectively. No prior or subsequent estimates of sea otter abundance are available for the Kenai Peninsula.

The Kodiak Archipelago was also surveyed in 1989 using the same helicopter method used along the Kenai Peninsula. The area included 2,960 km of shore line north of Rocky Pt. and the Buskin River. Group size and detection bias were estimated as in the Kenai Peninsula survey. The estimated Kodiak sea otter population size in October 1989 was

13,526 (se= 1,199). In 1994 Kodiak was again surveyed, using the fixed-wing method developed by Bodkin and Udevitz (1999). Although the two surveys used different methodologies, both estimates are corrected for undetected otters, and are therefore comparable. The estimated Kodiak sea otter population size in July 1994 was 9,738 (se= 2,615), which represents a decline of nearly 3,800 animals, at a rate of 7%/year. The cause of the decline at Kodiak is unknown, but is similar in magnitude and in the temporal scale to the decline observed in the central and western Aleutians.

In summary, estimating the distribution and abundance of sea otter populations along the Kenai and Kodiak coasts will be valuable in (1) providing baseline data on the current distribution and abundance of sea otters in areas of the spill where sea otter mortality occurred, (2) contributing to long-term population trend data which may be used in assessing initial damage and subsequent recovery of sea otter populations in the event of future oil spills, and (3) provide information on the geographic extent of a decline in sea otter populations in the spill area that may be independent of spill-related processes, but of importance to the state of the north Pacific/Bering sea ecosystem.

B. Rationale/Link to Restoration

Determination of sea otter restoration and recovery requires assessment of population status. Current data from spill-impacted areas outside Prince William Sound is 6-10 years old and other large-scale processes may be affecting sea otter populations in the spill area. Survey results from Kodiak in 1989 and 1994 suggest a significant decline. While the cause of the decline is unknown it may be linked to other large-scale processes in the north Pacific and may be independent of the EVOS. The proposed work will identify the direction and magnitude of change in sea otter populations and may allow evaluation of the relatedness of potential changes to events other than EVOS.

C. Location

Surveys will be conducted at the Kenai Peninsula and Kodiak Archipelago. Specific areas will be those used in previous surveys that may be modified to include known or anticipated changes in otter distribution.

Communities affected by the project include Seward, Homer, Port Graham, English Bay. Seldovia, Old Harbor and Kodiak.

COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE

The project will continue to inform and coordinate our community involvement activities, including the collection of indigenous knowledge with Dr. Henry Huntington, TEK specialist Chugach Regional Resources Commission and Hugh Short, Community Coordinator, EVOS Restoration Office. We will continue to solicit advice from the above parties and gather information on TEK through synthesis workshops, local community facilitators, and residents.

Efforts will be made 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. Project staff has and will continue to present information to local communities or prepare articles or photographs for Trustee Council publications. Boat and air charter contracts, and other services will be contracted from local sources when possible.

PROJECT DESIGN

A. Objectives

Provide current, unbiased estimates of sea otter abundance along the coasts of the Kenai Peninsula and the Kodiak Archipelago.

B. Methods

We will use previously developed aerial survey techniques which employ counts along systematic transects, and intensive search units (ISU's) to estimate a correction factor for each survey (Bodkin and Udevitz, 1999). We will conduct a single survey of the entire Kodiak Archipelago in the year 2000, and the Kenai Peninsula in 2001.

C. Cooperating Agencies, Contracts, and Other Agency Assistance

USFWS personnel, led by Angela Doroff, will be responsible for conducting the Kodiak aerial survey in 2000, analyzing survey data and preparing annual reports.

USGS personnel, led by Jim Bodkin, will be responsible for conducting the Kenai Peninsula aerial survey in 2001, analyzing survey data and preparing annual reports.

SCHEDULE

A. Measurable Project Tasks for FY 00

Sea Otters

June - August	Sea otter aerial survey, Kodiak (conducted by USFWS)

B. Project Milestones and Endpoints

FY00

December-March:	Coordinate and plan surveys, community involvement, prepare equipment.
June-August:	Conduct aerial sea otter surveys.
September-Nov:	Data analysis and report preparation. Coordinate with local communities.

This is a projected two year monitoring program designed to assess the recovery and status of an injured species. The FY01 survey of the Kenai Peninsula will be conducted by USGS. At the end of each year results will be compared with prior population estimates and evaluated in terms of the restoration goals to assess whether recovery has occurred. Due to the potential confounding effect of an ongoing large-scale decline in sea otter populations adjacent to the spill area, it will be impossible to determine the cause of non-recovery.

C. Completion Date

All project objectives will be met following FY01. The project may be terminated prior to FY01 if restoration guidelines for sea otters are met.

PUBLICATIONS AND REPORTS

Annual reports will be presented to the Chief Scientist by April 15 the following year. A final report will be prepared at the end of the proposed schedule unless continued monitoring is warranted or when recovery objectives are met. Special reports (publications) will be prepared during the course of the study if warranted. Publications will be prepared for peer-review journals when sufficient data has been collected to satisfy manuscript preparation. Journal publications will not be generated until after the project is completed.

PROFESSIONAL CONFERENCES

None in FY00.

NORMAL AGENCY MANAGEMENT

While sea otter population monitoring is a responsibility of the USFWS Marine Mammals Management Office, the proposed areas are not considered high priority at this time. The Aleutian Islands and Southeast Alaska, which has never been systematically surveyed for sea otters, are the two most important survey areas for the USFWS. Given the reality of flat-funded budgets, it is unlikely that the Kenai Peninsula and Kodiak Archipelago would be surveyed for at least 5-10 years unless funded by the EVOSTC.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

As described in the Introduction, this research relies on methods from other Trustee sponsored research, including project /043. Equipment purchased under this project will be used to conduct the proposed research and data collection and analysis will follow previously established protocols and standards.

PROPOSED PRINCIPAL INVESTIGATORS

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USGS-Biological Resources Division
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1011 E. Tudor Rd.
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PHONE: (907) 786-3803
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angela_doroff@fws.gov

PERSONNEL QUALIFICATIONS

Angela Doroff, Wildlife Biologist on the sea otter program in the Marine Mammals Management office. She has over 10 years of experience working in Alaska on a variety of sea otter projects including, population surveys, forage ecology, and demographic studies and over 9 peer-reviewed scientific publications. Ms. Doroff is currently co-leading the sea otter program for the Marine Mammals Management Office.

Jim Bodkin, Research Wildlife Biologist, and team leader for coastal ecosystem research in Alaska for the Alaska Science Center of USGS, Biological Resources Division. He has over 25 peer-reviewed scientific publications and directs an active coastal marine research program. He has studied and published on sea otter foraging ecology and community structuring since 1988 and has been principal investigator for sea otter survey methods development. Mr. Bodkin is currently a co-principal investigator for the Nearshore Vertebrate Predator Project (NVP), and is examining the recovery of sea otters.

LITERATURE CITED

Ballachey, B.E., J.L. Bodkin and A.R. DeGange. 1994. An overview of sea otter studies. *in* T. Loughlin editor. Marine mammals and the Exxon Valdez. Academic Press. San Diego, CA pages 47-59.

Bodkin, J.L. and M.S. Udevitz. 1994. Intersection model for estimating sea otter mortality along the Kenai Peninsula. *in* T. Loughlin editor. Marine mammals and the Exxon Valdez. Academic Press. San Diego, CA pages 81-95.

Bodkin, J. L. and M.S. Udevitz. In press. Status of attempts to estimate population trends of sea otters. Symposium on Surveys, Status and Trends of Marine Mammal Populations. 25-27 February 1998, Seattle WA.

DeGange, A.R., D.C. Douglas, D.H. Monson and C. Robbins. 1994. Surveys of sea otters in the Gulf of Alaska in response to effects of the Exxon Valdez oil spill. Final report, marine mammal study #6. Exxon Valdez Oil Spill Restoration Office. Anchorage, AK.

Estes, J. A. , M. T. Tinker, T. M. Williams, and D. F. Doak. 1998. Killer whale predation on sea otters linking oceanic and nearshore ecosystems. Science 282: 473-476.

2000 EXXON VALDEZ TRU : COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 2000

Budget Category:	Authorized FY 1999	Proposed FY 2000
Personnel		$15,000.0
Travel		$2,650.0
Contractual		$26,000.0
Commodities		$7,500.0
Equipment		$500.0
Subtotal	$0.0	$51,650.0
General Administration		$2,782.5
Project Total	$0.0	$54,432.5
Full-time Equivalents (FTE)		0.3
Other Resources		

LONG RANGE FUNDING REQUIREMENTS					
		Estimated FY 2001	Estimated FY 2002		
		$43,032.0			

Dollar amounts are shown in thousands of dollars.

Comments:
2001 budget includes .25 fte (gs-11), 110hrs aircraft charter, 15 days per diem for 2 and 10% GA

FY00

Prepared:

Project Number: 00469
Project Title: Sea otter baseline population surveys
Agency: Interior

FORM 3A
TRUSTEE
AGENCY
SUMMARY

2000 EXXON VALDEZ TRU : COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 2000

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 2000
A. Doroff	Wildlife Biologist	GS-11/3	3.0	5000.0		15,000.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		3.0	5000.0	0.0	
					Personnel Total	$15,000.0

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 2000
					0.0
Anch/Kodiak/Anch	250.0	1	40	60.0	2,650.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$2,650.0

FY00

Prepared:

Project Number:
Project Title: Sea otter baseline population surveys
Agency: Interior

FORM 3B
Personnel
& Travel
DETAIL

2000 EXXON VALDEZ TRU : COUNCIL PROJECT BUDGET
October 1, 1999 - September 30, 2000

Contractual Costs:		Proposed
Description		FY 2000
4A Linkage	120 hrs aircraft charter @ 200.00/hr	24,000.0
	20 hours aircraft standby 5 d @ 400.00/ d	2,000.0
When a non-trustee organization is used, the form 4A is required.	**Contractual Total**	$26,000.0

Commodities Costs:	Proposed
Description	FY 2000
Fuel transport	6,000.0
Aircraft tie-down time	1,000.0
Data memory cards and batteries	500.0
Commodities Total	$7,500.0

FY00

Prepared:

Project Number:
Project Title: Sea otter baseline population surveys
Agency: Interior

FORM 3B
Contractual & Commodities DETAIL

2000 EXXON VALDEZ TRU : COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 2000

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FY 2000
safety equiopment			500.0
			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**	$500.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency

FY00

Project Number:
Project Title: Sea otter baseline population surveys
Agency: Interior

FORM 3B
Equipment
DETAIL

Prepared:

2000 EXXON VALDEZ TRU : COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 2000

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

Comments:

FY00

Prepared:

Project Number:
Project Title: Sea otter baseline population surveys
Name: Interior

FORM 4A
Non-Trustee
SUMMARY

2000 EXXON VALDEZ TRU : COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 2000

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
						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
						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

FY00

Prepared:

Project Number:
Project Title:
Name:

FORM 4B
Personnel
& Travel
DETAIL

2000 EXXON VALDEZ TRU : COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 2000

Contractual Costs:	Proposed FY 2000
Description	
Contractual Total	$0.0

Commodities Costs:	Proposed FY 2000
Description	
Commodities Total	$0.0

FY00

Prepared:

Project Number:
Project Title:
Name:

FORM 4B
Contractual & Commodities DETAIL

2000 EXXON VALDEZ TRU COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 2000

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

FY00

Project Number:
Project Title:
Name:

FORM 4B
Equipment
DETAIL

Prepared:

00473

CHENEGA CORPORATION

Aleut Plaza, 4000 Old Seward Highway, Suite 101, Anchorage, Alaska 99503

Phone (907) 277-5706
Fax (907) 277-5700
e-mail chenega@chenegacorp.com

Title: Public Information Brochure on Lands Acquired by the Trustee Council from Chenega Corporation

April 14, 1999

EVOSTC
Molly McCammon
Anchorage Restoration Office
645 G Street, Suite 40
Anchorage, Alaska 99501

Dear Molly:

The Chenega Corporation would like to propose a project to the Exxon Valdez Trustee Council to assist us in providing the public with maps and an explanation of the rights and restrictions that have resulted from the acquisition of some of our lands by the Council.

Lands and easements acquired by the Council and now managed by the State of Alaska and the Forest Service are available to the public for use for recreation, hunting and fishing. With this access also comes the need for the public to know where and what they can do on these lands. We do not feel that all the burden of providing this information to the public should be the responsibility of Chenega Corporation. We are willing to share in the responsibilities but suggest that the Council and the management agencies should also share some of the responsibility. The Council has made a good attempt to tell the public that they have acquired the lands for restoration purposes, but has not made an attempt to tell the public how and what these lands can be used for. We propose that the Council fund a project that will provide the public with maps and information in the form of a brochure that is available from the Corporation and the management agencies.

We suggest that the Alaska Department of Natural Resources and the Forest Service work with the Corporation to develop a brochure providing the public with this information.

We are willing to discuss cost sharing for our share of the funding and suggest that the Council and the management agencies also contribute.

Maps developed by ADNR displaying the acquisitions should be used as a starting point for the brochure.

In discussions with the Forest Service it became obvious that this need exist through out the oil

spill area. The Council has acquired about 650,000 acres for restoration purposes, but the public has not been informed of what can be done on these lands. The Chenega Corporation would like to have this project funded for the lands in western Prince William Sound and suggests that a spill wide project also be considered.

The Forest Service is willing to take the lead on this project.

Very truly yours,

CHENEGA CORPORATION

Charles W. Totemoff,
President & CEO

Endowment of the Environmental Restoration Center at the University of Alaska Anchorage

Project Number:	00474
Restoration Category:	Reserve Account / Research and General Restoration
Proposer:	University of Alaska Anchorage
Lead Trustee Agency:	
Cooperating Agencies:	
Duration:	Perpetuity
Cost FY 00:	$2,200,000
Cost FY 01:	$0
Cost FY 02:	$0
Cost FY 03:	$0
Geographic Area:	All regions affected by the *Exxon Valdez* oil spill
Injured Resource/Service	Multiple resources

ABSTRACT

Proposed is a plan for creating an endowed environmental restoration center for research and community education at the University of Alaska Anchorage. The center will be created within the School of Engineering. An endowed research chair will be created within the center. Establishing the center will achieve two main goals. First, it will provide a mechanism for continuing research, restoration, and community education long after 2002 when settlement funds are no longer received by Alaska. Such activities will help Alaska develop local expertise and permanent solutions for the protection and restoration of areas affected by the *Exxon Valdez* oil spill. Secondly, creation of the proposed endowed research chair will serve as a prototype for creating other endowed chairs. Thus, much needed insight for creating research chairs will be provided so that the restoration goals of the Trustee Council may be best accomplished.

INTRODUCTION

Similar proposals for establishing an endowed research center at the University of Alaska Anchorage (UAA) were submitted in 1996 and 1998. Events since that time have emphasized the need and benefits of EVOS endowed research centers and research chairs at the University of Alaska. Consequently, the proposal has been updated to reflect the growing interest and support for creating endowed research centers and chairs.

The structure of the proposed center is ideally suited to address the identified goals of the Trustee Council. The recently passed resolution titled "Resolution of the EVOS Trustee Council concerning the Restoration Reserve and Long-term Restoration Needs" on March 1, 1999 identified many of the main goals of the Trustee Council. These goals included research and general restoration. Public testimony leading up to the EVOS Resolution described a need for a better connection between the spill communities and the work of the University. The proposed research center is designed to address these goals and needs.

Proposed is the endowment of an environmental restoration center for research and community education within the School of Engineering at UAA. Within this environment, the facilities of UAA and the entire university system can be utilized to continue research and restoration efforts in perpetuity.

Since many questions currently exist about how to create endowed research centers or chairs at the University of Alaska, the exact mechanism of how to do it cannot be described at this time. However, through public testimony before the Trustee Council, including that of University President Mark Hamilton, endowed chairs can be done and are welcomed at the University. The intent of this proposal is to provide the much needed and critical starting point for making it happen.

One endowed center is proposed. The proposed plan is intended to serve as a model to assist in the review of future proposals for multiple endowments which will most likely be submitted. As a model for endowments, the proposed center would greatly assist the planning of other centers or endowed chairs at any of the University of Alaska campuses. Moreover, the proposed work helps attain the goals for restoration and preservation while serving the educational needs of the community.

The proposed plan establishes a center that will conduct restoration research for oil damaged areas. An emphasis of the proposed plan is to create marketable research and educational opportunities for the Alaska community as well as the world. A main objective is to establish a mechanism for generating income and eventually become self-supporting. In this manner, the objectives for restoration, preservation, monitoring of spill damaged areas can be continued in perpetuity.

Personnel are well suited for implementing the proposed plan and making it a success. UAA School of Engineering faculty are experienced in applicable research for oil spill cleanup and restoration. Principle investigator Dr. Grant C. Baker has conducted research on chemical redistribution in soils and seawater, has received several awards for his teaching, and he is a commercial fisherman. Co-principle investigator Dr. Herbert P. Schroeder is creator and Director of ANSEP (Alaska Native Student and Engineering Program), and he worked in the oil industry for 16 years prior to his arrival at the University of Alaska Anchorage. Oil cleanup related environmental research is ongoing at the UAA School of Engineering. Dr. Orson Smith has several years of experience in arctic and coastal engineering.

UAA has an ideal location for creating an endowed research center. It is closely located to the newly created Seward SeaLife Center at the southern end of Prince William Sound. In addition, the road to Whittier is currently being constructed and is scheduled to open in about the year 2000. When done, northern Prince William Sound will be only about 45 minutes from Anchorage. Thus, the spill damaged areas of Prince William Sound and Cook Inlet will be very accessible from Anchorage.

Support for establishing endowed research centers or chairs at the University of Alaska is gaining support. Several members of the public including legislators have submitted resolutions and letters of support. Several letters are available for review on the Internet WEB site at:

http://www.alaska.net/~baker/evos.htm

In addition, House Joint Resolution HJR13 has passed the Alaska legislative House and is currently in the Senate. It is a resolution encouraging the Trustee Council to establish research chairs at the University based upon many good reasons. An Internet link to the HJR13 Resolution is provide at the above WEB site and is also attached as Exhibit 1.

Although it is clear that complete recovery from the *Exxon Valdez* oil spill will not occur for decades, annual payments from the Exxon Corporation will end in the year 2002. Implementing a plan that enables restoration and protection efforts to continue beyond 2002 is a serious challenge facing the Trustee Council and all Alaskans.

As currently proposed, the center would consist of research, community education/technology transfer, and student education branches. The flowchart shown in Figure 1 lists some of the major areas of activity that would be conducted by each branch. These include:

- Research and development activities for improved recovery and remediation techniques.
- Courses on oil spill technology and recent developments in remediation techniques by national experts.
- Distance delivery course presentations to high schools, universities, and industry.

