19.09.02 (7 of 12)

PROPOSAL FOR A DOCUMENTARY FILM COMPARING AND CONTRASTING *EXXON VALDEZ* OIL SPILL IMPACTS ON THE SUBSISTENCE USE OF INTERTIDAL RESOURCES, INCLUDING MUSSELS, CLAMS, CHITONS, AND OCTOPUS, IN THE COMMUNITIES OF CHENEGA BAY IN PRINCE WILLIAM SOUND, AND OUZINKIE ON KODIAK ISLAND

Project Number:	01481
Restoration Category:	Subsistence Restoration
Proposers:	Ouzinkie Tribal Council and Chenega Bay Village IRA Council
Lead Trustee Agency:	Alaska Department of Fish and Game
Alaska SeaLife Center:	
Duration:	second year of 2 year project
Cost FY 00:	$8.6
Cost FY 01:	$111.8
Cost FY 02:	00
Geographic Area:	Prince William Sound, Kodiak Island, Spruce Island
Injured Resource/Service:	Clams, intertidal communities, and subsistence

ABSTRACT

The purpose of this project is to produce a roughly 28 minute long documentary film on *Exxon Valdez* oil spill impacts on the subsistence use of intertidal resources, including mussels, clams, chitons, and octopus, by residents of two predominantly Alaska Native communities; Chenega Bay in Prince William Sound, and Ouzinkie in the Kodiak area. The proposed documentary would build on two previous subsistence documentaries funded by the Trustee Council (Restoration Projects 96214, and 98274) and will focus 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, and Ouzinkie, the first Kodiak area community to see the oil arrive. The documentary will compare and contrast the impact the *Exxon Valdez* oil spill has had on the use of intertidal resources in each community, as well as on the on-going EVOS restoration efforts to help residents mitigate these impacts. Funding in FY 00 supported development of an RFP and awarding of a contract to produce the video. Funding for the second year supports actual video production.

INTRODUCTION

Subsistence uses of natural resources are essential to the economies and cultures of the communities in the *Exxon Valdez* oil spill region, especially in the smaller predominantly Alaska Native communities. Many of the resource species on which these communities rely, were injured by the spilled oil.

Residents of the affected communities found that it was sometimes difficult for them to communicate the importance of these resources to their way of life to decision makers involved in the EVOS restoration process. Part of the problem was that the decision makers, including the Trustees, resource managers, and government attorneys are predominantly non-Native urban-dwellers. While decision makers did make the effort to visit communities in the spill area, these visits were necessarily infrequent and brief. Community residents saw the need for a more effective means of educating decision makers about their way of life and the spill impacts to their communities.

In answer to this need, the Tatitlek Village Council proposed the production of a series of films that would cover each species effected by the *Exxon Valdez* oil spill. Since 1996, two Tatitlek documentaries have been produced, in cooperation with the Department of Fish and Game, Division of Subsistence, and funding from the EVOS Trustee Council. The first documentary was on harbor seals (restoration project 96214), the second on herring and nearshore resources (restoration project 98274). These documentaries have proven popular in the spill area communities, and have also served as an effective tool for educating outsiders about the way of life and values of the residents of Tatitlek. This has created a better understanding among decision makers of the *Exxon Valdez* oil spill impacts to Tatitlek.

While the small predominantly Alaska Native communities in the spill region do have a lot of things in common, each community is unique. By the same token, the spill impacts to each community, and the local response to those impacts varied from community to community. The Tatitlek documentaries show a community that was significantly challenged by the *Exxon Valdez* oil spill, which has substantially triumphed over those challenges and is well on its way to recovery. The communities of Ouzinkie and Chenega Bay provide a contrast to the Tatitlek story. The beaches around Chenega Bay were much more heavily oiled than those around Tatitlek, and the oiling persists in many places. Chenega Bay residents remain concerned about using resources from the intertidal in their harvest areas. Even if they chose to harvest these resources, despite their concern, the intertidal species around Chenega Bay have declined to the point where they are not available to harvest. For Chenega Bay, recovery is not yet in sight.

For the communities of the Kodiak Island area, including Ouzinkie, the aftermath of the *Exxon Valdez* oil spill has coincided with an increase in paralytic shellfish poison (PSP), a toxin found in shellfish, which can be fatal to humans when consumed. There is, at present, no easy way for subsistence users to detect the presence of PSP in their shellfish harvesting areas. Until there is, Ouzinkie residents cannot use their intertidal resources with any confidence in their safety.

The Tatitlek documentaries are valuable educational tools. However, they only show part of the picture. The proposed Chenega Bay/Ouzinkie documentary, in combination with

the Tatitlek documentaries, will provide a more balanced view of the range of *Exxon Valdez* oil spill impacts to the small predominantly Alaska Native communities in the spill impact area, as well as the range of local responses to these impacts. The stories of Ouzinkie and Chenega Bay must also be told.

The current proposal has been submitted by the villages of Ouzinkie and Chenega Bay to obtain funding to produce a film on the subsistence uses of intertidal resources in the Kodiak area and 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 *Exxon Valdez* oil spill, the intertidal in Prince William Sound, and Kodiak and Spruce Islands provided fresh, easily accessible sea food all year round. 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. In the southwestern part of Prince William Sound 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 and Kodiak Island area 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 by residents of Chenega Bay increased their concerns about using intertidal resources.

Ouzinkie was the first Kodiak area community to see the oil arrive, mostly in the form of mousse and tar balls, and saw it in denser, fresher concentration than other communities in the region. A large proportion of Ouzinkie residents (61% of all adults) were employed on the *Exxon Valdez* oil spill clean up, and saw first hand the devastating effects of the spill on bird and marine life. It is for these reasons understandable that of the Kodiak area communities, Ouzinkie was the community in which subsistence harvests were curtailed the most severely. The harvesting of butterclams, a favorite wild food resource, came almost to a standstill. The aftermath of the *Exxon Valdez* oil spill coincided with an increase of red tides and paralytic shellfish poison (PSP) on Kodiak area beaches. This has compounded resident's concern about the safety of consuming shellfish from beaches where tar balls still wash up a decade after the *Exxon Valdez* oil spill, and has been an

inhibiting factor in the recovery of subsistence uses of intertidal resources by residents of Ouzinkie.

This project will provide the residents of Chenega Bay and Ouzinkie 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 communities that their knowledge of these resources, and their views 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 clams and other intertidal species by providing a harvester's perspective on intertidal communities and *Exxon Valdez* 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 Ouzinkie, as well as other locations in Prince William Sound, on Kodiak Island and Spruce Island.

COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE

This project is being jointly proposed by the Ouzinkie Tribal Council and the Chenega Bay Village IRA Council. Subcontracts will ensure each community's involvement in the production of the film. The councils and Council Presidents, Gail Evanoff and Paul Panamarioff, will be involved in selecting a contractor for the film, as well as 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 the Kodiak area and 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. The documentary will also highlight the difficulties each community has faced in returning to the harvest and use of these resources, as well as the on-going efforts to mitigate these difficulties being undertaken as part of the EVOS restoration program, including beach treatment, the clam restoration project, and the PSP testing program.

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 Chenega Bay), and the Kodiak area (focusing primarily on Ouzinkie). A film crew will visit each community for two weeks in April and May of 2001 to document the harvest and distribution intertidal resources. Interviews will be conducted with residents of each 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 2002, the documentary will be presented in public screenings in Chenega Bay, Ouzinkie, and Anchorage, and distributed to *Exxon Valdez* oil spill affected communities, libraries, Alaska Native organizations, and state and federal agencies.