- Outreach mentoring programs to surrounding areas.
- Student education and internships on oil spill recovery projects.
- Cooperative efforts with other University departments as well as state and federal agencies.

The propose center promises many benefits for the communities effected by oil spills from the establishment of endowed academic centers and chairs. Since the exact mechanism for implementation of endowed research centers is not known, many concerns and questions exist. Establishing an academic center at UAA as a working pilot program will allow the Trustee Council to find answers to the outstanding questions about the use of settlement funds for funding successful endowed research centers and chairs.

NEED FOR THE PROJECT

A. Statement of the Problem

It has become apparent restoration efforts need to continue beyond 2002. In response to this need, the Trustee Council recently made plans to set aside about $115,000,000 in an endowment for research and restoration needs.

The 10th Anniversary of the spill was commemorated in March with a three day symposium in Anchorage. The results and findings from many studies were presented. There is little doubt that spill oil seepage continues into the seawater from oiled seabed and shores. Damage from the oil contamination will continue for many years.

In addition, the threat of another oil spill is a major concern to Alaskans. In the case of the *Exxon Valdez* oil spill, a settlement was reached between Alaska and Exxon in a relatively short period. It cannot be assumed that another spill will result in a similar amount of funds so soon after a spill. In addition, the next spill could result in a legal battle with Alaska for many years. Alaska needs to be prepared to recover from another spill, and a mechanism is needed for preparing the State to respond to future spill events.

In the past few years since the *Exxon Valdez* oil spill, several oils spills have occurred along the Alaskan coast. In 1997, the vessel *Kuroshima* ran aground in Dutch Harbor. It was beached for several months and threatened the surrounding ecosystems. Research and education activities relevant to oil spill cleanup and ecosystem recovery are needed.

B. Rational/Link to Restoration

As shown in Figure 1, the proposed center will have research, education, and community outreach components. The center will incorporate the objectives of the *Exxon Valdez* settlement for restoration and protection of the areas affected by the spill by conducting research and education programs that will enhance Alaska's ability to restore oil damaged areas from the Exxon Valdez Oil Spill as well as improve cleanup methods for future oil spills.

In addition, research on oil spill technology has the potential to generate income through patents on developed processes, publication, and distance delivery courses. Last year, a University of Alaska faculty was recently awarded a patent for a cold region road design which was reported as having a tremendous potential for financial benefit to the University of Alaska. Similarly, patented processes for oil spill cleanup would have a worldwide market especially in cold climates such as along the coastlines of oil rich Russia. In addition, as the recent grounding of the *Kuroshima* highlights, oil cleanup techniques for Alaska would be of particularly interest wherever marine traffic occurred regardless of the originating country of the vessel. Consequently, the proposed endowed center has a high potential to become financially self-sustaining for restoration in perpetuity.

The University of Alaska Anchorage has an ideal location to serve the areas affected by the *Exxon Valdez* oil spill. With the construction of the road to Whittier currently planned to be open in about the year 2000, Prince William Sound will be very accessible to Anchorage. Thus, the facilities at the University of Alaska Anchorage can be readily utilized to conduct research and restoration efforts. In addition, Anchorage is a traffic center for airlines servicing many of the rural areas affected by the spill. These factors make UAA a natural hub for cooperative spill recovery efforts.

The School of Engineering is located in the Engineering Building at the main University of Alaska Anchorage campus. It houses over 26,500 square feet of classrooms, laboratories, and a modern computer facility. Laboratories are conveniently available for the study of fluids, soils, materials, surveying structures, environmental quality, and cold regions engineering.

Modern distance delivery facilities are also available on the main University of Alaska Anchorage campus. Facilities include equipment for video production, broadcast and delivery, interactive presentations, and reproduction. Thus, video production of techniques for improved recovery, course development for students, and technological short courses for presentation to industry can be readily performed and distributed.

Utilization of existing facilities and personnel can be a substantial help in extending recovery efforts. The proposed plan incorporates the objectives of the Trustee Council through the use of these resources. In addition, structure of the proposed plan implements a mechanism that results

in recovery efforts to become self-supporting with growth in a relatively short period of time.

C. Location

All areas affected by the *Exxon Valdez* oil spill will benefit from the proposed plan. In fact, the objectives of the Trustee Council are to be incorporated into the charge of the endowed center. Thus, recovery and protection of affected areas can continue long after 2002 when funds are no longer received by Alaska.

COMMUNITY INVOLVEMENT

Involvement of the community is a major objective of the proposed plan. This includes the development of outreach programs for recruiting and education of high school students, research positions for students, as well as the incorporation of existing high school and university programs such as ANSEP (Alaska Native Student Engineering Program), AISES (American Indian Science and Engineering Society), and other mentoring programs. Also, high school programs such as the Youth Area Watch could easily be incorporated. In this manner, students from the community can obtain a technical education while also gaining valuable work experience with a variety of state and federal agencies.

PROJECT DESIGN

A. Objectives

The following are objectives of the proposed program:

1. Establish an endowed environmental restoration center at the University of Alaska Anchorage School of Engineering.

2. Establish the infrastructure and activities of the endowed center to achieve the objectives of the Trustee Council for restoration, enhancing, and protection of areas affected by the spill.

3. Establish community and student education opportunities.

B. Methods

The proposed plan calls for $200,000 the first year to establish the infrastructure needed for the center. An additional, $2,000,000 will be placed in an endowment fund of the UA Foundation.

Three UAA engineering faculty in conjunction with Trustee Council, UA Foundation, UA Board of Regents, and UAA administration will coordinate the establishment of the endowed center. The exact mechanism for implementation will be determined that will achieve the goals of the Trustee Council. Initial efforts would include the preparation of laboratory facilities to conduct research on oil spill remediation and establishing education needs.

Endowment funds managed by the UA Foundation have earned an average of about 13% over the past 5 years. The maximum withdrawal rate on an annual basis is limited to 5%. Thus, if a conservative 10% average earnings is assumed, the principal of a $2,000,000 endowed fund would grow by about $130,000 each year after about 5 years. In addition, another $130,000 would be available to conduct the work of the center.

An endowment fund can be structured to custom fit the needs of the Trustee Council. Briefly stated, the Trustee Council and the University create an agreement that meets the needs of the Trustee Council. Many of the questions and uncertainty about how to endow research chairs will be easily resolved when this occurs. But, there needs to be a starting point and an initial plan. Hence, there is a need for the current proposal.

Moneys received through the foundation will be matched whenever possible with external funding from agencies such as National Science Foundation (NSF). Also, part of the proposed plan is to develop processes for patent. Patented recovery processes, such as for beach remediation and containment, will be marketed to oil producers throughout the world. The patent licensing facilities of the University of Alaska can provide the needed expertise and services. Thus, the proposed plan will provide unique mechanisms for enhancing the principal beyond the usual inflation proofing techniques.

C. Cooperating Agencies, Contracts, and Other Agency Assistance

It is foreseen that several agencies will be utilized to accomplish the work of the endowed center. These include local and rural high schools, Alaska SeaLife Center, Alaska Department of Fish and Game (ADF&G), Alaska Department of Environmental Conservation (ADEC), in addition to other state and federal Agencies.

SCHEDULE

A. Measurable Project Tasks for FY00

Oct. 1 - Nov. 1, 1999:	Academic center committee is formed. Schedule is set for needed reviews by Trustee Council, UA Foundation, UA Board of Regents, University and Trustee Legal Councils, and UAA administration.

Nov. 1- Dec. 1, 1999:	Exact criteria and structure for endowed center is established in cooperation with Trustee Council.
Dec. 1 - March 1, 2000:	Research and education plans completed.
March 1 - April 1, 2000:	Final report with recommendations is prepared for Trustee Council and research and education activities begin.
Beyond April 1, 2000:	Annual report on recovery work with financial updates.

B. Project Milestones and Endpoints

October 1, 1999:	Approval and commitment by the Trustee Council for establishment of endowed center.
Feb. 1, 2000:	Center is established.
April 1, 2000:	Final presentation of results to Trustee Council.

C. Completion Dates

The initial work to establish an endowed center will be completed by April 2000. The work of the endowed center is intended to be self-supporting and continue in perpetuity.

PUBLICATIONS AND REPORTS

It is foreseen that substantial contact with the Trustee Council members and advisory boards will occur as the proposed plan is developed and implemented. By April 2000, a complete report will be presented to the Trustee Council. The report will present the status of the center and provide answers to the questions confronting the Trustee Council concerning the establishment of additional endowed academic centers and chairs.

PROFESSIONAL CONFERENCES

Research and other activities funded by the endowed center will be presented in the many usual forums available to faculty at the University of Alaska. These forums include presentation of papers at conferences, publication of books and research journal articles. Also, student work will be presented in papers through professional student organizations at national competition.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

Part of the proposed plan is to determine the best avenues for incorporation of Trustee Council objectives for restoration with the activities of the endowed center. It is expected that these efforts will be reported to the Trustee Council throughout FY00 until the best working mechanism is determined and approved by the Trustee Council.

PROPOSED PRINCIPLE INVESTIGATORS

Dr. Grant C. Baker - Director, Student Education and Research
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PERSONNEL

Dr. Grant C. Baker, Assistant Professor of Civil Engineering at the University of Alaska Anchorage. He has eight years of university teaching experience. Dr. Baker has conducted research in chemical treatment of soils, development of oil refining catalysts, corrosion prevention engineering, and is active in program development of engineering courses within the School of Engineering. He has received both UAF and UAA engineering professor of the year awards, and was recently selected for the WHO's WHO Among America's Teachers and for the WHO's WHO in the West. Dr. Baker holds a B.S degree in Chemical Engineering, M.S. in Mining Engineering, and a Ph.D. in Geophysics. He has commercially fished in Prince William Sound, Kodiak, and Togiak starting in 1979.

Dr. Herbert P. Schroeder, Associate Professor of Civil Engineering at the University of Alaska Anchorage. Dr. Schroeder is Chairman of ANSEP (Alaska Native Science and Engineering Program) at UAA. Dr. Schroeder worked more than 15 years in the Alaska oil industry prior to joining the faculty in 1991. He holds a B.S. in Mechanical Engineering from UAF, an M.S. in Civil Engineering, Construction Engineering and Management from Oregon State University, and a Ph. D. in Civil Engineering, Construction Engineering and management from the University of Colorado Boulder.

Dr. Orson Smith received a B.S. degree in Mechanical Engineering in 1971 from the University of Kentucky, a graduate Diploma in Coastal Engineering and Port Planning in 1979 from the International Institute of Hydraulic and Environmental Engineering in Delft, the Netherlands, an MS in Civil Engineering in 1986 from Mississippi State University and a Ph.D. in Physical Oceanography in 1989 from North Carolina State University. He is a registered Professional Civil Engineer in the State of Alaska. Orson accumulated 20 years' experience with the US Army Corps of Engineers as a Project Manager of dredging, hydrographic surveying, port, harbor, coastal erosion control, flood control, and other civil works projects, primarily in Alaska, but extending to coastal areas of the lower 48 and a number of overseas locations. He also led coastal and arctic engineering research projects for that agency. He presently teaches fluid mechanics, arctic engineering, physical oceanography, wave mechanics, design of ports and harbors, coastal engineering, and hydrographic surveying for the UAA School of Engineering. Orson is leading several active research projects related to sea ice, ice navigation, and shoreline resources in Alaska, with emphasis on Cook Inlet and Prince William Sound.

Bill Text

H

BILL ID: CSHJR 13(FIN)

CS FOR HOUSE JOINT RESOLUTION NO. 13(FIN)
Relating to using oil spill settlement funds to create a long-term research and monitoring endowment.
BE IT RESOLVED BY THE LEGISLATURE OF THE STATE OF ALASKA:
WHEREAS the biological resources of the northern Gulf of Alaska were affected by the Exxon Valdez oil spill; and
WHEREAS the Exxon Valdez oil spill disrupted the economic and social lives of many of the local residents in the Prince William Sound area; and
WHEREAS a spill of the magnitude of the Exxon Valdez oil spill not only affects the wildlife and fish habitat, but also has economic, social, and psychological effects in rural Alaska where traditional life styles of local populations, including the Native population, may be severely disrupted; and
WHEREAS baseline scientific data is inadequate to assess positively the damage of the Exxon Valdez oil spill, to manage major spills, and to realistically restore the environment; and
WHEREAS Alaska has more coastline than any other state in the union, making it imperative that Alaska take the lead in using the accumulation of scientific knowledge and promoting the advancement of scientific technology now as well as in the future; and
WHEREAS, with scientific advancements in the decades ahead, eventual enhancement of many biological resources will be possible; and
WHEREAS the mission of the Exxon Valdez Oil Spill Trustee Council is to efficiently restore the environment injured by the spill to a healthy, productive ecosystem, while taking into account the importance of quality of life and the need for viable opportunities to establish and sustain a reasonable standard of living; and
WHEREAS, because the Exxon Valdez Oil Spill Trustee Council is in charge of restoring, rehabilitating, replacing, enhancing, or acquiring equivalent resources and services in the oil spill region, the accumulation of scientific knowledge to manage a future oil spill must be a high priority in the council's program; and
WHEREAS, although significant research projects have been supported by the council, many important areas of inquiry remain that can be effectively addressed only over an extended period of time; additionally, there are significant research projects relating to spill technology, restoration methods, and ecosystem preservation that need to be pursued and extended for maximum public benefit; and
WHEREAS the Exxon Valdez Oil Spill Trustee Council restoration plan includes adequate provisions for establishing a sound future-oriented program of research and top-level study that would accumulate and spread knowledge of the North to the world; and
WHEREAS the University of Alaska has taken a leadership role in many of these areas of study and is strongly committed to working in rural Alaska as well as to attracting students from rural Alaska; and
WHEREAS the University of Alaska is a statewide system with locations in Valdez, Cordova, Petersburg, Homer, Seward, Kodiak, Juneau, Anchorage, Fairbanks, Bethel, Dillingham, and many other locations in rural Alaska; and
WHEREAS the University of Alaska is currently conducting research in fisheries and oceanography; and
WHEREAS endowed academic chairs would provide the continuing quality scientific investigation, scientific publications, and excellence in training that will be needed by the agencies and the industry responsible for resource management and development into perpetuity; and
WHEREAS the establishment of selected endowed chairs in relevant instructional, research or public service programs would further ensure that the lessons learned from the Exxon Valdez tragedy will continue to be explored and discussed in classrooms, laboratories, public seminars, and community outreach programs; and
WHEREAS a high caliber of endowed professors attract the highest quality graduate students and most often have a competitive edge in securing grants and contracts; and
WHEREAS endowed university research is normally broad in scope, produces peer-reviewed publications, has long-term continuity, and produces an outflow of trained professionals; and
WHEREAS the University of Alaska already has an appropriate foundation for managing endowed chairs, thus eliminating the cost of a new bureaucracy, and has the resources to enhance an endowment in time with additional funds acquired from other agencies and from industry; and
WHEREAS the Exxon Valdez Oil Spill Trustee Council expends money obtained from settlement of oil spill litigation; and
WHEREAS, by October 2002, as a result of the past and anticipated future deposits into the restoration reserve, it is estimated that the principal and interest in the reserve, together with remaining unobligated settlement funds, will be approximately $170,000,000 unless, before that time, ongoing negotiations concerning the Karluk and Sturgeon rivers and adjacent lands result in a habitat acquisition agreement that obligates some of these funds; and
WHEREAS, absent a purchase agreement on the Karluk and Sturgeon rivers, $170,000,000 is the total of the funds estimated to be available to support long-term restoration based on projected investment returns allowable through the federal court registry

EXHIBIT 1
Page 1 of 2

under the court's existing authority and thus reasonably anticipated as available for restoration purposes by the Exxon Valdez Oil Spill Trustee Council starting with fiscal year 2003; and

WHEREAS the limits of the existing investment authority of the Exxon Valdez Oil Spill Trustee Council have resulted in the loss of millions of dollars in potential earnings, and, to effectively address restoration needs in the future and support a comprehensive program that maintains its value over time, the council's investment authority must be amended by the Congress;

BE IT RESOLVED that the Alaska State Legislature supports the recent action of the Exxon Valdez Oil Spill Trustees to create a long-term research and monitoring endowment using $115,000,000 of the expected reserve; and be it

FURTHER RESOLVED that the Alaska State Legislature encourages the Exxon Valdez Oil Spill Trustee Council to consider using a portion of the research funds to establish endowed chairs at the University of Alaska in relevant areas of research, instruction, and public service; and be it

FURTHER RESOLVED that the Alaska State Legislature supports the Exxon Valdez Oil Spill Trustee Council's efforts to remove the trust funds from the United States Treasury in order to achieve efficiencies and maximize earnings as supported by recommendations from its internal auditors and the General Accounting Office auditors, and urges the Alaska Congressional delegation to work with the Exxon Valdez Oil Spill Trustee Council to achieve these goals.

COPIES of this resolution shall be sent to the Honorable Tony Knowles, Governor of Alaska; the Exxon Valdez Oil Spill Trustee Council; Mark Hamilton, President of the University of Alaska; Michael J. Burns, President of the Board of Regents of the University of Alaska; and to the Honorable Ted Stevens and the Honorable Frank Murkowski, U.S. Senators, and the Honorable Don Young, U.S. Representative, members of the Alaska delegation in Congress.