The proposers cannot guarantee that the documentary will be broadcast on television. However, programming staff at KAKM (the Public Broadcasting Television Station in Anchorage) have been contacted to learn what criteria they use in deciding what programs to air. KAKM is most interested in airing programs that are produced not-for-profit, that are educational and aimed at adults, and which convey a positive message about Alaska. KAKM sets their broadcast schedule 6 to 8 weeks ahead, and would require at least that amount of notice prior to the desired air-date. For broadcast on KAKM, the actual length of a "half hour" program should be 26 minutes and 46 seconds, to allow for station identification and promotions. the proposers will work with the contractor to design and produce a documentary that will fit these criteria, will be attractive to broadcast programmers, and therefore more likely to be aired.

Each community's story will be told in interviews with residents and visits to local harvest areas. The stories of the two communities will be compared and contrasted.

Chenega Bay

Interviews will be done with active harvesters, some of whom are also elders, including: John M. Totemoff, Don Kompkoff, Sr., Pete Kompkoff, Jr., Larry Evanoff, Diane Selanoff, and Peter Selanoff.

Topics to be discussed include: experiences at the time of the *Exxon Valdez* oil spill, the persistence of oiling, continuing impacts on resource species, and subsistence harvests, and restoration efforts, including beach treatment efforts and the clam restoration project.

Three harvest areas will be visited during filming:

1) Bishop Rocks, Evans Island—This beach was previously used by Chenega Bay residents for seining salmon, harvesting chitons and octopus, as well as for recreation. The beach here was heavily oiled, and was subjected to mechanical clean-up techniques and application of Inipol. Subsurface oil remains here, and the beach is naked of life.
2) Sleepy Bay, LaTouche Island—Prior to the *Exxon Valdez* oil spill Chenega residents harvested sea weed for food here, and the area was also important to marine mammal hunters, because it was a pinniped haulout area. This was one of the most heavily oiled beaches in Prince William Sound, with a thick layer of crude oil covering the beach, and subsurface oiling in excess of 4 feet in depth in the sandy areas of the beach. The beach was treated with both hot and cold mechanical washing, and bulldozing. Today the beach is barren of life.
3) Fox Farm, Elrington Island—Hunters from Chenega Bay used to be able to count on there being seals on this beach, and sea lions nearby. This was also an important place to hunt deer. This beach was not as heavily hit as some others in Prince William Sound. However, it was impacted by tar balls, and there are still tar mats on the beach. Deer were found dead on this beach following the spill. The abundance of life has been reduced on this beach.

Ouzinkie

A round table group interview will be done with Kenneth Anderson, the Natural Resource Specialist for Ouzinkie, and four or five elders from the community including Zach Chichenoff, Floyd Anderson and Fred Squartsoff.

The group will discuss the status of intertidal resources and harvests before the spill and since the spill. The elders will draw on their lifetime experience, and traditional knowledge, to talk about the changes in the intertidal resources through time. They will also talk about PSP, and about the efforts, in coordination with the EVOS Trustee Council, to develop a fast and simple PSP test for use by harvesters.

The following harvest areas will be visited during filming:

1) Camels Rock
2) Spruce Island clamming beach

—these are both important clam harvest areas in close proximity to the community of Ouzinkie. These beaches were impacted by tar balls following the *Exxon Valdez* oil spill. PSP has been a problem on these beaches in the years since the spill.

C. Cooperating Agencies, Contracts, and Other Agency Assistance

The production and post production work on the film will be contracted out, through a request-for-proposals (RFP) process, 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.

Each bidder will be required to submit two samples of their work, consisting of a 20 to 30 minute long film, along with their proposal. Bids will be evaluated by a panel, including the Village Council Presidents of Ouzinkie and Chenega Bay, the Spill Area Wide Community Involvement Coordinator, and staff of the Division of Subsistence , Alaska Department of Fish and Game. Evaluation criteria will include understanding of the project (as demonstrated in the proposal), quality of work, appropriateness of the methodology suggested in the proposal, and price. A preference will be given for Alaska businesses.