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Return to BASIS Main Menu(21st Legislature)

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EXHIBIT 1
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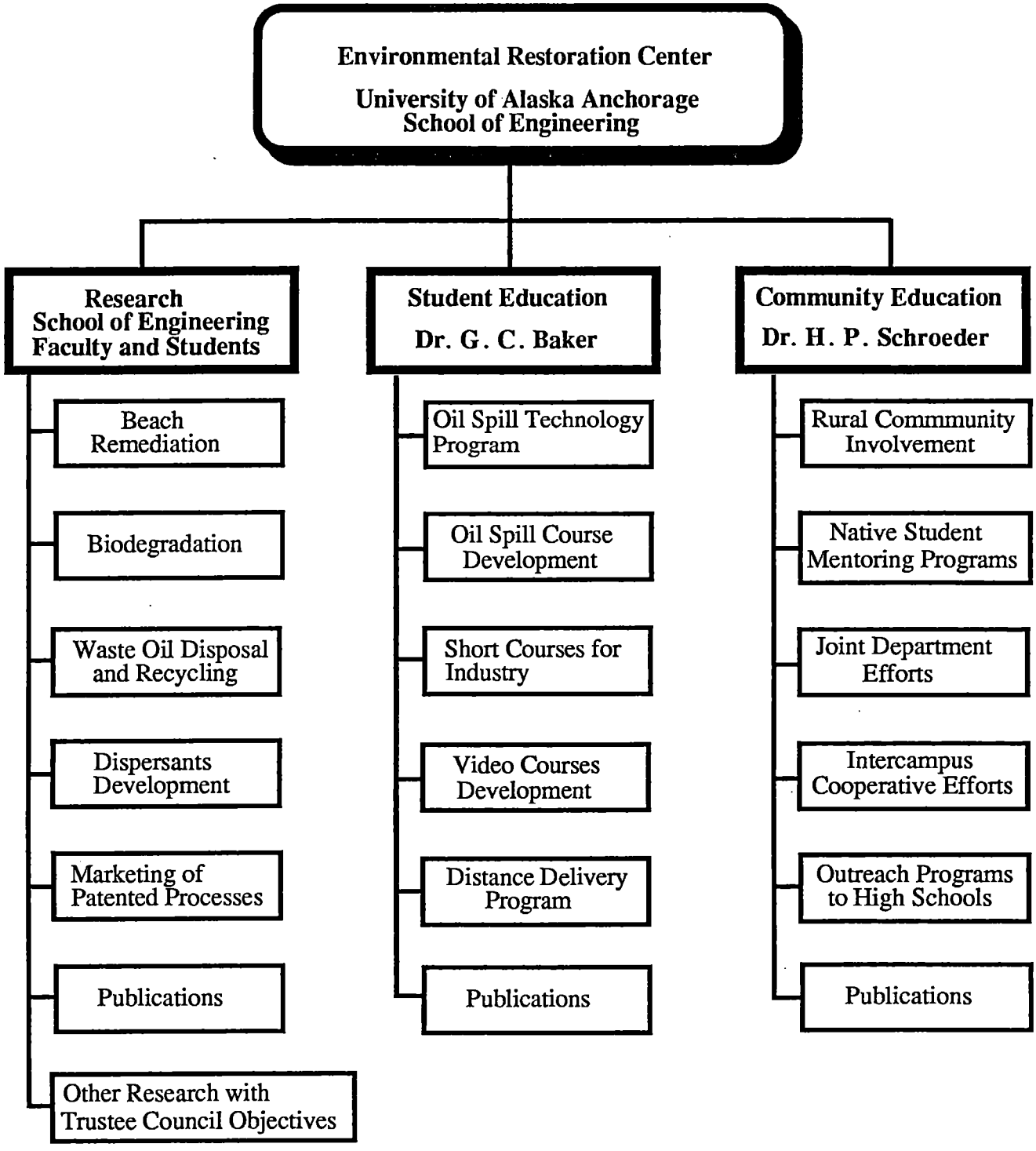

Figure 1: Flowchart illustrating the multiple disciplinary functions of the proposed endowed Environmental Restoration Center at the University of Alaska Anchorage

2000 EXXON VALDEZ TRU | **COUNCIL PROJECT BUDGET**

October 1, 1999 - September 30, 2000

Budget Category:	Authorized FFY 1999	Proposed FFY 2000	LONG RANGE FUNDING REQUIREMENTS					
Personnel		$46.5						
Travel		$0.0						
Contractual								
Commodities		$1.0						
Equipment		$152.5						
Subtotal	$0.0	$200.0	Estimated FFY 2001	Estimated FFY 2002	Estimated FFY 2003	Estimated FFY 2004	Estimated FFY 2005	
Indirect								
Project Total	$0.0	$200.0		$2,000.0				
Full-time Equivalents (FTE)		9.2						
			Dollar amounts are shown in thousands of dollars.					
Other Resources								

Comments:
This proposal requires a one-time payment of $2,200,000 to support an endowed academic center at the University of Alaska Anchorage. Of this amount, $2,000,000 will be deposited in an endowment fund of the UA Foundation. The remaining $200,000 will be used for initial establishment of the Center (salaries and equipment) in the first year. This preliminary budget is contingent upon approval by the UAA business office.

2000

Prepared: 1 of 4

Project Number: 00474
Project Title: Endowed Academic Center
Name: University of Alaska Anchorage

FORM 4A
Non-Trustee
SUMMARY

4/15/99

2000 EXXON VALDEZ TRU : COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 2000

Personnel Costs:			Months	Monthly		Proposed
	Name	Position Description	Budgeted	Costs	Overtime	FFY 2000
	Dr. G. Baker	Program Coordinator	4.7	4.8		22.6
	Dr. H. Schroeder	Program Coordinator	4.5	5.3		23.9
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
		Subtotal	9.2	10.1	0.0	
					Personnel Total	$46.5

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

2000

Project Number:
Project Title: Endowed Academic Center
Name: University of Alaska Anchorage

FORM 4B
Personnel
& Travel
DETAIL

Prepared:

4/15/99

2000 EXXON VALDEZ TRU : COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 2000

Contractual Costs:	Proposed
Description	FFY 2002
Endowment Fund	2,000.0
Contractual Total	$2,000.0

Commodities Costs:	Proposed
Description	FFY 2000
Preparation materials for multiple reports and presentations.	1.0
Commodities Total	$1.0

2000

Project Number:
Project Title: Endowed Academic Center
Name: University of Alaska Anchorage

FORM 4B
Contractual & Commodities DETAIL

Prepared:

4/15/99

2000 EXXON VALDEZ TRU COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 2000

New Equipment Purchases:	Number of Units	Unit Price	Proposed FFY 2000
Description			
Equipment appropriate for establishment of Center's facilites as approved by Trustee Council			152.5
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
Those purchases associated with replacement equipment should be indicated by placement of an R.		**New Equipment Total**	$152.5

Existing Equipment Usage:	Number of Units	
Description		

2000

Project Number:
Project Title: Endowed Environmental Restoration Center
Name: University of Alaska Anchorage

FORM 4B
Equipment
DETAIL

Prepared: 4 of 4

4/15/99

Project Title: **Effects of Oiled Incubation Substrate on Pink Salmon Reproduction**

Project Number:	00476
Restoration Category:	Research
Proposer:	Ron Heintz NMFS, Auke Bay Laboratory ABL Program Manager, Dr.Stan Rice NOAA Program Manager: Bruce Wright
Lead Trustee Agency:	NOAA
Cooperating Agencies:	ADF&G
Alaska SeaLife Center:	No
Duration:	Second of 3 years
Cost FY00:	$81,700
Cost FY01:	$36,000
Geographic Area:	Little Port Walter, Baranof Island, Southeast Alaska
Injured Resource:	Pink salmon

ABSTRACT

This project examines the effects of oil exposure during embryonic development on the gamete viability of pink salmon that survive to spawn. The objective is to determine if exposure to oil during incubation could explain the reduced gamete viability reported for pink salmon in Prince William Sound under Restoration Study 191A. In that study eggs taken from pink salmon returning to oiled streams had higher mortality rates than eggs taken from salmon in unoiled streams. These data suggest a dramatic effect of oil on vertebrate reproduction that has not previously been described. The plausibility of reduced gamete viability is suggested by effects demonstrated in 191B, including reduced marine survival and growth of returning adults; however this effect still requires unequivocal demonstration. This is the second year of this study. During the first year, fry were exposed, marked and released. During the second year, adults will be recovered and their gametes crossed to demonstrate their viability. Estimates of viability will be obtained in the third year of the project and these will be used to complete a model of life cycle effects resulting from incubation of eggs in oiled gravel.

INTRODUCTION

This experiment tests the hypothesis that incubation in water contaminated by oiled gravel produces adult pink salmon with reduced reproductive capacity. After the Exxon Valdez oil spill (EVOS), pink salmon embryos developing in oiled streams experienced increased mortality (Bue et al. 1995). Further experiments reported by Bue et al. (1998) indicated that adult fish returning to oil contaminated streams had reduced gamete viability. In these experiments, gametes were collected from adults returning to oil contaminated and uncontaminated streams and incubated in a hatchery before they could be they could be exposed to oil. Despite the identical incubating environments, the gametes derived from oil contaminated streams consistently produced fewer viable embryos than gametes derived from uncontaminated streams. This difference was thought to result from differences in the incubating environments experienced by the adults contributing the gametes and therefore suggested a previously undescribed long-term effect of oil on reproductive ability.

Demonstrating a long-term effect of oil on pink salmon reproduction has important implications for managers in Princce William Sound as well as managers seeking to restore wildlife populations in other locations. The effects observed in pink salmon after the EVOS were a direct result of their dependence on the intertidal environment for early development. This implies that other species with similar dependencies were also at risk. Furthermore, the exposure levels shown capable of causing long-term impacts on growth and marine survival in pink salmon are less than or equal to the Alaska State water quality criteria, which are among the most rigorous in the United States. This suggests that water quality criteria in locations outside Alaska may limit the potential for restoring fish populations in streams located near hydrocarbon sources such as urban runoff.

The intent of this experiment is to examine the effects of oil exposure on pink salmon reproduction under controlled laboratory conditions. Environmental exposures will be simulated by incubating embryos in gravel with a known concentration of oil from fertilization to emergence in a simulated intertidal environment. The fish will be marked and released. Upon maturity, returning adults will be recovered and the viability of their gametes will be compared to those taken from unexposed, but similarly handled, fish.

The procedure proposed here repeats the experiments performed under Restoration 191B, but with the sole purpose of testing the hypothesis that incubating in oiled gravel impairs the reproductive ability of salmon that survive to maturity. Consequently, we have limited the exposures to two doses, released sufficient numbers of fish to guarantee an adequate number of returning adults, and marked the fish externally so that exposure levels can be readily discerned when the fish return to spawn. These procedures significantly reduce the cost of the study.

Projects 191B and 076 were successful in measuring oil impacts to marine survival and straying,

but the coded-wire tags required to identify the treatment groups in that study had to be recovered and decoded before adult pairs could be matched for mating. The delays encountered while decoding hundreds of tags led to reduced gamete viability in all the treatments, which may have masked any oil related effects. This follow-up study uses external marks to alleviate that problem and is designed specifically to test for oil effects on gamete viability.

NEED FOR THE PROJECT

A. Statement of the Problem

Field and laboratory work conducted after the EVOS by Restoration Study 191A suggested that pink salmon in contaminated streams had reduced fitness when they were exposed to low concentrations of polynuclear aromatic hydrocarbons (PAH). Field evidence for reduced fitness included observations of increased embryo mortality in contaminated streams (Bue et al. 1995) and reduced viability in gametes taken from adults returning to contaminated streams (Bue et al. In press). These data have been supported by laboratory studies (Heintz et al. 1995 and Wertheimer et al. 1996) that have shown the sensitivity of pink salmon embryos to water contaminated with very low concentrations of oil.

The laboratory studies provided a basis for estimating the total reduction in fitness for pink salmon exposed to water contaminated with oil at concentrations approaching those prescribed by the Alaska State water quality criteria. The reductions in embryo survival, growth, and marine survival can be integrated to calculate a total reduction in the average fitness for exposed populations of nearly 50%. However, reduced gamete viability among individuals as reported by Bue et al. (In Press) has not been adequately demonstrated among the survivors of the laboratory exposures. In 1995, gametes taken from fish exposed as embryos in the 1993 experiments appeared to have reduced viability, but inadequate numbers of fish prevented statistical verification of this observation. In 1997 we recovered sufficient numbers of fish that had been exposed as embryos in 1995 experiments, however high mortality rates were observed in all the treatment groups including the controls, possibly masking elevated mortality rates in the exposed groups. The source of these high mortality rates is unknown, but is probably related to the time required to hold the gametes prior to spawning in order to find sufficient numbers of mates among all the returning fish.

The effects already described for pink salmon that incubate in oil gravel suggest the plausibility of reduced gamete viability. These include effects on fitness related characters such as growth and marine survival. In addition, histopathological examination of fry emerging from oiled gravel demonstrated an effect of oil on gonad development (Marty et al. 1997). Previous attempts to demonstrate gamete viability have provided results that are highly suggestive of oil related effects, and have generally included exposure to a number of doses to allow generation of dose response curves. In the study proposed here, the design is aimed at demonstrating an effect of oil exposure on gamete viability. Thus, we have limited the number of treatments in order to maximize the number of fish that survive to adult, and we will mark fish externally to identify exposure level to minimize the holding time for gametes prior to fertilization.

B. Rationale/Link to Restoration

Pink salmon are an ideal species for identifying prolonged population effects resulting from embryonic oil exposure. Pink salmon have been widely studied because of their commercial value and relatively simple life history, and their dependence on the intertidal for incubating in PWS made them a premier sentinel species for detecting oil damage after EVOS. Consequently, a large amount of effort and money was expended towards understanding how oil affected pink salmon populations. This work has led to important advances in our understanding of the scope and mechanisms of oil toxicity and has led to developing a model describing the average reduction in reproductive fitness of exposed populations. Laboratory confirmation of Bue et al.'s claim of an oil effect on gamete viability for pink salmon is the last piece of data required to construct a new paradigm for oil toxicity .

Confirmation of the field observations of reduced gamete viability (Bue et al. 1995) will provide managers with a more comprehensive model for the long-term effects of oil on pink salmon. This information is important to managers working to restore salmon populations in PWS as well as locations in less pristine locations. Concentrations found to be effective at reducing average fitness (Heintz 1995) are significantly lower than those required by the Alaska State water quality criteria and are typical of concentrations in urban locations (Maltby et al. 1995). Of additional value is the demonstration that oil has life long effects for organisms exposed during embyonic development. Both the exposure mechanism and the extent of the effects described in this work represent significant advances in the understanding of oil toxicity.

C. Location

This project is underway at Little Port Walter (LPW), a research hatchery operated by NMFS in southeastern Alaska. This location is appropriate because it has been the site of these studies since their inception. The facility provides easy access to the intertidally spawning pink salmon stock that has been the subject of previous experiments. In addition, the exposure apparatus requires a simulated intertidal environment and such a system is in operation at LPW.

COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE

This project will take place in southeastern Alaska, but depends on contract labor for marking fish for a period of 6 weeks in the spring of 2000. All efforts will be made to advertise our labor requirements in the spill zone. We will continue to provide information to interested public (primarily fishermen) who visit the station; we will be displaying at the facility the posters developed for the Restoration Workshop for 97191B and 97076 as interpretative tools. In addition, in 1999 we have traveled to Cordova to present a summary of our results to the public.

PROJECT DESIGN

A. Objectives

1. Determine the effect of incubating in oiled gravel on reproductive capacity of pink salmon.

2. Complete the model of life cycle impacts from incubation in oiled gravel.

We are currently testing the hypothesis that incubating in gravel contaminated with oil leads to reduced gamete viability. Fish have been exposed, marked and released. Gametes will be collected at the end of FY 00. Examination of gamete viability will provide information for completing a life-history model for oil toxicity which allows us to quantify the effect of oil on each of the major life-history stages of pink salmon in terms of reduced survival. Thus far, we have demonstrated that embryos developing in oil contaminated gravel have reduced survival, and fry that survive incubation have reduced growth and reduced survival to maturity. These observations account for a 50% reduction in the average survival of a population of pink salmon exposed to PAH concentrations equal to the Alaska State water quality standard. The proposed study will refine the model by providing an estimate of the specific loss in reproductive ability in exposed individuals. To our knowledge this type of analysis does not exist for any vertebrate and these effects occur at concentrations that are commonly seen in urban locations.

B. Methods

The exposure mechanism and fish culture procedures followed those described in previous proposals for Restoration Study 191B. Gametes were taken from an intertidally spawning pink salmon stock, transferred to our hatchery at Little Port Walter where they were incubated beginning in FY98. The eggs were exposed to effluent from either oil-coated or untreated gravel. In FY99, approximately 60,000 surviving fry from each exposure group were marked by excising the adipose fin and one pelvic fin depending on exposure regime. Marked fish were held for a short period to recover from the marking procedure and then released. Exposures began in September of 1998; between 50 and 500 mature fish representing each treatment are expected to return in September 2000.

All pink salmon returning to the Sashin Creek weir will be inspected for marks during the 2000 escapement period (FY00). Marked fish will be sorted by treatment groups into holding pens since the external marks will provide for immediate identification of exposure level. On a given spawning date, sufficient numbers of fish will be removed from each pen and spawned, ensuring minimal holding times for gametes prior to spawning. Spawning will be directed by a contracted expert in fish reproduction to ensure maximal survival. Previously, we have released fish from multiple treatments which necessitated the use of coded-wire tags for identifying them upon return. This approach allowed us to quantify oil effects on growth, marine survival, and homing fidelity but not gamete viability due to the long time periods associated with tag recovery decoding on a given spawning date.

Gamete viability will be determined for the oil treatment and the control groups. Three experiments will be performed to evaluate the reproductive viability of the parents. The objective of the first experiment will be to determine the average offspring survival of parents exposed to oil during incubation . The importance of this experiment is that all the possible crosses within an exposure group can be made and the overall average survival measured, however the primary source of variation will be measurement error and no information will be available on individual variation. Therefore, the second experiment's objective will be to estimate how much of the variability in offspring survival is due to individual variation. This experiment will determine individual variability and thus provide control for the interpretation of the results of the first experiment. Lastly, the objective of the third experiment is to identify the genetic component to variability or heritability of offspring survival. The benefit of this third experiment, besides demonstrating a genetic effect of oil, is that calculation of the genetic heritability of the damage provides a basis for calculating how long the effect will persist in the exposed population. In all experiments survival will be measured to fertilization, eyeing, and emergent fry stages. The numbers of defective or dead progeny will be compared between treatment groups. Because these gametes will not be incubated in an oiled environment, any observed increases in mortality or defective individuals can be attributed to oiling effects upon the first generation.

First Experiment

Average offspring survival will be estimated in the first experiment by measuring the survival in pools of gametes comprising all the possible pairwise crosses. On each day of spawning, 2 embryo pools will be formed per treatment. Upon formation of an embryo pool, 6 subsamples, each of approximately 150 embryos, will be randomly selected and incubated in an individual cell within a Heath tray. On a given day, pools will be formed by randomly assigning half the males and females from a treatment group to one of two subgroups. Each female in a subgroup will contribute approximately 900 eggs to a common pool, the pool will be mixed and the mixture divided into a number of aliquots equal to the number of males in the subgroup. Each male in the subgroup will fertilize one aliquot, and the fertilized eggs will be recombined in a common container, mixed and divided into six aliquots that will be incubated in randomly assigned locations. Thus, the average survival of a treatment group on a given day will be the mean of the average survivals in each of the two subgroups.

The estimates of mean survival of the treatment groups will be compare with t tests after assuming that variability between groups of like-treated incubators is negligible. A t test between, for example, treatment 1 and 2, when there are d spawning days, q treatments, p subgroups per treatment, and r cells per subgroup will have the following form:

$$t_{((p-1)*q*d)df} = \frac{\frac{1}{d}[\overline{sv_{11}} + \ldots \overline{sv_{1d}} - \overline{sv_{21}} \ldots - \overline{sv_{2d}}]}{\sqrt{\frac{1}{d^2} * \frac{s_c^2}{p*r} * 2*d}}$$

where,

$\overline{sv_{ij}}$ = Survival rate for treatment I on day j

s^2_c = Combined Between-Pools Mean Square obtained by ANOVA.

Comparisons will be made between each of the doses and the control and the overall α will be maintained at 0.05.