In consultation with the communities and ADF&G staff, the video production company will create a more detailed 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 (February 1 2000-December 15 2001)

This project will be completed over two fiscal years and the budget will be divided accordingly. In the first year (2000) ADF&G personnel will develop an RFP and award a contract. Because of previous commitments, ADF&G personnel will not be able to develop the RFP until July of 2000. During the second year (2001) all phases of video production will be completed and the contractor will provide a completed film by December 15, 2001.

Pertinent Dates:

February 1, 2000:	Project Approval
July 1- September 30, 2000:	Develop contract guidelines, evaluate bids, and award contract.
October 1 - March 30, 2001:	Pre-Production Phase, develop story-line for film.
April-June 2001:	Production Phase, contractor to travel to Chenega Bay and Ouzinkie, as well as locations in Prince William Sound and

	on Kodiak and Spruce Islands, to film interviews and harvesting footage.
July 1-November 30, 2001:	Post Production Work.
December 15, 2001:	Contractor will provide completed film and deliver 100 copies.
February 2002	Public screenings of documentary in Ouzinkie, Chenega Bay, and Anchorage.

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, Ouzinkie, 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 INVESTIGATORS

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William E. Simeone
Subsistence Resource Specialist II
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PROJECT PERSONNEL

Kenneth Anderson
Mr. Anderson, a life-long resident of Ouzinkie, is the Natural Resource Specialist for Ouzinkie. In that capacity, he has been digging clams at designated beaches, and sending samples to the ADEC laboratory in Palmer for PSP testing for two years.

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.

Paul Panamarioff
Mr. Panamarioff was born in Ouzinkie, and is a life-long harvester of subsistence foods. He is currently president of the Ouzinkie Tribal Council.

William E. Simeone
Dr. Simeone has worked in oil spill and subsistence related projects in Prince William Sound for the last ten years. Five of those years have been with the Alaska Department of Fish and Game, Division of Subsistence. During that time Dr. Simeone administered, coordinated, and consulted on two documentary films funded by the Exxon Valdez Trustee Council, restoration projects 96214, and 98274.

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Budget Category:	Authorized FY 2000	Proposed FY 2001
Personnel		$10.0
Travel		$3.8
Contractual		$90.2
Commodities		$0.0
Equipment		$0.0
Subtotal	$0.0	$104.0
General Administration		$7.8
Project Total	$0.0	$111.8
Full-time Equivalents (FTE)		0.2
Other Resources		

LONG RANGE FUNDING REQUIREMENTS					
			Estimated FY 2002		
			$0.0		

Dollar amounts are shown in thousands of dollars.

Comments:

FY01

Prepared: 4/14/00

Project Number: 01481
Project Title: Intertidal Documentary
Agency: Alaska Department of Fish and Game

FORM 3A
TRUSTEE
AGENCY
SUMMARY

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 2001
William E Simeone	SRS II	16C	2.0	5.0		10.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		2.0	5.0	0.0	
					Personnel Total	$10.0

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 2001
Two round trips to Chenega Bay and Prince William Sound	0.4	2	10	0.1	1.8
Two round trips to Ouzinkie and Spruce Island	0.5	2	10	0.1	2.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$3.8

FY01

Prepared: 4/14/00

Project Number: 01481
Project Title: Intertidal Documentary
Agency: Alaska Department of Fish and Game

FORM 3B
Personnel
& Travel
DETAIL

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Contractual Costs:	Proposed
Description	FY 2001
Ouzinkie Village Council (for logistical support, boats, fuel))	7.5
Chenega Bay Village IRA Council (for logistical support, boats, fuel)	7.5
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)	75.0
Postage to distribute copies of video	0.2
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$90.2

Commodities Costs:	Proposed
Description	FY 2001
Commodities Total	$0.0

FY01

Prepared: 4/14/00

Project Number: 01481
Project Title: Intertidal Documentary
Agency: Alaska Department of Fish and Game