Second Experiment

For the second experiment, fish from the oil and control doses will be mated using a fully-crossed half-sib design (Falconer 1981). In this design, the remaining eggs from an exposed female and a control female are each split into two aliquots. One aliquot from each female is fertilized with aliquots of sperm from the same oil-exposed male, and one aliquot from each female is fertilized with aliquots of sperm from the same control male. This 2 x 2 breeding matrix will be replicated so that every female is represented in a breeding matrix or until there are 30 breeding matrices for each treatment, whichever is greater. Each half-sib family will be incubated in an individual container.

Third Experiment

The third experiment will be performed under contract by the University of Alaska using gametes collected at the same time as those used in the previous experiments. The fish will be used to produce ten 2 x 3 mating sets: 'oiled' females crossed with oiled males and ten 2 x 3 mating sets: 'unoiled' females crossed with unoiled males. Within each set, eggs from each female will be separately fertilized using semen from 3 males. Therefore, each set will produce 6 families, resulting in a total of 60 oiled families and 60 unoiled families (oiled and unoiled F1). Each family will be divided in 2 parts, each of which will be randomly placed in an incubator compartment. Data to be collected for each of the 240 incubator compartments includes: mortality rate at eye, hatch, and emergence, and developmental rate to eye, hatch, and emergence.

Additive genetic, maternal, non-additive genetic, and phenotypic variances will be estimated and heritabilities, and ratios of maternal and nonadditive genetic variances to phenotypic variances will be calculated using an animal model solved by applying a derivative free technique for estimating variance components employing restricted maximum likelihood (Graser et al., 1987).

The derivative-free restricted maximum likelihood (DFREML) analysis procedure of Meyer (1988) will be utilized. The technique has been utilized to analyze data from breeding experiments of fish (Crandell and Gall, 1993). Heritability estimates may be used to predict expected genetic change due to natural selection for a range of selection intensities (Van Vleck, 1987).

C. Cooperating Agencies, Contracts and Other Agency Assistance

Fish spawning and handling of gametes in FY 00 will be directed by a contracted expert in the field of fish reproduction. The statistical analysis of the results for experiment 1 have been designed by the Alaska Department of Fish and Game (ADF&G). The design and execution of experiment 3 will be contracted to University of Alaska through ADF&G.

SCHEDULE

A. Measurable Tasks for FY 00 (October 1, 1999 - September 30, 2000)

Sept. 2000: Collect gametes from returning adults and cross them.

B. Project Milestones

Completed:
Sept. 1998: Set-up exposure apparatus, collect gametes, begin exposures.

May 1999: Release marked fry

Underway:
Sept. 2000: Examine oil effect on gamete viability by recovering and spawning marked adults when they return to weir.

Aug 2001: Complete analysis of gamete viability.

C Completion Date

Final Report will be submitted on August 15, 2001 in FY 2001.

PUBLICATIONS AND REPORTS

FY 99: Annual Report describing the doses, exposure apparatus and effects on early incubation.

FY 00: Final Report

Other manuscripts planned:
Heintz, R. 2000. Effect of incubating in oil on pink salmon reproductive capacity.

Journal Unknown.

Heintz, R. 2000. Incubating in oiled gravel damages the entire life-history of pink salmon. Journal Unknown.

PROFESSIONAL CONFERENCES

No conferences planned in FY 00, travel to 2000 Oil Spill Symposium is covered in other Proposed Project Plans.

NORMAL AGENCY MANAGEMENT

This project will complete the work begun under Restoration 191B which has been performed cooperatively between the Trustees and NMFS from the outset. However, NMFS proposes providing most labor requirements for this project and seeks funding for primarily contractual labor and commodities. There is no charge for project support costs which include management of the LPW facility and project budget, production of reports or hydrocarbon chemistry to verify dosing. There was no charge for setting up the experiment in FY98 and early FY99, NMFS covered costs associated with setting up the exposure apparatus, spawning pink salmon, and maintaining the incubation for 9 months. In outlying years, NMFS will cover costs associated with the several man-weeks associated with spawning the returning fish, and evaluating their gamete viability.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

This project will be coordinated with continuation of ADF&G research and monitoring efforts regarding pink salmon embryo survival under Restoration 191A. This study also coordinates the results of Restoration 191B and 076 by completing a life-history model for oil effects on pink salmon. Investigators and agencies will coordinate by sharing data. NOAA/NMFS will coordinate with the Trustees by providing labor requirements and laboratory overhead.

PROPOSED PRINCIPAL INVESTIGATOR

Name	Ron Heintz
Affiliation	NMFS
Address	Auke Bay Laboratory 11305 Glacier Hwy. Juneau, AK 99801
Phone	907-789-6058
Fax	907-789-6094
E-mail	ron.heintz@noaa.gov

PRINCIPAL INVESTIGATOR

Ron Heintz has been involved in examining the effects of *Exxon Valdez* oil on pink salmon since 1992. He has developed the methods proposed for this project, published 3 papers has another in review on this topic. In addition, he has presented results of these studies at 10 professional meetings.

OTHER KEY PERSONNEL

Robert Bradshaw will assist in all the fish culture and logistics.
Stan Rice and Jeff Short will assist in data interpretation.

LITERATURE CITED

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Maltby, L., D. M. Forrow, A. B. A. Boxall, P. Calow and C. I. Betton. 1995. The effects of motorway runoff on freshwater ecosystems: 1. Field Study. Env. Tox and Chem. 14:6

1079-1092.

Marty, G. D., J. W. Short, D. M. Dambach, N. H. Willits, R. A. Heintz, S. D. Rice, J.J. Stegeman and D. E. Hinton. 1997. Ascites, premature emergence, increased gonadal cell apoptosis, and cytochrome P4501A induction in pink salmon larvae continuously exposed to oil-contaminated gravel during development. Can. J. Zool. 75:989-1007.

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Wertheimer, A. C., S. D. Rice, A. G. Celewycz, J. F. Thedinga, R. A.Heintz, R. F. Bradshaw, and J. Maselko. 1996. Effects of oiled incubation substrate on straying and survival of wild pink salmon. Restoration Project 95076 Annual Report. *Exxon Valdez* Trustee Council, Anchorage, AK.

1999 EXXON VALDEZ TI E COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 1999

Budget Category:	Proposed FFY 1999	Authorized FFY 2000						
Personnel	$19.8	$23.1						
Travel	$6.0	$6.0						
Contractual	$33.0	$35.4						
Commodities	$10.0	$10.0						
Equipment		$0.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	$68.8	$74.5	Estimated FFY 2001	Estimated FFY 2002	Estimated FFY 2003	Estimated FFY 2004	Estimated FFY 2005	
General Administration	$5.3	$5.9						
Project Total	$74.1	$81.7	$36.0	$0.0	$0.0	$0.0	$0.0	
Full-time Equivalents (FTE)		0.3						
	Dollar amounts are shown in thousands of dollars.							
Other Resources		$58.0						

Comments:

NOAA Contribution:
Principle Investigator R. Heintz, 3 mo = $18.0
Fishery Research Biologist, R. Bradshaw 4.0 mo = $20.0
Fishery Research Biologist, J. Maselko 2 mo. = $10.0
Additional Operating Costs of Little Port Walter Field Station = $10.0k

Total NOAA/NMFS Contribution = $58.0k

FY00

Project Number: 00476
Project Title: Oil Effects on Pink Salmon Reproduction
Agency: National Oceanic & Atmospheric Administration

FORM 3A TRUSTEE AGENCY SUMMARY

Prepared:4/13/99

1999 EXXON VALDEZ TR COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FFY 1999
R Heintz	Co-PI: Fishery Research Biologist	12/3	3.5	6.6		23.1
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		3.5	6.6	0.0	
					Personnel Total	$23.1

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FFY 1999
Little Port Walter Filed Station -- 4 staff, 6 crew, multiple trips					0.0
Beaver Charters	1.0	5			5.0
					0.0
Attend Oil Spill Conference in Anchorage	1.0	1			1.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$6.0

FY00

Project Number: 00476
Project Title: Oil Effects on Pink Salmon Reproduction
Agency: National Oceanic & Atmospheric Administration

FORM 3B Personnel & Travel DETAIL

Prepared:4/13/99

Contractual Costs:	Proposed
Description	FFY 1999
NOAA Contract Labor (spawing crew)	6.6
1 x $16.50 x 400h	19.2
4x$16.00x300h	9.6
1x$32.00x300h (spawning expert)	0.0
	0.0
	0.0
	0.0
	0.0
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$35.4

Commodities Costs:	Proposed
Description	FFY 1999
groceries	5.0
gloves, anaesthetic, buckets,spawning supplies	5.0
Commodities Total	$10.0

FY00

Project Number: 00476
Project Title: Oil Effects on Pink Salmon Reproduction
Agency: National Oceanic & Atmospheric Administration

FORM 3B
Contractual & Commodities
DETAIL

Prepared:4/13/99

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

Existing Equipment Usage: Description	Number of Units	Inventory Agency
Incubation units	4	NOAA
nets and frames	8	NOAA
weir	1	NOAA

FY00

Project Number: 00476
Project Title: Oil Effects on Pink Salmon Reproduction
Agency: National Oceanic & Atmospheric Administration

FORM 3B
Equipment
DETAIL

Prepared:4/13/99

Project Title: Defining Critical Habitat for Marine Reserves: Spatial and Temporal Distribution of Anadromous and Pelagic Fishes in the Gulf of Alaska

00478

Project Number:	New Proposal
Restoration Category:	Research
Proposer:	Dr. Jennifer L. Nielsen Alaska Biological Science Center USGS-Biological Resources Division 1011 E. Tudor Rd. Anchorage, Alaska 99503
Lead Trustee Agency:	DOI
Cooperating Agencies:	na
Alaska SeaLife Center:	Yes
Project Duration:	1st year, 3-year project
Cost FY 00:	$188.8
Geographic Area:	Prince William Sound, Gulf of Alaska
Injured Resource/Service:	Pacific halibut (*Hippoglossus stenolepis*), king salmon (*Oncorhynchus tshawytscha*), coastal cutthroat trout (*O. clarki clarki*), ling cod (*Ophiodon elongatus*)

ABSTRACT

The definition of "critical habitat" in the marine environment is essential to the development of reserves or protected areas in relationship to a sustainable commercial or sport fishery. This proposal seeks to investigate the temporal and spatial distribution of four key fish species (Pacific halibut (*Hippoglossus stenolepis*), king salmon (*Oncorhynchus tshawytscha*), coastal cutthroat trout (*O. clarki clarki*), and ling cod (*Ophiodon elongatus*) in the Gulf of Alaska that fall under the jurisdiction of the Trustee Council in their efforts to restore the resources and services injured by the spill. Individual fish will be monitored using satellite pop-up and archival satellite tags on live fish, monitoring their seasonal movements and critical habitats in near-shore and marine environments in the Gulf of Alaska.

INTRODUCTION

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 marine 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 are 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 sets the foundation for investigations into the temporal and spatial distribution of four key fish species (Pacific halibut (*Hippoglossus stenolepis*), king salmon (*Oncorhynchus tshawytscha*), coastal cutthroat trout (*O. clarki clarki*), and ling cod (*Ophiodon elongatus*) in the Gulf of Alaska that fall under the jurisdiction of the Trustee Council in their efforts to restore the resources and services injured by the spill. Real-time data collected from this proposal will be posted at an internet site developed specifically for local access and community involvement in the project's development and implementation.

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). For example, the recent study of the effects of commercial halibut fishing on the Glacier Bay marine ecosystem by P.N. Hooge and S. J. Taggart of the USGS/BRD have shown limited but seasonally predictable movements of halibut within Glacier Bay (G. Irvine, USGS/BRD, personal communications). 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, Stanford University, personal communications).

The range of signal available at depth, required recapture of tagged fish, and/or the temporal scale of signal recoveries limit sonic and radio telemetry tags for fish. New technology involving microwave archive tags and satellite-linked telemetry with temperature, light, and pressure sensors can be used to identify critical habitat in near-shore and pelagic fishes that are unavailable with more conventional technologies. There are two versions of satellite pop-up tags currently developed for fish. One (PTT100) can store location data based on solar angle and a set number of average or instantaneous temperature points (up to 60). This tag is commercially available from Microwave Telemetry, Inc. A second, more technical tag is in development which measures and records light intensity, hourly temperatures, and/or pressure for up to one year and downloads these data remotely to a satellite link from any location. These tags, while commercially unavailable at this time, have been field tested on a limited number of deep-sea pelagic fishes (tuna and marlin) and can be made available in limited quantities for this study location (P. Howey, Microwave Telemetry, Inc., personal communications). Size restrictions are a problem with the first series of satellite pop-up tags for fishes, but smaller, more hydrodynamic tags are currently in development at Microwave Telemetry, Inc. and will be available for research in this proposal in 2001.

This proposal requests funding to initiate satellite telemetry studies of four fish species important to the ecological and economic stability of Prince William Sound and the Gulf of Alaska: Pacific halibut (*Hippoglossus stenolepis*), king salmon (*Oncorhynchus tshawytscha*), coastal cutthroat trout (*O. clarki clarki*), ling cod (*Ophiodon elongatus*). Information about critical habitat, marine migrations or movements, and the general geographic distribution of these species within the Gulf of Alaska ecosystem are unknown. We incorporate three elements into this request: 1) initial studies in capativity of tagging effects, efficiency, and physiological response in individual fish at Alaska SeaLife Center (FY00 & FY02); 2) initiate and monitor satellite telemetry studies on released fish in the wild (FY00 – FY02); 3) develop data links for satellite data at the local community level and development of a critical-habitat model for Prince William Sound and the Gulf of Alaska for individual fish species and all species combined based on telemetry results and local user input data.

Based on preliminary results and analysis of data made available in recent satellite telemetry studies on bluefin tuna (B. Block and H. Dewar, personal communications) the proposed work will lead to conclusions regarding marine habitat use and critical environmental factors for anadromous and marine species in this study. These data will generate physiological and environmental information on fishes never studied before within the marine environment in Alaska, serve as another window into recovery of the nearshore and marine ecosystems impacted by the spill, and will lead to recommendations for specific geographic boundaries or zones of management in the Gulf of Alaska marine reserve.

NEED FOR THE PROJECT

A. Statement of Problem

The development of marine reserves or protected areas in geographic localities with subsistence, commercial, and sport fisheries depend on sound scientific knowledge of "critical habitat" and ecosystem use at several temporal and spatial scales. Our knowledge of marine habitat use over time for different life stages of Pacific halibut, king salmon, coastal cutthroat, and ling cod in the Gulf of Alaska are currently limited to information from harvest statistics and antidotal information from resource users and managers (Int. Pac. Halibut Comm. 1987; Pelletier and Parma 1994), with the notable exception of recent work done on halibut in Glacier Bay (Chilton et al in press; Hooge and Taggart unpublished data). Knowledge of the distribution of individual fish over time within the Gulf of Alaska ecosystem is needed to make sound management decisions at the inception of reserves or protected areas. Without sound scientific support, initial development of marine reserves can create significant conflict among diverse user groups. 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 reserve will aid in the development of a common-ground database on fish distributions over time and space during the development of reserve boundaries and temporal management units within the reserve where frequent conflict-of-interest problems are expected to arise.

B. Rationale/Link to Restoration

Information collected during this study will contribute to the assessment of recovery status and definition of impediments to recovery (critical habitat) for four economically and ecologically important fish species found in Prince William Sound and the Gulf of Alaska. This proposed work represents a sound scientific approach to understanding the factors that affect population dynamics on multiple temporal and spatial scales and will help in the definition of critical habitat for the proposed marine reserve. 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 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 the marine reserve.

C. Location

Data to be compiled will come from throughout Prince William Sound and the Gulf of Alaska, based on fish movement and tag duration. Initial physiological data concerning tagging effects and efficiencies will be assessed using a limited number of individuals in captivity at the Alaska SeaLife Center in Seward, AK. Tagging of wild fish will take place in collaboration with the local sport fishing community, primarily from Prince William Sound. Satellite data recovery, data analysis, critical habitat mapping , and the development of a web-site for real-time data access will be done by the staff of the USGS/BRD Alaska Biological Science Center, Anchorage, AK.

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, and all articles, video, or photographs of the tagging study will be available to the Trustee Council. The nature of the tagging study and the charismatic character of the fish subjects make this a potentially high profile public relations project for the recovery and Trustee Council.

PROJECT DESIGN

A. Objectives

1. Develop critical marine habitat criteria based movement of tagged fish within the Gulf of Alaska:

   a. study initial tagging effects and efficiencies on four species using short-term captivity studies on a limited number of individuals at the Alaska SeaLife Center

   b. tag and release live individual fish captured in the Prince William Sound sport fishery using satellite and archive satellite tags

   c. monitor and plot individual fish behavior and movement throughout the Gulf of Alaska over several temporal and spatial scales based on known ocean bathymetry and tag data.

2. Summarize data recovered from individual tags via satellite links and publish results in peer-reviewed scientific journals.

3. Create a public access internet site for the display and development of study results with real-time deposition of tag recovery data throughout the duration of the project.

B. Methods

Fish will be collected in FY00 from the sport fishery and transported live to the Alaska SeaLife Center for tests of tagging effects and efficiencies. Tests will include location attachment studies, physiological stress during and after tagging, and stability of implantation over time. These tests will be monitored by the PI, at least two veterinary scientists with a background in fish, and a representative from the satellite tag vendor. Due to the developmental time line of the smaller microwave satellite tags we will target Pacific halibut and king salmon in the first year. Based on available size (3.5 grams) and design (tag is housed in a composite, positively buoyant, low-drag housing that is towed by the fish via a short "leader" attached to a tagging dart), these species holds the most promise for functional efficiencies using the short duration tags (PTT100) currently available. Several features of the satellite tags will be tested from a boat in the field without fish in FY00, i.e. efficiency of light sensors at latitudes within the Gulf of Alaska, temperature cycles at depth, stability of pressure sensors at depth, etc. Little is known about local halibut movements or physiology in relationship to habitat use in the Gulf of Alaska. Based on the results of our captivity experiments for halibut and tests of tags in the field, we will begin tagging and monitoring real-time data on habitat use by halibut and king salmon in the Gulf of Alaska in FY00 and continue tagging at increased efforts in FY01. Measurements of fish location coupled with environmental habitat data (i.e. temperature, depth, and environmental parameters from site localities) will contribute important information on halibut and salmon ecology in this area.

Tag implantation in salmonids has been well studied previously using radio and sonic tags (reviewed in Eiler 1995). Therefore, we propose no aquaculture requirements for king salmon at the Alaska SeaLife Center. Tests of satellite-linked tagging efficiencies and habitat use for king salmon and coastal cutthroat trout will take place in the field in FY00-02. Studies of critical

marine habitat in these species will depend on catch-and-release of large sized individuals made available to our study under contract with commercial or private sport boats from Prince William Sound. Large king salmon will probably be easily available from the sport fishery, but limits on capture frequency and size may make coastal cutthroat trout less easy to obtain. Limited experimental releases of currently available satellite-linked tags on salmonids will be made in FY00 with follow up tagging in FY01 and FY02 based on recovery efficiencies from the previous year and availability of fish.

Tagging of ling cod and smaller salmon will require completion of the development of smaller, more hydrodynamic satellite tags by the vendor projected for sometime in FY01. Ling cod will require attachment and tag efficiency tests in captivity at the Alaska SeaLife Center similar to those done on Pacific halibut. We project captivity studies and tagging in the field for this species to FY02. Tagging of additional salmonid fishes (king salmon and coastal cutthroat trout) with these new smaller tags will also take place in FY01-FY02, or as soon as the tags are available for experimental studies.

Conversion of satellite 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. Data for location and position for individual fish will be plotted by species and for all species combined 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 (Swilhard and Slade 1985; Baltz 1990; Cressie 1991; Thompson et al. 1992).

The development of the internet link to tagging studies and results will run parallel to the ongoing field studies and tagging data development (FY01 & FY02). The initial 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 data collected by a number of research collaborators as yet unnamed (i.e. commercial or sport boat captains, fishing volunteers, and community internet developers). Known collaborators include: Dan Mulcahy, DVM, USGS/BRD fish and wildlife veterinarian, Riley Wilson, DVM Anchorage Zoo, Dr. Paul Howey, Microwave Telemetry, Inc., Philip Hooge and Spencer Taggart, USGS/BRD Glacier Bay, Dr. Barbara Block, Hopkins Marine Station, Stanford University, Dr. Heidi Dewar, the Pfleger Institute of Environmental Research, Dr. Steve McCormick, fish physiologist, NMFS, Conte Anadromous Fish Laboratory, and the staff of the Alaska SeaLife Center. All technical and clerical staff will be current employees of USDGS/BRD Alaska Biological Science Center or qualified individuals contracted directly for this project.

SCHEDULE

A. Measurable Project Tasks for FY 00

Jan.1 – Mar. 30	Purchase 16 satellite-linked tags, develop field protocols, and prepare live tanks (3) for halibut at Alaska SeaLife Center. Consult with resource

	managers and local users on best populations to target for captivity and tagging studies.
Mar 20 – May 5:	Collect live Pacific halibut and transport to Alaska SeaLife Center.
May 6 – Aug 15:	Captivity test on halibut physiology, tagging effects and efficiency, and survival trials.
June 15 – July 20:	Field trials of environmental sensors in satellite tags in Prince William Sound and develop contracts with sport fishing boats for initial tagging study on king salmon.
July 21 – Sept. 30:	Capture, tag, and release initial set of 8 king salmon and 8 halibut in Prince William Sound.
Sept. 5 - Oct. 31	Develop WebPages for study results and plot initial data. Consult on future tagging locations and applications.
Nov.1 – Dec. 15	Analyze data from initial tagging recoveries.
December 31, 2000	Submit progress report on initial halibut and salmon tagging studies.

B. Measurable Project Tasks for FY 01

Jan.1 – May 30	Data analysis for FY00 satellite recoveries. Purchase additional tags (estimated number will be based on initial field trials and funding), develop field protocols, and consult with resource managers and local users on best populations to target for tagging studies.
May 6 – Aug 15:	Intensive field implementation of satellite tags on king salmon and halibut, potential target capture localities include Kodiak, the Barrens and Seward areas.
July. 5 - Sept. 31	Update WebPages with study results. Present preliminary results at professional meeting (Association of Ichthyologists and Herpetologists).
Oct. 1 – Dec. 15	Analyze combined FY00 and FY01 satellite data by species and by ecosystems.
December 31, 2001	Submit progress report on halibut and salmon studies.

C. Measurable Project Tasks for FY 02

Jan.1 – Mar. 30	Purchase additional tags, develop field protocols, and prepare live tanks (1) for ling cod at Alaska SeaLife Center. Consult with resource managers

	and local users on best populations to target for captivity and tagging studies.
Mar 20 – May 5:	Collect live ling cod and transport to Alaska SeaLife Center.
May 6 – Aug 15:	Captivity test on ling cod physiology, tagging effects and efficiency, and survival trials.
June 15 – July 20:	Field trials of environmental sensors in satellite tags in cod and coastal cutthroat trout and develop contracts with sport fishing boats for tagging studies.
July 21 – Sept. 30:	Capture, tag, and release king salmon, coastal cutthroat trout, and ling cod in Prince William Sound.
August. 5 - Oct. 31	Recover satellite data from FY02 tagging set and combine with previous year's data. Update WebPages with study results. Present results at professional meeting (American Fisheries Society).
Nov.1 – Dec. 15	Develop critical habitat recommendations based on total tagging results. Prepare manuscript on results of study for publication and submit for peer-review.
December 31, 2002	Submit final report on satellite-linked tags in anadromous and pelagic fish in the Gulf of Alaska.

C. Project Milestones and Endpoints

This project will be completed upon submission of the final report prior to Dec. 31, 2002.

C. Completion Date

All project objectives will be met during FY2002.

PUBLICATIONS AND REPORTS

A final report of activities will be submitted to the Restoration Office on or before 31 December 2002.

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

Website development and maintenance of our tagging database will be available FY01-FY02. At the end of the project we will transfer the internet site to a webmaster designated by the Trustee Council.

PROFESSIONAL CONFERENCES

American Fisheries Society FY00
Association of Ichthyologists and Herpetologists FY01
American Fisheries Society FY02

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 of 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. 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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USGS-Biological Resources Division
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PERSONNEL QUALIFICATIONS

Jennifer Nielsen is Supervisory Fisheries Team Leader and Research Biologist with the Alaska Biological Science Center, USGS Biological Resources Division. She has conducted salmonid and fisheries research throughout the western Pacific for the past 20 years. 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 bluefin 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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2000 EXXON VALDEZ TRU COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 2000

Budget Category:	Actual FY 1999	Proposed FY 2000
Personnel	$0.0	$50.0
Travel		$15.5
Contractual		$38.0
Commodities		$25.1
Equipment		$50.0
Subtotal	$0.0	$178.6
General Administration	$0.0	$10.2
Project Total	$0.0	$188.8
Full-time Equivalents (FTE)		1.0
Other Resources		

LONG RANGE FUNDING REQUIREMENTS					
		Estimated FY 2001	Estimated FY 2002		
		$227.0	$162.0		

Dollar amounts are shown in thousands of dollars.

FY00

Prepared:4/15/99

Project Number: New Proposal 00478
Project Title:Defining Critical Habitat for Marine Reserves
Agency: DOI-BRD

FORM 3A
TRUSTEE
AGENCY
SUMMARY

2000 EXXON VALDEZ TRU : COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 2000

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 2000
J. Nielsen	Fisheries Team Leader	GS13/03	3.0	7.2		21.6
TBA	Fisheries Technician	GS5/02	4.0	2.3	1.0	10.2
TBA	Aquaculture Technician	GS7/02	4.0	2.7	1.0	11.8
D. Mulcahy	Fish/Wild. Veterinarian	GS13/05	0.5	6.8		3.4
D.Douglas	Fish/Wild Scientists	GS12/05	0.5	6.0		3.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		12.0	25.0	2.0	
					Personnel Total	$50.0

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 2000
Anchorage-Homer for sampling	120.0	10	4	187.0	1,948.00
Anchorage-Seward for halibut in captivity	210.0	8	35	173.0	7,735.00
Professional meeting PI	650.0	1	7	260.0	2,470.00
Columbia MD - Anchorage (attachment training PI)	650.0	1	5	185.0	1,575.00
Monterey CA - Anchorage (H. Dewar - tag assessment)	388.0	1	7	204.0	1,816.00
					0.00
					0.00
					0.00
					0.00
					0.00
					0.00
					0.00
				Travel Total	15.54

FY00

Prepared:4/15/99

Project Number: New Proposal
Project Title: Defining Critical Habitat for Marine Reserves
Agency: DOI-BRD

FORM 3B
Personnel
& Travel
DETAIL

Contractual Costs:	Proposed FY 2000
Description	
Private longline fishers (R. Wilson)	4.0
Fishing vessel lease (private) - 3 days	15.0
CDFG boat leased by BRD - day costs (1 day)	1.4
SeaWorld Center Tank Rent/Operations	16.0
Satellite link recovery costs	1.6
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$38.0

Commodities Costs:	Proposed FY 2000
Description	
Materials and supplies - aquaculture	17.0
Materials and supplies - longline	4.6
Boat supplies	1.2
Consumables (food)	2.3
Commodities Total	$25.1

FY00

Prepared:4/15/99

Project Number:New Project
Project Title: Defining Critical Habitat for Marine Reserves
Agency: DOI-BRD

FORM 3B
Contractual & Commodities DETAIL

2000 EXXON VALDEZ TRU E COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 2000

New Equipment Purchases:	Number	Unit	Proposed
Description	of Units	Price	FY 2000
PTT100 pop-up tags (12 @ 2700 ea.)	12	2700.0	32.4
Pop-up prototype tags (4 @4400 ea)	4	4400.0	17.6
			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**	$50.0

Existing Equipment Usage:	Number	Inventory
Description	of Units	Agency

Effects of food stress on survival and reproductive performance of seabirds

Project Number:	00479
Restoration Category:	Research
Proposed By:	USGS, University of Washington
Lead Trustee Agency:	DOI
Cooperating Agencies:	University of Washington
Duration:	2nd year, 4-year project
Cost FY 00:	$125,200
Cost FY 01:	$129,600
Cost FY 02:	$75,000
Geographic area:	Cook Inlet, Gulf of Alaska
Injured resource:	Common Murre, Pigeon Guillemot, Black-Legged Kittiwake

ABSTRACT

Traditional field methods of assessing effects of fluctuations in food supply on the survival and reproductive performance of seabirds may give equivocal results. Here we propose to apply an additional tool: The measure of stress hormones in free-ranging seabirds. Food stress can be quantified by measuring base levels of stress hormones such as corticosterone in the blood of seabirds, or the rise in blood levels of corticosterone in response to a standardized stressor: capture, handling and restraint. We will apply these techniques to seabirds breeding in Lower Cook Inlet and also use captive birds for controlled experiments. This study provides a unique opportunity for a concurrent field and captive study of the behavioral and physiological consequences of stress in seabirds. Moreover, it will provide the basis for management of seabird populations in the areas affected by the *Exxon Valdez* oil spill, and it will have broader applications for seabird monitoring programs.

INTRODUCTION

During the last decade, reduced productivity, increased mortality and subsequent population declines occurred among some seabirds and marine mammal species in the Gulf of Alaska. It has been suggested that declines in food availability resulted in food-related stress (Merrick *et al.* 1987, Piatt & Anderson 1996). Oil pollution from the Exxon Valdez oil spill may have exacerbated these stress-related effects. In this context, nutritional stress can be defined as changes in the physiological conditions of individuals that experience a long-term shortage of food or rely on low quality and/or contaminated food resources that impair their ability to reproduce successfully. Alternatively, less severe food shortages may allow reproduction to proceed, but additional stress such as from anthropogenic sources may precipitate reproductive failure. It is frequently difficult, or impossible, to detect these possible types of perturbations by using traditional field methods (Piatt & Anderson 1996).

An approach using well-characterized responses of hormones to stress can provide a sensitive indicator of chronic stress in the environment, or the potential impact of future stressors (Wingfield et al. 1997). Food-related stress is associated with elevated levels of corticosteroids (also known as "stress hormones") in the peripheral system of affected animals (Axelrod & Reisine 1984; Wingfield, 1994). In seabirds, corticosterone levels were elevated in free-living Magellanic penguins exposed to oil pollution (Fowler et al. 1995), and in Black-legged Kittiwakes breeding under poor foraging conditions (Kitaysky et al., in press *a*). Chronically elevated corticosteroid levels are known to result in regression of the reproductive system, suppression of memory and immune systems, lead to muscle wasting and cause neuronal cell death (e.g. Sapolsky 1987; Wingfield 1994). Exposure to oil pollution and decreased food availability can have similar debilitative effects on foraging and reproductive behaviors in seabirds. The effects of the stress can be detected and monitored through measurements of baseline plasma levels of corticosterone in the peripheral system of potentially affected seabirds. The pattern and extent of a corticosterone increase following application of a standardized stressor such as capture, handling and restraint then indicate potential for stress effects. Furthermore, experimental manipulations with corticosterone levels in wild and captive seabirds provide a way to examine the mechanisms by which increased mortality and decreased reproduction are expressed.

The factors regulating seabird populations are poorly understood. Variations in mortality of adult birds and reproductive success due to natural fluctuations in the availability of food and anthropogenic impacts are probably among the most important factors (Cairns 1992). Life-history theory predicts that in long-lived animals, an increase in parental investment in current reproduction may impair post-breeding survival of parents and the probability of their successful reproduction in the future (Williams 1966, Charnov & Krebs 1974, Stearns 1992). Being long-lived animals, with an estimated life span of about 25-30 years (e.g., Ydenberg 1989), seabirds might buffer the cyclic variability of food resources by pursuing long-term reproductive strategies (Ricklefs 1990). For example, some seabirds can maintain their investment in reproduction at a constant level despite a large variation in foraging conditions (Pugesek 1981,

Bolton 1995, Kitaysky 1996). This parental strategy can result in large fluctuations in reproductive success but relatively small variations in the post-breeding survival of parent seabirds. Other seabirds are known to adjust their effort in current reproduction in relation to foraging conditions during a particular breeding season (Burger & Piatt 1990, Shea & Ricklefs 1985, Shea & Ricklefs 1996, Kitaysky 1996, Kitaysky et al. submitted *b*). For example, if feeding conditions are poor, adults should increase foraging effort to raise young. This parental strategy results in relatively low variation in bird reproductive success, but large variation in post-breeding survival of parent seabirds. In both scenarios, a trade-off between reproduction and survival must be balanced to maintain populations.

In contrast to regular, natural fluctuations in food availability, anthropogenic impacts such as oil pollution or commercial fisheries are unpredictable. These may also shift the balance between the processes of reproduction and survival in seabird populations. We hypothesize that the shift in the balance between reproduction and survival is responsible for the marked decline of some seabird populations in the Gulf of Alaska. It is also well known that unpredictable events in the environment have the potential to be severely stressful in terms of increased secretion of corticosteroids. Thus circulating levels of corticosterone in seabirds indicate not only current stress state, but the pattern of secretion in response to capture and handling also provides a simple test of vulnerability of the population to stress as well. We predict that the patterns in reproduction and survival of the affected population of seabirds can be altered in two possible ways. First, low reproductive rates can result from the decreased post-fledging survival of juvenile seabirds that have experienced long-term food shortages or were fed poor quality food during their development. Second, the post-breeding survival of parent seabirds that reproduced during food shortages may be decreased.

In this study we propose to examine the possible consequences of food-related stress by measuring circulating levels of plasma corticosterone as an indicator of current and potential stress. Although the impacts of stress on behavior and physiology of individuals are potentially very important to the processes of reproduction and mortality in seabird populations, the physiological mechanisms underlying these relationships are not known. We also propose to investigate the influence of the foraging and parental behaviors altered by stress on survival and reproduction of several species of seabirds that breed in the Gulf of Alaska and have been affected by the *Exxon Valdez* oil spill. The results of EVOS-funded of 1996, 1997 and 1998 show clearly that the hormone aspects of the proposed study are effective and will be powerful indicators of current stress state and equally important, may point to populations that are vulnerable to future stress.

NEED FOR THE PROJECT

A. Statement of the Problem

Immediate and potential long-term effects of food-related stress on foraging and reproductive behavior in seabirds are not completely known. Recent declines of seabird populations in the Gulf of Alaska may be a result of a decrease in reproductive success due to an elevated mortality of food-stressed chicks after fledging, and/or the increased mortality of parents that rear their young under poor feeding conditions. Traditional field methods of assessing potential pollution-related stress on the survival and reproductive performance of seabirds may give equivocal results. Lack of knowledge of the long-term effects of pollution-related stress on physiology and behavior prevents us from developing a successful rehabilitation program for seabird populations in the areas affected by the *Exxon Valdez* oil spill. The basic problem is that we do not know the mechanisms of how and at what stage of a bird's life the effects of stress might most strongly affect survival and reproductive performance. Furthermore, we know even less about the recovery of populations from stressful episodes in their life cycles. The latter is critical if we are to implement future programs to successfully manage seabird populations.

B. Rationale

Long-term effects of pollution and stress on seabird reproductive biology are poorly known mostly because, to date, there have been no possibilities for a concurrent study of stress, survival and the monitoring of foraging conditions in seabirds. A critical concurrent assessment of variation in foraging conditions and survival of seabirds in Lower Cook Inlet will be provided by on-going projects that are designed specifically for these purposes (APEX project #00163, Restoration Project #00338). An ideal natural experiment to study effects of food stress can be conducted in Cook Inlet because seabirds at one study colony (Chisik Island) are chronically deprived of food, while seabirds at another study colony (Gull Island) have a surplus of food. From these studies, we will develop a protocol to monitor populations of seabirds at other colonies for possible effects of both natural and human-induced environmental perturbations.

B. Location

The proposed field studies will be based out of Homer, Alaska. Studies will be conducted at the colonies in Kachemak Bay, and in western Cook Inlet. Captive-rearing, learning, and foraging efficiency trials will be conducted at the University of Washington.

COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE

None for this phase of the project.

PROJECT DESIGN

We propose to investigate whether profiles of corticosterone in free-living seabirds reflect stress status and vulnerability to environmental stress, and how increased corticosterone levels affect reproduction and survival of individual seabirds. To address these questions we will investigate hypotheses and predictions on the relationships among stress physiology, behavior and reproduction in seabirds that breed in the areas affected by the *Exxon Valdez* oil spill. The first set of hypotheses states that the observed population declines are due to a decrease in post-breeding survival or reduced reproductive performances of adult seabirds that reproduce in the areas affected by the *Exxon Valdez* oil spill. In particular, parent seabirds that rear their chicks in the area affected by pollution complete the reproductive season in poorer physiological conditions and suffer greater post-breeding mortality compared with birds that rear young under favorable environmental conditions. These hypotheses predict that: (a) pollution-related stress results in chronically elevated concentrations of corticosterone in the peripheral system of parent seabirds; (b) prolonged increases in concentration of corticosterone cause reproductive failure and an increase in the post-breeding mortality. The second set of hypotheses states that the observed population declines are due to a decrease in post-fledging survival of juvenile seabirds in the areas affected by the *Exxon Valdez* oil spill. In particular, seabirds chicks that were reared in the area affected by pollution complete the reproductive season in poorer physiological conditions and suffer greater post-fledging mortality compared with young reared under favorable environmental conditions. These hypotheses predict that the recovery of seabirds from pollution or food-related stress depends on: (a) age- and species-specific responses to stress in general; (b) the degree to which individuals are stressed and how debilitated they may become by exposure to chronically high corticosterone levels; and (c) foraging conditions after exposure to stress.