FORM 3B
Contractual & Commodities DETAIL

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FY 2001
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
Those purchases associated with replacement equipment should be indicated by placement of an R.		**New Equipment Total**	$0.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency

FY01

Prepared: 4/14/00

Project Number: 01481
Project Title: Intertidal Documentary
Agency: Alaska Department of Fish and Game

FORM 3B
Equipment
DETAIL

Establishment of A Biotoxin Monitoring Program in the Kodiak Island, Prince William Sound Area

"Submitted Under the BAA"

Project Number:	01482
Restoration Category:	Monitoring, Research
Proposer:	Jellett Biotek Limited
Lead Trustee Agency:	ADEC
Cooperating Agencies:	Chugach Regional Resources Commission/Kodiak Island Youth Area Watch
Alaska SeaLife Center:	NO
Duration:	2nd year, 3-year project
Cost FY 01:	$200.9
Cost FY 02:	$100
Geographic Area:	Prince William Sound, Kodiak
Injured Resource/Service:	Clams, Mussels, Subtidal communities

ABSTRACT

During FY 00 Jellett Biotek successfully developed and optimized a rapid test for detecting paralytic shellfish poisoning in shellfish samples from Kodiak Island.

This proposal involves the establishment of a beach-monitoring program for marine biotoxins, in partnership with the Youth Area Watch that will generate valuable data on annual, seasonal and geograpical changes of the abundance of marine biotoxins. The project also involves the adaptation of the rapid tests to detect toxic phytoplankton in water samples as an "early warning system" of toxic blooms. The relationship between toxic alga blooms and the contamination of shellfish will be researched. The data generated may identify beach areas that tend to be free of toxins over the year and help target areas for shellfish harvest or even aquaculture production.

The results of this monitoring program may lead to safe subsistence food resources for local communities, jobs and economic development through potential aquaculture operations, and provide vital information for protecting and enhancing shellfish resources. The project will provide meaningful scientific exposure and training to Kodiak Island students, as well as a cost-effective biotoxin-monitoring program.

The restoration being proposed is the improved availability of shellfish such as mussels and clams as a subsistence food. Currently no historical records of toxic phytoplankton or shellfish toxicity exist for the Kodiak Island area.
In FY 00 Jellett Biotek was provided funding by the Trustee Council to optimize our rapid test kit for PSP to the toxicity profile found in shellfish samples on Kodiak Island. The MIST Alert™ for PSP rapid test kits provide a qualitative (yes/no) indication of the presence of toxicity in less than 20 minutes. The test kits are lateral flow immunochromatographic devices similar to the platform used for home pregnancy tests. The kits are extremely easy to use, have a shelf life in excess of one year, and work in a wide range of ambient temperatures. Sixty-seven shellfish samples from a project undertaken the previous year in partnership with the Alaskan Department of Environmental Conservation Lab in Palmer, Alaska, and the Fisheries Industrial Training Centre in Kodiak (Dr. Brain Himmelbloom) were used to optimize the MIST Alert™ for PSP test kits. These 67 samples were a small subset of a much larger data set generated in partnership with the DEC lab during a year long trial of the Jellett Biotek cell based quantitative PSP test kits.

The first few production lots of the MIST Alert™ test kits produced a false positive rate of about 25%, when compared to the mouse bioassay. A number of test parameters were modified, as was the buffer solution. Lot #6 provided 100% agreement with the mouse bioassay on the 67 Kodiak samples.

Due to the low number of samples involved, additional samples from the DEC lab have been requested from the 1999 toxin-monitoring season, which will be used to further validate and optimize the test kits.

During FY00, Jellett Biotek also began optimization of our rapid test for domoic acid (amnesic shellfish poisoning or ASP) but was hampered by the lack of occurrence of this toxin in Alaskan shellfish samples. Shellfish samples from other countries containing ASP are being used to validate the ASP test.