Thus, our main objective is to explore the relationships among endocrinological parameters, foraging conditions and survival of seabirds that breed in the areas affected by the *Exxon Valdez* oil spill

A. Background and Preliminary Results

Decreases in the availability of food can account for the increased mortality of seabird chicks in nests. Nevertheless, a high tolerance of juvenile seabirds to intermittent or low rates of food provisioning by their parents can buffer against an immediate loss in reproductive success (Kitaysky 1996). Juvenile seabirds possess an ability to retard growth processes in response to the dietary restrictions and might fledge successfully despite severe food shortages during their development (Øyan & Anker-Nilssen 1996). Controlled experiments have shown that food-related growth retardation can account for the lower body mass and smaller body size of the young at fledging when compared to the young raised on *ad libitum* nutritional regimes (Kitaysky 1996). However, low body mass of young seabirds at fledging is not a reliable predictor of post-fledging survival (Lloyd 1979, Hedrgren 1981, Harris & Rothery, Harris et al.

1992). Potential deleterious effects of retardation in morphological development (other than effects of low body mass at fledging) on post-fledging survival of food-stressed individuals have never been studied in seabirds. Chronic stress in mammals affects hippocampal regions of the brain (Sapolsky et al. 1986) which can result in less efficient learning of new behavioral methods, e.g. foraging techniques, by stressed young. Long-term effects of food-related stress during early development in Zebra finches (*Poephila guttata*) include reduced body size and possibly lower reproductive success during the adult stage of their life (Boag 1987, Boag & Grant 1981, Zink 1983). Thus, there is a possibility that food-stress in young seabirds results in increased post-fledging mortality due to a low ability of the retarded young to learn foraging techniques and/or a reduction in their foraging efficiency.

Results of EVOS-funded studies in 1996 and 1997 revealed that the types and quantities of different forage fish available to seabird parents can affect the physiological condition of their young at fledging. Black-legged Kittiwake chicks that were raised on restricted amounts of food, or poor-quality diets (APEX Project 98163N), had significantly elevated levels of corticosterone compared to the control chicks (Kitaysky et al. in press *d;* Fig. 1). These results allowed us to establish an empirical relationship between daily energy intake and corticosterone levels in Black-legged Kittiwake chicks. We used this relationship to estimate daily energy intake of wild Black-legged Kittiwake at the Gull Island colony in 1997 (Fig. 1). The estimated values of daily energy intake were very similar to those obtained from conventional methods (growth rates, asymptotic mass), giving us confidence that secretion of corticosterone reflects the nutritional status of Black-legged Kittiwake chicks.

Results of our studies have shown that Black-legged Kittiwake and Common Murre chicks respond to a standardized stressor such as capture, handling and restraint, by increasing plasma levels of corticosterone (Fig. 2 & 3). Specifically, food-restricted Black-legged Kittiwake chicks had significantly higher stress-response compared to individuals that were fed larger quantities of food (Fig. 2). Similarly to the baseline levels of corticosterone, acute stress-induced levels of corticosterone reflected daily energy intake of Black-legged Kittiwake chicks (Fig. 2). Also, Common Murre chicks reared by their parents on the food-poor colony (Chisik Island) had higher stress-response compared to chicks on the food-rich colony (Gull Island) (Fig. 3). The increased adrenocortical response to the standardized stressor reflects poor physiological condition, in particular, depleted endogenous fat reserves, of food-stressed seabird chicks and indicates their susceptibility for further stress (Kitaysky et al. in press *d*).

Corticosterone appears to be involved in the regulation of begging behavior by young Black-legged Kittiwakes and Common Murres (Kitaysky et al., submitted *c*). An increase in begging intensity among the stressed chicks influences food-provisioning behavior of their parents, and might result in an increase in the parents' investment in foraging for the young. An increase in parental investment in current reproduction can potentially decrease post-breeding survival of parent birds and the probability of their successful reproduction in the future (e.g., Jacobsen et al. 1995, Pugesek & Diem 1990, Golet et al. 1998).

Studies of the effects of food shortages on parental behavior of seabirds have shown that the duration of the chick-rearing period may be extended if food conditions are poor (e.g., Harris & Rothery 1985, reviewed in Ydenberg 1989). Changes in food availability, for instance food shortages that follow El Niño events, did not affect growth of young seabirds suggesting that parents were able to compensate for a decrease in food availability by adjusting their efforts in chick-provisioning for the changed feeding conditions or pursuing brood reduction strategy (Shea & Ricklefs 1996). An increase in the duration of parental care and a possibility of additional investment of parent seabirds in reproduction during food shortages might lead to an increase in post-breeding mortality. For example, results of field experiments indicated that parent Atlantic puffins that were experimentally exposed to a prolonged chick-rearing period were in poor physiological condition at the end of breeding season compared to control birds (Erikstad et al. 1997). This raises a possibility that seabirds which reproduce during seasons of food shortages would suffer a greater post-breeding mortality compared to the birds that reproduce under conditions that are favorable for reproduction.

Results of our studies have shown that parent Black-legged Kittiwakes and Common Murres respond to a standardized stressor such as capture, handling and restraint, by increasing plasma levels of corticosterone (Kitaysky et al. in press *a*, and in prep.). These results indicated that the hormonal response of adult seabirds can be used to assess susceptibility to stress as might be expected during food shortages. Specifically, in 1997, when Black-legged Kittiwakes nesting on Chisik Island showed the first signs of food shortages at the egg-laying stage they also modulated their stress response compared with those of birds in the egg-laying on Gull Island colony (Fig. 6). Continued food shortages resulted in a further significant elevation of circulating baseline levels of corticosterone (Fig. 4) and a suppression of stress response in kittiwakes breeding on Chisik Island (Fig. 6). Black-legged Kittiwakes failed to produce any chicks on Chisik Island in 1997 (Piatt et al., unpublished). Using endocrinological parameters alone, it was possible to predict this failure at the egg-laying stage of their reproductive season (Kitaysky et al., in press *a*).

On the other hand, chick-rearing under favorable foraging conditions does not alter the physiological condition of parent Black-legged Kittiwakes. In particular, exposure to the standardized stressor did not indicate a significant difference in the hormonal response of birds raising young compared to those with experimentally removed chicks (Wingfield et al. in prep.). This raises a possibility that not chick-rearing *per se*, but an additional effort in foraging for the young during food shortages can alter the physiological conditions of parent Black-legged Kittiwakes and result in decreased post-breeding survival of adults. Moreover, the pattern and extent of a corticosterone increase following application of the standardized stressor allows us to assess changes in physiology of a parent in relation to its normal effort in reproduction as opposed to changes associated with food-stress (Kitaysky et al. in press *a*).

In 1997, we did not find an increase in circulating levels or a suppression of stress levels of corticosterone in breeding Common Murres at early stages of reproduction on Chisik Island compared to Gull Island (Kitaysky et al. in prep). However, we observed a rapid increase in

circulating levels of corticosterone during the chick-rearing stage, and this increase occurred earlier in the season among murres breeding on Chisik Island than on Gull Island (Fig. 5). The phenology of reproduction was similar between the colonies suggesting that, in addition to the species-specific seasonal increase of corticosterone secretion, food shortages affected the physiological condition of parent murres on Chisik Island. The experimental manipulation revealed that parent murres respond to elevation of corticosterone by fledging their young (Table 1). To verify this result, we compared the age of fledglings between Chisik and Gull Islands and found that parent murres fledged their young at earlier age at Chisik Island, where feeding conditions are poor (Fig. 7). We also manipulated the corticosterone levels in murre chicks but did not find an effect of the experimentally elevated corticosterone levels on the age of chicks at fledging (Fig. 8). Thus, parent Common Murres can avoid food-related stress during reproduction by fledging their young at an early age. Therefore, it is less likely that a population decrease of Common Murres on Chisik Island is related to high mortality of adult birds breeding under poor foraging conditions. It can, however, result from a low recruitment of young at this colony because of either low survival of chicks that left nests at an early age or a delay in reproductive maturation of young birds that experienced nutritional stress during early development. However, the effects of stress on physiological condition, foraging behavior and future survival of food-stressed murre chicks have yet to be investigated.

Overall, the results of EVOS-funded studies during 1996-1998 provide a strong background for the proposed research on the effects of food-related stress on physiological condition and reproductive behaviors of seabirds. Our findings fully justify the general assumption of the proposed research that monitoring and experimental manipulations with stress-hormones will allow us to identify and investigate the effects of the food-stress on reproductive biology of seabirds in areas affected by the *Exxon Valdez* oil spill.

B. Objectives

1. Establish whether populations at Gull and Chisik Islands are chronically stressed. Determine baseline levels of corticosterone in relation to varying foraging conditions.

2. Investigate the potential for future stress in populations at Gull and Chisik Islands. Measure circulating levels of corticosterone in response to a standardized stressor: capture, handling and restraint.

3. Examine the effects of variation in daily energy intake on baseline levels of corticosterone in Common Murre chicks. Determine the effects of food-related stress on behavior, morphological development and rate of corticosterone secretion of juveniles in captivity.

4. Determine the relationship between circulating levels of corticosterone and post-breeding survival of parents at Gull and Chisik Islands. Monitor survival and reproduction of the affected individuals during subsequent reproductive seasons.

C. Methods

We will focus on the comparison of the endocrinological characteristics of seabirds breeding at Gull Island, where foraging conditions were continually good during the last few years, with those nesting under poor feeding conditions at Chisik Island.

1. Correlations among corticosterone levels, reproductive stage and varying foraging conditions.

To assess whether seabirds from the different populations are chronically stressed or not, we will determine baseline levels of corticosterone in relation to the reproductive stages, pre-incubation, incubation and chick-rearing. Adult birds will be captured at the breeding colonies by using a noose pole. We will collect a blood sample (approximately 100-150 μL) from the brachial vein of the wing immediately after capture. To determine the potential for stress in different populations we will measure circulating levels of corticosterone in response to a standardized stressor, capture, handling and restraint. For that, additional samples of blood (15-30 μL) will be collected from the same birds over a period of 1 h after capture (at 5, 10, 30 and 60 min intervals). To collect blood samples from chicks we will use similar methods as for adult birds, except that the first sample will be smaller (30-50 μL).

The results of our pilot study indicate that a sample size of N>7 (per each group of birds) was sufficient to detect significant inter- and intra-specific differences in baseline concentrations of corticosterone in adult birds and juveniles (Figures 1-6). Therefore, approximately 7-10 adult birds and chicks will be sampled at each colony at every stage of the reproductive period (total 25-30 birds of each species per colony/year). After sampling, adult birds will be released at the colony and chicks returned to their nests. Previous field and captive studies indicate that taking blood does not affect the long-term physiological condition or behavior of birds (J. Wingfield, personal observations). In 1996, 1997 and 1998, Black-legged Kittiwakes and Common Murres released after bleeding at Gull Island and Chisik Island were sighted at their nests within 1-10 min period. Similarly, bleeding captive seabird chicks does not appear to affect their behavior or development (A. Kitaysky and M. Romano, personal observations).

2. Captive study of the effects of food-related stress.

To test whether the food/pollution-related stress affects behavior, morphological development and physiological condition of young seabirds, we will raise Common Murre chicks on three different nutritional regimes in captivity. For the experimental treatments (15 chicks per each treatment) we will use the methods described by Romano and co-authors (Romano et al., unpublished; Kitaysky et al. in press *d*) where either quantity and quality of the chick diets will be altered or a supply of mineral oil will be given to chicks with food. In particular, one group of young will be raised on reduced quantities of the high quality food (sandlance, *Ammodytes hexapterus*, and capelin, *Mallotus villosus,* or herring, *Clupea harengus*). Chicks from the second experimental treatment will be raised on sufficient amounts of food of poor quality

(juvenile pollock, *Theragra chalcograma*). Chicks from the control group will be raised on the food of high and poor quality given *ad libitum*.

To assess whether the food/pollution stress affects the physiological condition of Pigeon Guillemot chicks, this component of the study will be coordinated with a study of captive Pigeon Guillemot chicks at the Alaska Sealife Center (Restoration Project #00327).

3. Correlations among corticosterone levels, foraging conditions and postbreeding survival.

To determine the relationship between variation in circulating levels of corticosterone and post-breeding survival of parents at Gull and Chisik Islands we will monitor hormonal levels (as described above), survival and reproduction of the affected individuals during subsequent reproductive seasons. This component of the study will be coordinated with EVOS-funded project (Restoration Project #00338) that is specifically designed to address the issue of survival of adult murres and kittiwakes in relation to foraging condition. We anticipate that a sample size of 200 individuals of each species (as proposed in Restoration Project #00338), would allow us to make a conclusive statement about the relationships between stress and survival in Black-legged Kittiwakes and Common Murres in Lower Cook Inlet.

4. Laboratory analyses.

In parallel to the field and captive research we will conduct the laboratory analyses of blood samples taken from the birds during the experimental manipulations. All blood samples will be taken from the brachial vein of the wing, blood plasma will be separated from blood cells and then frozen at –10°C. All plasma samples will be transported to the laboratory at the University of Washington and processed according to the radio-immuno assay techniques (see Wingfield et al. 1991 for the details).

D. Contracts and Other Agency Assistance

The field and captive experiments, and laboratory analyses will be carried out by Dr. Alexander Kitaysky, a research associate in the Zoology Department at University of Washington, Seattle, with the aid of one full-time assistant and one field assistant. Dr. John Piatt of the US Geological Survey will serve as field supervisor, providing logistical support and hiring the assistant and volunteers. Radio-immuno assay analyses of blood samples collected during the proposed research will be conducted in Dr. Wingfield's laboratory at UW. Dr. Wingfield will provide the supervision of laboratory analyses, and provide logistical support.

SCHEDULE

A. Project Tasks for FY 00 (October 1, 1999 - September 30, 2000)

January-April:	preparation for field work, hiring personnel
February:	Annual Report on FY 99 results
May-June:	blood sampling during pre-incubation stage, setting study plots for the experimental work
July:	blood sampling during incubation stage, study plot monitoring
August:	blood sampling during chick-rearing stage, colony work: implanting birds with the hormonal implants, monitoring parental feeding rates and chick survival
July-October:	chick-rearing in captivity at the University of Washington
FY01:	lab analyses, data analyses, reports, etc.

B. Project Milestones and Endpoints

The ultimate goals of this study are (*i*) to assess whether or not populations of seabirds breeding in Lower Cook Inlet are chronically stressed; (*ii*) to quantify potential for stress at different stages of a bird's life-cycle under varying foraging conditions; (*iii*) to develop a "field endocrinology" protocol to monitor populations of seabirds in different habitats for possible effects of environmental disturbance both natural and human-induced. Objectives ***i*** and ***ii*** will require at least three years of field and laboratory work to quantify the relationships between baseline levels of corticosteroids and foraging conditions before final conclusions can be made. Objective ***iii*** will be accomplished after all field and laboratory tasks are completed. .

If the objectives are achieved, it should be possible by year 2002 to evaluate current status and potential for stress at the colonies in Lower Cook Inlet. Moreover, it will reveal how effects of stress on reproduction and survival are expressed in seabird populations. This will provide the basis for management of seabird populations in the areas affected by the oil spill.

C. Completion Date

The study will be completed in December of 2002, after two reproductive seasons at the colonies in Lower Cook Inlet, laboratory analyses and sufficient time for analyses of results and preparation of manuscripts for publication.

Originally we proposed three years of captive trials on post-fledging foraging efficiency and recovery from stress at Alaska SeaLife Center (see previous version of the proposal). We will further explore the possibility of using the facilities of Alaska SeaLife Center for a study of recovery from stress. Meanwhile, the captive experiments will be conducted at the University of Washington.

PUBLICATIONS AND REPORTS

February 15, 2000:	Annual report on work accomplished in summer-fall period of 1999, and preliminary results.
February 15, 2001:	Annual report on work accomplished in summer-fall period of 2000, extensive analyses of results and preliminary conclusions.
February 15, 2002:	Annual report on work accomplished in summer-fall period of 2001, and preliminary results.
September 30, 2002:	Final report on work accomplished and results obtained, 1998-2002.

We also plan to publish interim and final results of this study in conference proceedings and scientific journals. Note that results of our studies in 1996 and 1997 are already in press or submitted to peer-reviewed journals for publication.

NORMAL AGENCY MANAGEMENT

None of the proposed research described here would normally be conducted by the USGS.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

This study addresses a number of questions related to conservation and management of Alaskan seabirds. The proposed research will be coordinated with on-going projects being supported by the Exxon Valdez Oil Spill Trustee Council and US Geological Survey.

EXPLANATION OF CHANGES IN CONTINUING PROJECTS

The design of the proposed work has not changed, and the budget is the same as that originally proposed and accepted by the EVOSTC in FY98.

PRINCIPAL INVESTIGATORS

Principal Investigator and Project Leader - Dr. Alexander S. Kitaysky, Research Associate with the University of Washington, Seattle. Obtained a Ph.D. in Ecology and Evolutionary Biology from University of California in 1996 (dissertation on behavioral, physiological and reproductive responses of seabirds to environmental variability). Since 1986, studied seabird behavior and physiology at colonies in Okhotsk Sea and on the Aleutian Islands, and foraging behavior of seabirds at sea in Bering Sea, Aleutian Islands and in Gulf of Alaska.

Dr. John F. Piatt (Research Biologist GS-14, Alaska Biological Science Center, USGS, Anchorage, AK) obtained a Ph.D. in Marine Biology from Memorial University of Newfoundland in 1987. His dissertation involved seabird-forage fish interactions. Since 1987, he has studied seabirds both at colonies and at sea in the Gulf of Alaska, Aleutian Islands, and Bering and Chukchi seas. His is an author on over 75 peer-reviewed scientific publications about seabirds, fish, marine mammals, and effects of oil pollution on marine birds.

OTHER KEY PERSONNEL

Professor John Wingfield (University of Washington, Seattle). Financial and logistic support for laboratory analyses in his lab at UW. He is an author on over 250 scientific publications. Prof. Wingfield is Chair of the Zoology Department at UW and an internationally recognized leader in the field of avian endocrinology.

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Kitaysky A.S., J.C. Wingfield, and J.F. Piatt. (*c*) Corticosterone facilitates begging and affects resource allocation in the Black-legged Kittiwake. Submitted to *Behavioral Ecology.*

Kitaysky A.S., J.F. Piatt, J.C. Wingfield, and M. Romano. (*d*) The adrenocortical stress-response of Black-legged Kittiwake chicks in relation to dietary restriction. *J. of Comparative Physiology B*, in press.

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Table 1. Behavioral response of parent Common Murres to an experimental increase in circulating levels of corticosterone. At the experimental nests (n=6, chick age = 13.5 (SD=2.51) days after hatching) parents were implanted subcutaneously with two 25 mm silicon tubes filled with the cristallized cotricosterone, parents at the control nests (n=6, mean chick age = 13.0 (SD=2.45) days after hatching) were implanted with empty tubes. Direct observations (during two days between 7 a.m. and 21 p.m.) were carried out 24 hours after the implantation. By that time, implanted parents fledged their chicks, whereas most of controls stayed with their chicks at the colony (difference between the treatments is statistically significant: $\chi^2 = 8.57$, p=0.003).

Experimental treatment	Behavioral response of parents	
	Fledged their chicks	Stayed at the nest with chicks
Controls	1*	5
Implanted	6	0

* - number of nests where parents were manipulated.

Figure 1. Black-legged Kittiwake chicks that were raised on restricted diets (low lipids to proteins ratio, Romano M., unpublished data), had significantly elevated baseline levels of corticosterone (open circles, mean ± SE). Analysis of covariance with the diet composition as a factor and the energy intake as a covariate has shown significant effects of both, diet composition ($F_{2,39}$=3.38, p=0.04, not shown) and energy intake ($F_{1,39}$=28.77, p<0.001). Solid circle shows baseline plasma concetrations of corticosterone of wild Black-legged Kittiwake chicks at Gull Island in 1997. According to the observed levels of corticosterone, daily energy intake of wild chicks were ca. ~530 kJ day^{-1}, which was similar to actually recorded values (Piatt J.F., unpublished data). Data from Kitaysky et al. in press *a*.

Figure 2. Comparison of stress response to the standardized stressor (capture, handling and restraint) among food-restricted (solid circles), well fed (open circles) and wild Black-legged Kittiwake chicks (squares). Data from Kitaysky et al. in press *a*.

Figure 3. Comparison of stress response to the standardized stressor (capture, handling and restraint) among Common Murre chicks reared by their parents at food-poor (Chisik I.) and food-rich (Gull I.) colonies in 1997.

Figure 4. In 1997, baseline levels of corticosterone were significantly elevated in kittiwakes breeding at Chisik Island (poor foraging conditions) compared to those of birds breeding at Gull Island (favorable foraging conditions) (colony effect: $F_{1,55}$=13.24, p=0.001).

Figure 5. In 1997, increase in baseline levels of corticosterone occurred earlier in Common murres breeding at Chisik Island that in those at Gull Island (mean ± SE).

Figure 6. Comparison of stress response to handling between Black-legged Kittiwakes breeding under poor foraging conditions at Chisik Island (solid circles and bars represent mean ± SE, sample sizes are 7 and 7 individuals in the egg-laying and chick-rearing stages, respectively) and under favorable conditions at Gull Island (open circles, n=10 and n=8 in the egg-laying and chick-rearing stages, respectively). At Chisik Island, breeding kittiwakes modulated their response to a standardized acute stressor compared to those of birds at Gull Island (repeated measures ANOVA, time after capture x colony effect: $F_{4,112}$=6.64, p<0.001). Data from Kitaysky et al. in press *d*.

Figure 7. In 1997, Common murre chicks were fledging at a younger age at the food-poor colony on Chisik Island compared to food-rich colony on Gull Island (mean ± SE).

Figure 8. The experimental increase in circulating levels of corticosterone does not change a duration of chick development in the nest in the Common Murre (mean ± SE). Experimental chicks were implanted subcutaneously with one silicon 25 mm tube filled with the crystallized hormone. Controls were implanted with empty tubes.

Figure 1. Effects of food-restriction on baseline levels of corticosterone in captive Black-legged Kittiwake chick

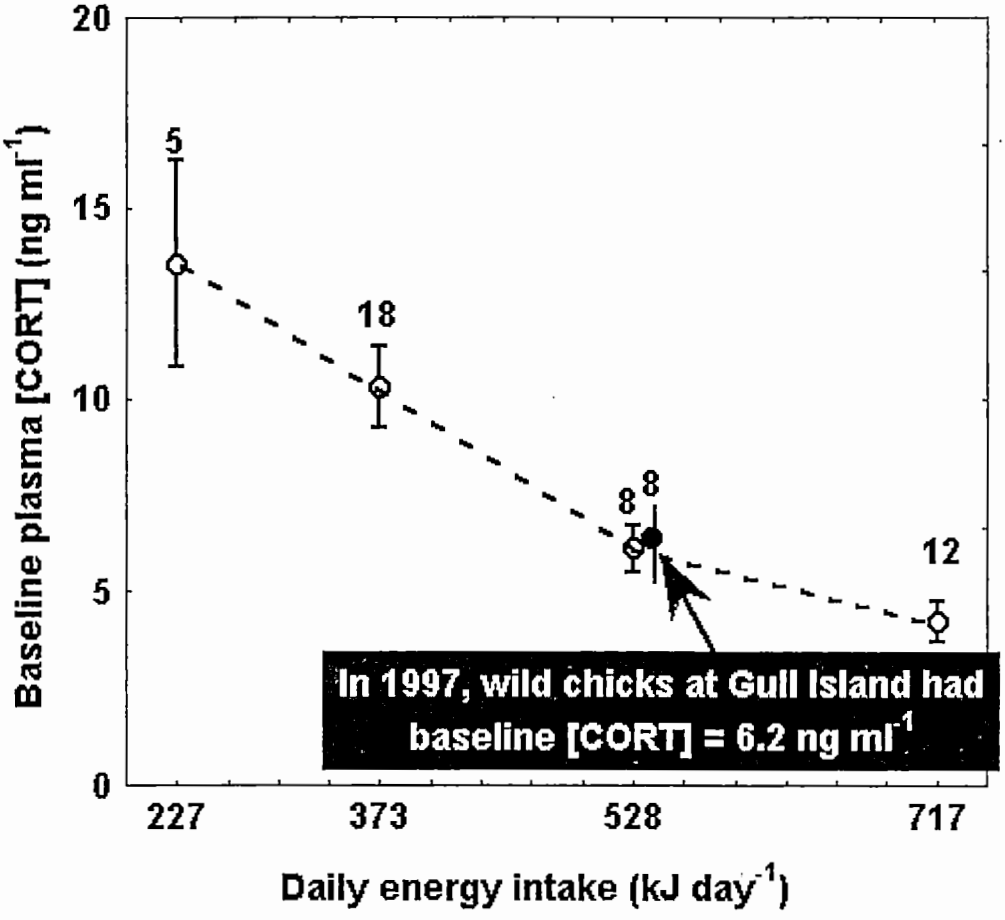


Figure 2. Adrenocortical response to a standardized acute stressor in food-restricted captive and wild kittiwake chicks

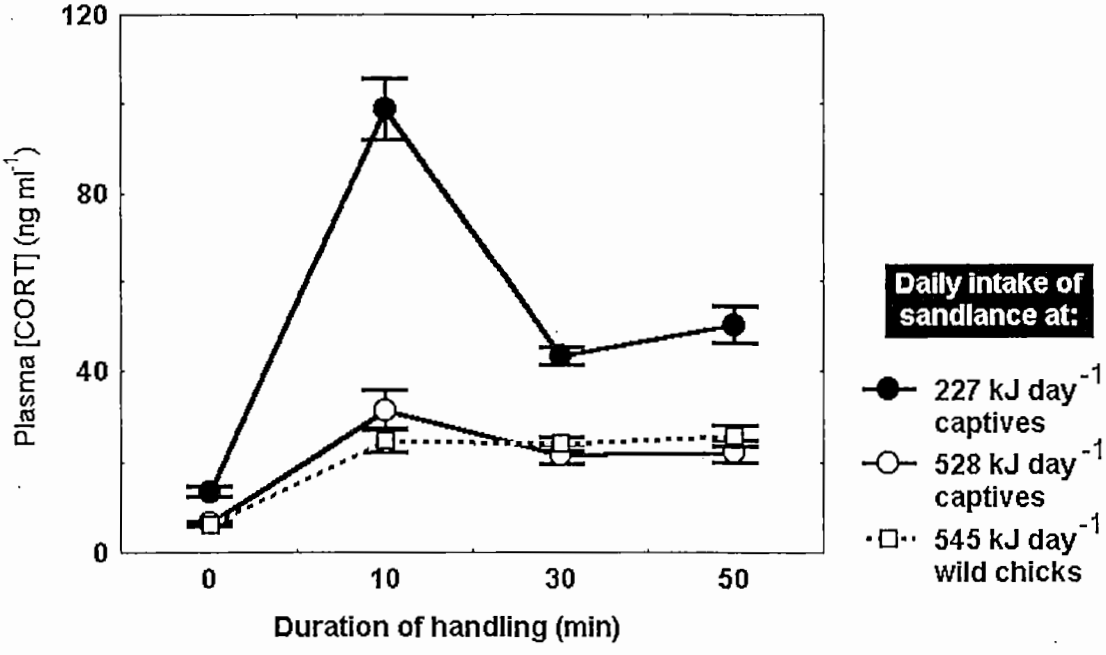


Figure 3. Adrenocortical response to a standardized acute stressor in Common Murre chicks on food-poor (Chisik I.) and food-rich (Gull I.) colonies in 1997

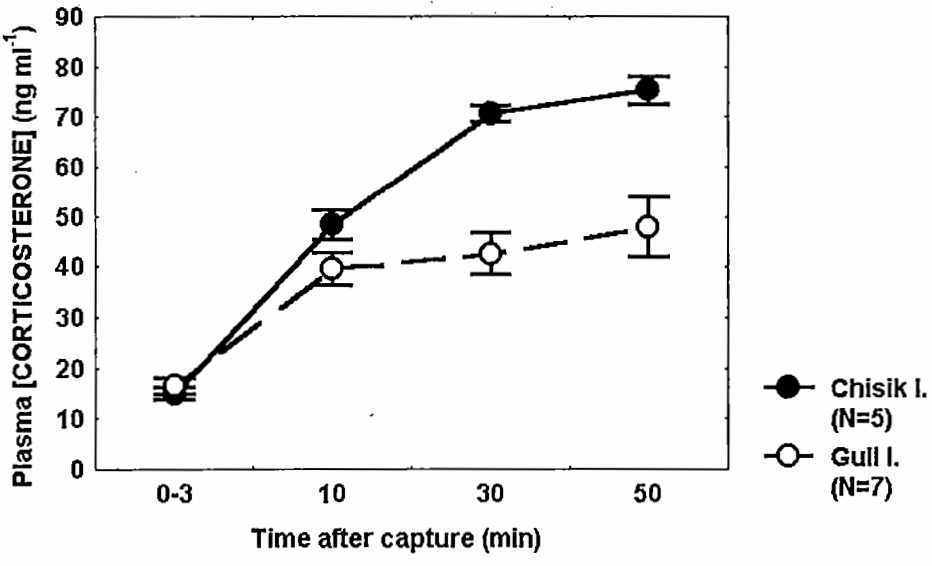


Figure 4. Seasonal dynamics of baseline plasma corticosterone in adult Black-legged kittiwakes breeding on food-poor (Chisik I.) and food-rich (Gull I.) colonies

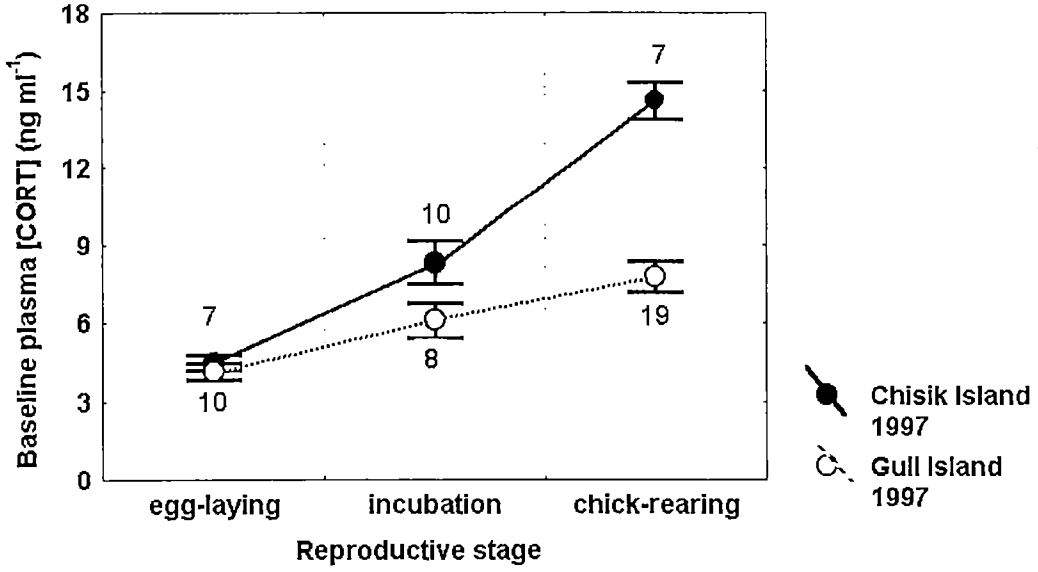


Figure 5. Seasonal dynamics of baseline plasma corticosterone in adult Common Murres breeding on food-poor (Chisik I.) and food-rich (Gull I.) colonies

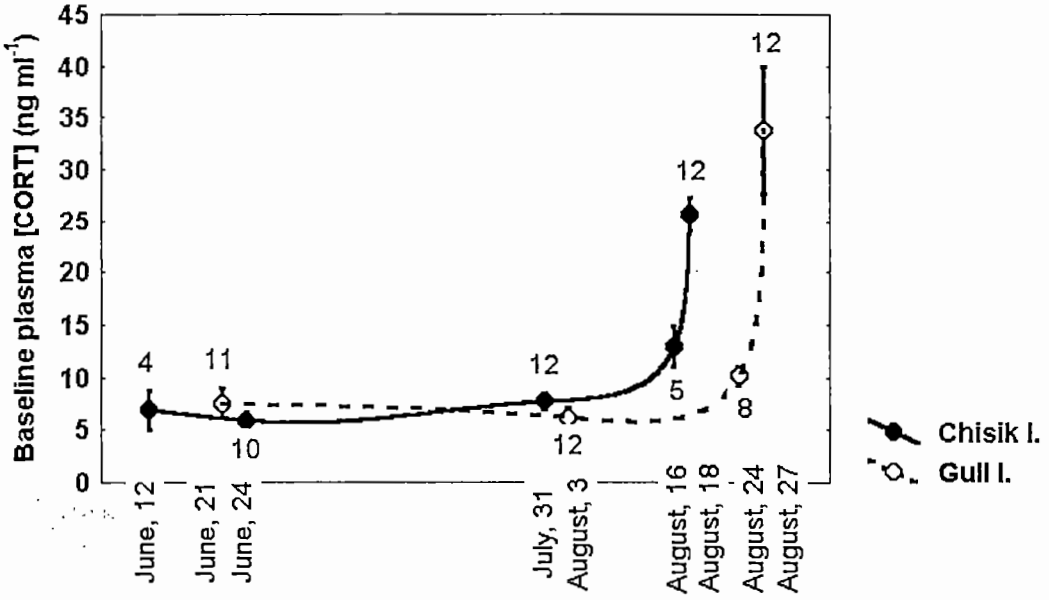


Figure 6. Adrenocortical response to a standardized stressor of adult Black-legged kittiwakes breeding on food-poor (Chisik I.) and food-rich (Gull I.) colonies in 1997