At the time of preparing this proposal, Jellett Biotek is planning field trials of the rapid tests with the Kodiak Island Youth Area Watch (KIYAW) (which is an integral part of our FY 00 funding with the Trustee Council). The KIYAW participants will be trained in how to obtain and prepare shellfish samples from a small sample of traditionally important shellfish harvest beaches in the Kodiak area. They will then conduct the rapid test and record the data. The KIYAW may also be involved in a number of other scientific experiments and observations as part of other projects submitted to the Trustee Council by other scientists. These activities will provide the students hands on exposure and participation in a scientific project for educational and motivational purposes, while at the same time generating useful scientific data that may lead to more effective economic use of the shellfish resources in the region.

This proposal builds on the previous contract awarded to Jellett Biotek to optimize the rapid tests to conditions in Kodiak. It lays the groundwork for the establishment of an ongoing biotoxin-monitoring program in the Kodiak Island area.

It also includes the necessary R&D and field trials to adapt the MIST Alert™ rapid tests to testing water samples as well as shellfish tissue. The ability to detect toxic phytoplankton in waster samples is expected to provide an important **"early warning system"** for the presence of PSP causing phytoplankton, before it contaminates the shellfish resource on the beaches. Data from the project will be used to produce a "toxicity map" for Kodiak Island to enable informed decision on locations most suitable for shellfish subsistence harvest and potential aquaculture sites.

Details of the work completed in FY00 are available as two separate reports submitted to the Bruce Wright, COTR, NOAA.

Independent of the Trustee Council sponsored project last year; Jellett Biotek conducted a yearlong study of temporal and geographical distribution of marine biotoxin toxicity in the North West Coast of Canada. Our study found that marine biotoxin toxicity did not occur uniformly along the coast, and the selection of specific areas or beaches is an important consideration for establishing shellfish harvest or aquaculture sites. (Our detailed report is available upon request). It is expected that the same will be true of Kodiak Island. The development of the rapid marine biotoxin testing technology combined with a partnership with the KIYAW makes a cost-effective approach to this project possible.

Need for the Project
A. Statement of the Problem

There has been a loss or reduction in available subsistence food resources in the oil spill affected areas with species such as harbour seals, sea lions, ducks and herring. The shellfish resource such as mussels and clams has also been affected, but is recovering.

The availability of cost effective, simple to use, field marine biotoxin testing technology can enable coastal communities to test the occurrence of these toxins on a seasonal and geograpical basis. No data currently exists for Kodiak Island to correlate the presence of toxic algae to the levels of toxicity eventually found in shellfish samples. This project will generate the data to allow these correlations to be made to better understand and predict the rate and degree of shellfish contamination by toxic algae. This information will become vital in assessing when it is safe to harvest shellfish on a subsistence basis at specific locations, or where potential aquaculture sites may be located that will minimize the chance of contamination by marine biotoxins.

Currently the Department of Environmental Conservation Lab in Palmer does not test the shellfish resources on Kodiak Island. Logistical difficulties in obtaining and shipping samples to the DEC lab in Palmer, the high cost of the mouse bioassay, and the history of PSP poisonings in the area, focus the need for a reliable on site marine biotoxin testing program for Kodiak Island.

B. Rationale/Link to Restoration

This project should be undertaken to collect scientific information on the occurrences and severity of marine biotoxin outbreaks in the Kodiak Island area and to assess how closely these events are linked to toxic phytoplankton abundance in the area. This information may then be used to identify windows of safe harvest opportunity for the subsistence and recreational shellfishery. It will also provide aquaculture site location information that may minimize the risk of biotoxin contamination. The access to the shellfishery will help replace subsistence food resources lost or limited as a consequence of the oil spill in the affected areas and may lead to economic development opportunities through potential aquaculture site development.