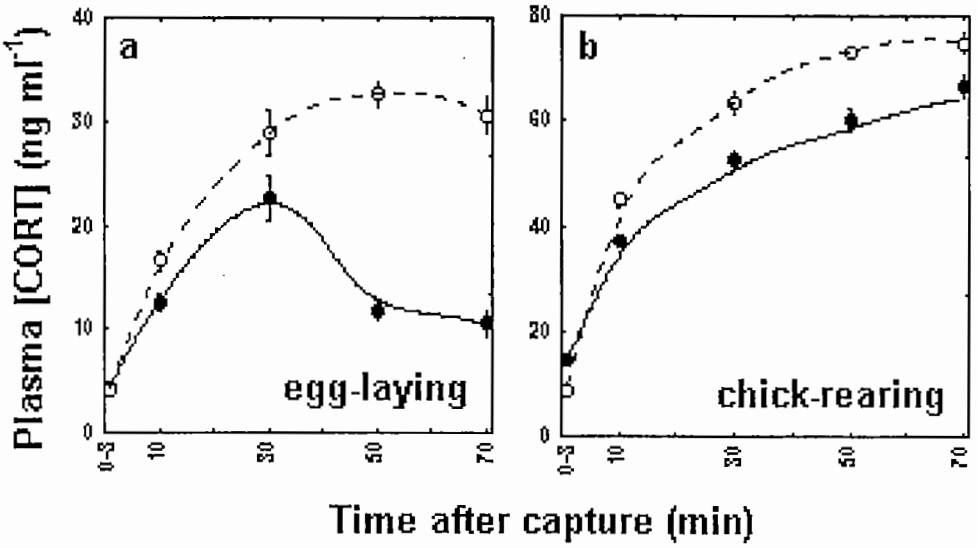


Figure 7

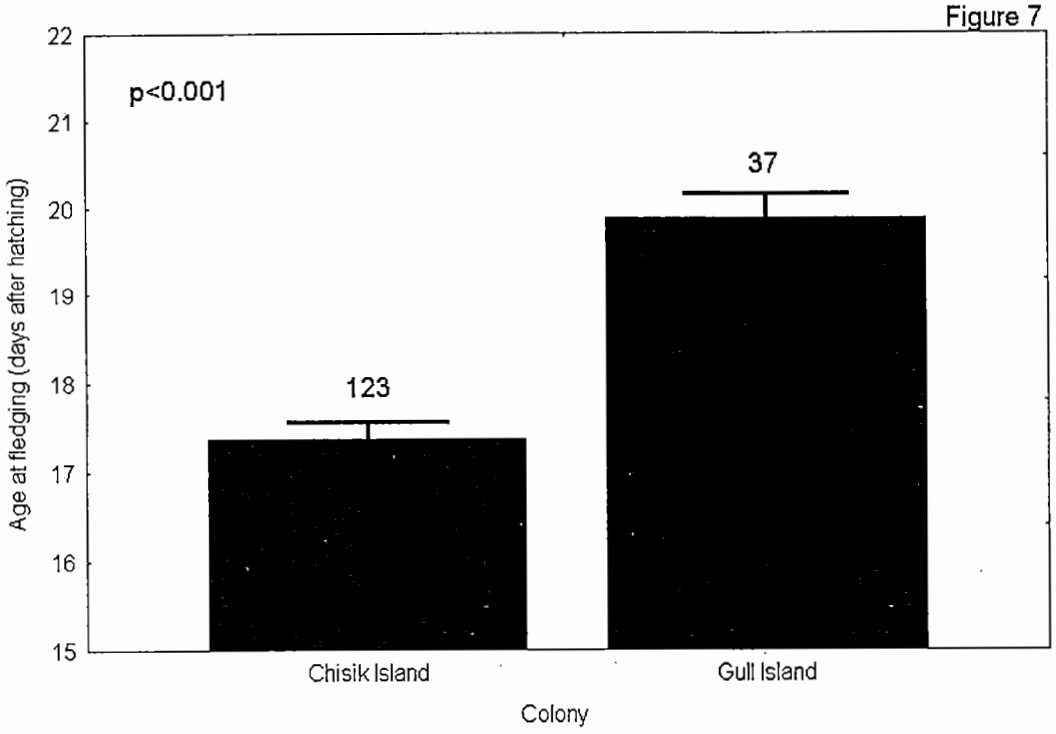
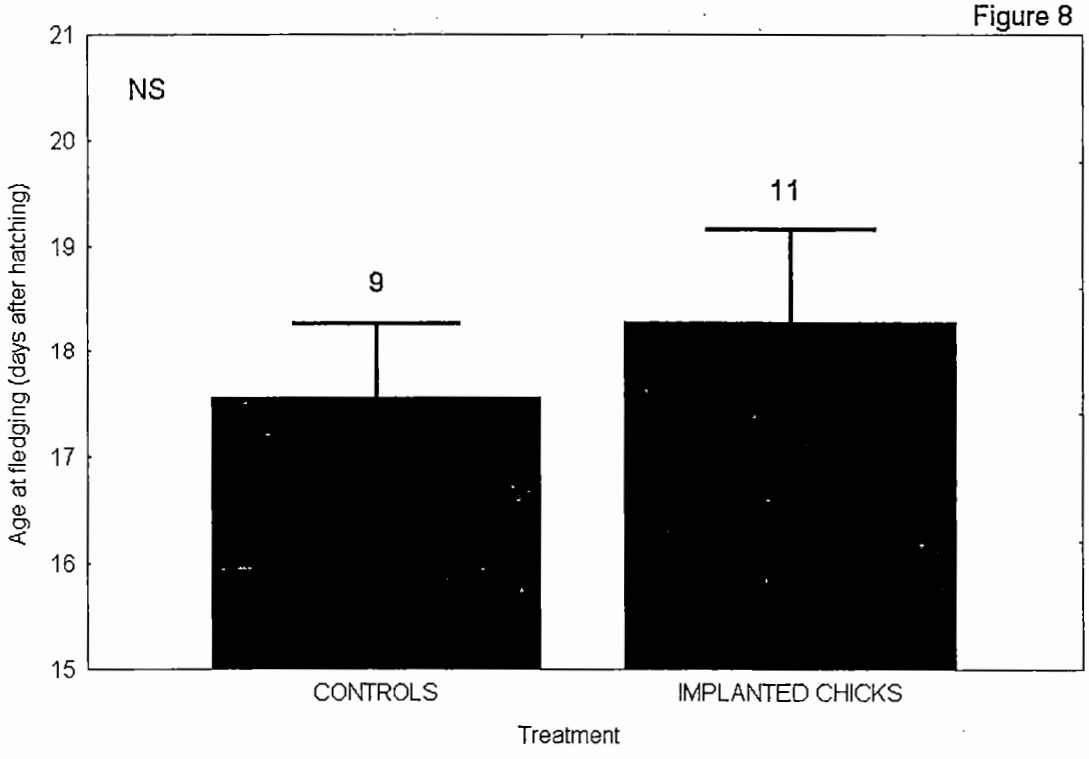

p<0.001
37
123
Age at fledging (days after hatching)
22
21
20
19
18
17
16
15
Chisik Island
Gull Island
Colony

Figure 8


NS
21
20
19
18
17
16
15
Age at fledging (days after hatching)
9
11
CONTROLS
IMPLANTED CHICKS
Treatment

2000 EXXON VALDEZ TRU : COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 2000

Budget Category:	Authorized FY 1999	Proposed FY 2000						
Personnel		$12.4						
Travel		$2.4						
Contractual		$90.0						
Commodities		$5.2						
Equipment		$7.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	$80,000.0	$117.0			Estimated FY 2001	Estimated FY 2002		
General Administration	$4,700.0	$8.2						
Project Total	$84,700.0	$125.2			$129.6	$75.0		
Full-time Equivalents (FTE)		0.3						
			Dollar amounts are shown in thousands of dollars.					
Other Resources								

Comments:

FY00

Prepared: 4/11/99

Project Number: 00479
Project Title: Effects of food stress on survival and reproductive performance of seabirds
Agency: U.S. Geological Survey

FORM 3A
TRUSTEE
AGENCY
SUMMARY

2000 EXXON VALDEZ TRU COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 2000

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 2000
Vacant	Biotech	GS-7	4.0	3.1		12.4
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		4.0	3.1	0.0	
					Personnel Total	$12.4

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 2000
Seattle-Anc	0.8	2			1.6
Anc-Homer	0.2	4			0.8
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$2.4

FY00

Prepared:

Project Number: 00479
Project Title: Effects of food stress on survival and reproductive performance of seabirds
Agency: U.S. Geological Survey

FORM 3B
Personnel
& Travel
DETAIL

2000 EXXON VALDEZ TRU COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 2000

Contractual Costs:	Proposed FY 2000
Description	
University of Washington Research Work Order	
Post-doc Salary + Benefits + GA= 65K	65.0
Lab Assistant	25.0
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$90.0

Commodities Costs:	Proposed FY 2000
Description	
Food	1.5
Fuel	1.5
Misc. field supplies	1.0
Fish for seabird growth expts	1.2
Commodities Total	$5.2

FY00

Prepared:

Project Number: 00479
Project Title: Effects of food stress on survival and reproductive performance of seabirds
Agency: U.S. Geological Survey

FORM 3B
Contractual & Commodities DETAIL

New Equipment Purchases:	Number of Units	Unit Price	Proposed FY 2000
Misc Scientific field supplies			1.0
Laboratory supplies for Radio-immunoassay			6.0
Those purchases associated with replacement equipment should be indicated by placement of an R.		**New Equipment Total**	$7.0

Existing Equipment Usage:	Number of Units	Inventory Agency
All boat, lodging, field laboratory, and logistic support provided by APEX project 98163M (Cook Inlet Seabirds). Equivalent value of about 25K.		
University of Washington, research laboratory of Dr. John Wingfield. Equivalent value of complete laboratory support including supplies for radio-immunoassy (above) is about 40K		

FY00

Prepared:

Project Number: 00479
Project Title: Effects of food stress on survival and reproductive performance of seabirds
Agency: U.S. Geological Survey

FORM 3B
Equipment
DETAIL

PROPOSAL FOR A DOCUMENTARY FILM ON THE SUBSISTENCE USE OF INTERTIDAL RESOURCES, INCLUDING MUSSELS, CLAMS, CHITONS, AND OCTOPUS, IN PRINCE WILLIAM SOUND

Project Number:	00481
Restoration Category:	Subsistence Restoration
Proposer:	Chenega Bay Village IRA Council
Lead Trustee Agency:	Alaska Department of Fish and Game
Alaska SeaLife Center:	
Duration:	1st year, 1 year project
Cost FY 00:	$93.1
Cost FY 01:	0.0
Cost FY 02:	0.0
Geographic Area:	Prince William Sound
Injured Resource/Service:	Clams, intertidal communities, and subsistence

ABSTRACT

The purpose of this project is to produce a 28 minute documentary film on the subsistence use of intertidal resources in Prince William Sound, including mussels, clams, chitons, and octopus. In the harbor seal documentary (Restoration Project 96214) Tatitlek residents discussed their view of the relationship between the *Exxon Valdez* oil spill, Pacific herring populations, harbor seal populations and their ability to continue subsistence activities. This was followed by the herring and nearshore documentary (Restoration Project 98274), in which Tatitlek residents expanded on the discussion by documenting their use of herring and nearshore resources, including the ecological and biological knowledge people use to harvest those resources. The proposed documentary would build on the previous documentaries, focusing on the use of the resources in the intertidal, the area hardest hit by oil, and broaden the discussion by bring in the perspective of the residents of Chenega Bay, the first community directly in the path of the spilled oil.

INTRODUCTION

INTRODUCTION

Subsistence uses of natural resources are essential to the economies and cultures of the communities in the oil spill region. In FY 96, the Trustee Council provided funding (96214) to produce a documentary on subsistence harbor seal hunting in Prince William Sound. The project was proposed by the village of Tatitlek, which depends heavily on subsistence harvests of harbor seal, Pacific herring and other marine resources. When first proposed, it was the intention of the Tatitlek Village Council and the Department of Fish and Game, Division of Subsistence to produce a series of films that would cover each species effected by the oil spill. Two Tatitlek documentaries have been produced, the first on harbor seals, the second on herring and nearshore resources. The current proposal has been submitted by the village of Chenega Bay to obtain funding to produce a film on the subsistence uses of intertidal resources in Prince William Sound.

NEED FOR THE PROJECT

A. Statement of Problem

The injured service this project addresses is subsistence. The injured resources are intertidal communities, including mussels, clams, chitons, and octopus. Prior to the oil spill, the intertidal in Prince William Sound provided fresh, easily accessible sea food during the winter months. A favorite saying among residents of Chenega was, "When the tide is out, the table is set."

The intertidal zone was the hardest hit by the oil, especially in the shellfish harvesting areas around Chenega Bay. The oil penetrated sandy beaches, to depths of as much as four feet in some areas. On rocky beaches, the oil formed pools and oozed into pockets and crevices. Intertidal resources on some of the beaches with heaviest oiling were smothered. The more aggressive attempts to remove the oil, such as high-pressure, hot water washing, also killed animals in the intertidal. The effects of the use of chemicals, such as Inipol, in the intertidal raised questions for subsistence users that have never been answered to their satisfaction. These impacts to the intertidal zone disrupted harvest activities and created concerns about the safety of the resources. These concerns led people to look at the resources much more carefully. The residents of the Prince William Sound villages were the first to note changes in the composition of the intertidal communities in the wake of the spill, and the first to note the slowed growth of intertidal bivalves. The observation of small white lesions on chitons in 1991 increased residents concerns about using intertidal resources.

This project will provide the residents of Chenega Bay an opportunity to be a part of the effort to help in the recovery of intertidal resources, and in so doing, put them in contact with researchers and information about these critical resources. It is the hope of the community that their knowledge of these resources, and their view about the importance of subsistence, will be communicated through the film to the Trustee Council, to scientists, and to the general public.

B. Rationale/Link to Restoration

The EVOS Restoration Plan: Update on Injured Resources and Services, March 1999, lists intertidal communities and clams as injured and recovering, but not recovered.

The restoration objective for subsistence states that recovery will have occurred when " the cultural values provided by gathering, preparing, and sharing foods are integrated into community life" (p.82). One strategy to meet this objective is to "facilitate the participation of and communication with subsistence users in the restoration process" (p.86). Continuing concern about the safety of intertidal resources from beaches near Chenega Bay, where oil contamination has persisted, has greatly affected subsistence harvesting, resulting in lost opportunities to teach subsistence skills and traditional knowledge associated with these resources. One means of preserving these skills and knowledge, and ensuring they are transmitted to the next generation is to document them on film. This is also a good strategy for integrating local and traditional knowledge into on-going restoration efforts.

The intent of this project is to contribute to the restoration of intertidal resources and subsistence uses by providing a medium for harvesters to transmit their knowledge and observations, gained from years of experience, to the scientific community. Currently no other medium exists that presents harvesters' knowledge within its own contextual framework. Producing this video will help fill this void and enhance the restoration of Pacific herring and nearshore resources by providing a harvester's perspective on intertidal communities and oil spill impacts. As such, this project will contribute to various restoration strategies including: Sound Ecosystem Assessment; the Enhancement of Subsistence Resources; and Increase Involvement of Subsistence Users in the Restoration Process.

C. Location

Filming will take place in Chenega Bay and other locations in Prince William Sound.

COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE

This project was is being proposed by the Chenega Bay Village IRA Council. A subcontract will ensure community involvement in the production of the film. The village council and Council President, Gail Evanoff, will be involved in selecting a contractor for the film and in decisions concerning the content of the film.

PROJECT DESIGN

A. Objectives

The overall objective of this project is to promote the recovery of injured intertidal communities and their subsistence use through the production of a documentary on the subsistence uses of these resources in Prince William Sound. This includes harvesting techniques, methods of processing, the distribution of resources and the traditional knowledge employed in the harvest of intertidal resources.

B. Methods

A twenty-eight (28) minute documentary film will be produced through a professional services contract. The film will document the subsistence harvest of intertidal resources in Prince William Sound, focusing primarily on the village of Chenega Bay. A film crew will visit the village for two weeks in April and May of 2000 to document the harvest and distribution intertidal resources. Interviews will be conducted with a wide spectrum of the community to gather traditional knowledge and views about the importance of these resources and subsistence to the community. A subcontract within the contract will support community involvement. In February 2001, the documentary will be presented in public screenings in Chenega Bay and Anchorage, and distributed to oil spill affected communities, libraries, Alaska Native organizations, and state and federal agencies.

C. Cooperating Agencies, Contracts, and Other Agency Assistance

The production and post production work on the film will be contracted out to an experienced film maker who has the expertise to make a quality film. In contracting out for this production, the proposers will seek a contractor who will create and produce the product rather, than sub-contracting for creative talent. By hiring a video production company, the proposers will maintain control over all aspects of the process. In consultation with the community and ADF&G staff the video production company will create a story line before shooting the film. All footage will be shot on location and include interviews with members of the community and footage of harvesters. Once the film is completed, the production company will edit the footage using digital state of the art editing equipment.

SCHEDULE

A. Measurable Project Tasks for FY 98 (October 1, 1999-September 30, 2000)

October 1, 1999:	Project Approval
October - November 1999:	Develop contract guidelines, evaluate bids, award contract.
December 1999 - March 2000:	In consultation with harvesters and ADF&G staff, contractor will develop story line for film.
April-May 2000:	Travel to Chenega Bay and Prince William Sound to film harvesting footage.
June-November 2000:	Edit film.

December 2000:	Contractor will provide completed film and deliver 100 copies.
February 2000	Public screenings of documentary in Chenega Bay and Anchorage.

A. Project Milestones and Endpoints

October 1999:	Project Approval.
November 1999:	Contract Awarded.
March 2000:	Storyline completed.
May 2000:	Filming ends.
June 2000:	Editing begins.
November 2000:	Editing completed.
December 2000:	Completed film delivered.
February 2000:	Film screened and distributed.

A. Completion Date

December 2000

PUBLICATION AND REPORTS

The film will be widely distributed to federal and state agencies, non-governmental agencies, and interested parties. Showings will take place in Chenega Bay, and Anchorage.

PROFESSIONAL CONFERENCES

The film may be shown at professional conferences.

NORMAL AGENCY MANAGEMENT

This project does not fall under existing statute or regulation governing the activities of the Alaska Department of Fish and Game, Division of Subsistence.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

This project will contribute to various restoration strategies including: Sound Ecosystem Assessment; the Enhancement of Subsistence Resources; and Increase Involvement of Subsistence Users in the Restoration Process.

PROPOSED PRINCIPAL INVESTIGATOR

Gail Evanoff, President

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Rita A. Miraglia
Subsistence Resource Specialist III
Alaska Department of Fish and Game
Division of Subsistence
333 Raspberry Road
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PROJECT PERSONNEL

Gail Evanoff
Mrs. Evanoff was involved in the effort to get the community of Chenega reestablished and Chenega Bay has been her primary home since 1983. She was the primary spokesperson for the community during the initial response to the *Exxon Valdez* oil spill, she coordinated the local beach treatment efforts, represented her community on the Oil Spill Health Task Force, and has served as the EVOS community facilitator for Chenega Bay. She is currently president of the Chenega Bay Village IRA Council.

Rita Miraglia
Ms Miraglia has served as the oil spill coordinator for the Division of Subsistence since 1990. As such, she organized and participated in the subsistence resource collection and testing programs of 1990 and 1991, and participated in the community based subsistence restoration planning process, begun in 1994. She served as the Division's primary liaison with the Oil Spill Health Task Force, and was the lead communicator of restoration study findings to communities in the oil spill impact area through community meetings and newsletters. Ms Miraglia has a Masters degree in Anthropology from the State University of New York. Before coming to the Division, she worked for Chugach Alaska Corporation. As a member of CAC's Oil Spill Response Team, Ms Miraglia sat on the Interagency Shoreline Clean-up Committee in Valdez in 1989, and the Cultural Technical Advisory Group in 1990, working to ensure that the concerns of the predominantly Alaska Native communities and Native regional organizations were considered in the oil spill response.

2000 EXXON VALDEZ TRUS :OUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 2000

Budget Category:	Authorized FY 1999	Proposed FY 2000
Personnel		$14.3
Travel		$1.8
Contractual		$70.0
Commodities		$0.0
Equipment		$0.0
Subtotal	$0.0	$86.1
General Administration		$7.0
Project Total	$0.0	$93.1
Full-time Equivalents (FTE)		0.2
Other Resources		

LONG RANGE FUNDING REQUIREMENTS					
		Estimated FY 2001	Estimated FY 2002		
		$0.0	$0.0		

Dollar amounts are shown in thousands of dollars.

Comments:

FY00

Prepared: 4-12-99

Project Number: 00481
Project Title: Intertidal Documentary
Agency: Alaska Department of Fish and Game

FORM 3A
TRUSTEE
AGENCY
SUMMARY

2000 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1999 - September 30, 2000

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 2000
Rita A. Miraglia	Subsistence Resource Specialist III	18E	2.5	5.7		14.3
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		2.5	5.7	0.0	
					Personnel Total	$14.3

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 2000
Two round trips to Chenega Bay and Prince William Sound	0.4	2	10	0.1	1.8
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$1.8

FY00

Prepared: -99

Project Number: 00481
Project Title: Intertidal Documentary
Agency: Alaska Department of Fish and Game

FORM 3B
Personnel
& Travel
DETAIL

2000 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1999 - September 30, 2000

Contractual Costs:	Proposed FY 2000
Description	
Chenega Bay Village IRA Council (for local logistical support, boats, fuel)	10.0
The Alaska Department of Fish and Game will develop a request for proposals for a documentary film maker. (described under Methods on page 4 of detailed project description)	60.0
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$70.0

Commodities Costs:	Proposed FY 2000
Description	
Commodities Total	$0.0

FY00

Prepared: 4-12-99

Project Number: 00481
Project Title: Intertidal Documentary
Agency: Alaska Department of Fish and Game

FORM 3B
Contractual & Commodities DETAIL

2000 EXXON VALDEZ TRUS COUNCIL PROJECT BUDGET
October 1, 1999 - September 30, 2000

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

FY00

Prepared: 4-12-99

Project Number: 00481
Project Title: Intertidal Documentary
Agency: Alaska Department of Fish and Game

FORM 3B
Equipment
DETAIL