This project provides meaningful scientific and educational opportunities for students in the KIYAW, as well as the opportunity for hands on participation in a scientific research project using state of the art technology. This project may easily be interwoven with the scientific curriculum at the school, providing a stimulating and practical research and study environment for the students and the potential for an ongoing cost effective local biotoxin monitoring program.

The rapid testing technology will be adapted to detecting toxic algae in water samples, thus providing an "early warning system" for potential shellfish contamination. This will provide additional information of toxic bloom activity and its relationship to contamination of shellfish, as well as enhanced safety of the shellfish resource. The activities during this project could well become a model and a demonstration project for other coastal communities.

C. Location

The project will use the KIYAW students on Kodiak Island to perform the water and shellfish sample collection and biotoxin monitoring. This activity will be coordinated with other scientific observations from other projects to provide an integrated, cohesive field study for the students.
The data generated will be widely distributed and made available on the internet for other students, the shellfish industry, governments and the scientific community.
All coastal communities with potential shellfisheries may be interested in this model and affected by the results of this project.

COMMUNITY INVOLVEMENT AND TRADITIONAL KNOWLEDGE

This project will rely heavily on local knowledge of the communities for identifying potentially important shellfish areas, which should be monitored. In addition, communities where there is interest in economic development through potential aquaculture operations will be monitored for suitability. The project will rely partially on advice and guidance provided by the Chugach Regional Resources Commission and from information from the KIYAW participants.

Upon completion of the project there will be broadly based community meetings to discuss the subsistence and commercial potential identified by the project, as well as the potential for implementing long term monitoring strategies. Economic development strategies will be developed and discussed in collaboration with the Chugach Regional Resources Commission, the affected communities and tribal councils.

Integration of the monitoring program into the school curriculum will be investigated.

Project Design

A. Objectives

The objectives of this project are as follows:

1. To optimize the MIST Alert™ rapid tests to adapt them to detect toxic phytoplankton in water samples as an "early warning system" to warn of the occurrence of biotoxin contamination
2. To establish a beach-monitoring program in partnership with the KIYAW to collect information on the temporal and regional occurrences of marine biotoxins that could affect the shellfish resource on Kodiak Island. In addition data will be collected on the correlation of the abundance of toxic phytoplankton in water and contamination of shellfish resources.
3. To produce a "toxicity map" of Kodiak Island as an indicator where shellfish harvest and aquaculture areas should be located
4. To assess the interest and potential for economic development in the affected area through the development of community aquaculture projects
5. To assess the potential to incorporate a beach-monitoring program into the Kodiak Island school curriculum as a demonstation model for other areas.

B. Methods

The first hypothesis to be tested is that the MIST Alert™ tests may be modified to detect toxic phytoplankton in marine water samples, thereby acting as an "early warning"for marine biotoxin contamination.

The second hypothesis is that there is a correlation between the presence of toxic algae in water samples and the rate of toxification of shellfish resources

The third hypothesis to be tested is that there are temporal and geographical variations of the marine biotoxin contamination of the shellfish resources on Kodiak Island. Some areas are less likely to be affected by this contamination than others.

The fourth hypothesis is that an effective on site biotoxin monitoring program may be developed for Kodiak Island that will enable safer subsistence and economic use of the shellfish resource.

The project will develop a beach-monitoring program using the MIST Alert™ marine biotoxin screening technology to collect information on the temporal and geographical occurrence of marine biotoxins on Kodiak Island. The rapid tests will be optimized to detect toxic algae in water samples, thus acting as an "early warning" of potential contamination.

The project will involve establishing approximately 20-25 strategic biotoxin monitoring sites around Kodiak Island, based on community input on traditional and important shellfish harvest areas and access for obtaining samples. Members of the KIYAW will be trained to collect shellfish samples, produce appropriate extracts, perform the MIST Alert™ tests and record the

data. They will also be taught how to take a water sample using a plankton net tow as well as the extraction and testing of the sample on the MIST Alert™ rapid test. The KIYAW will also perform complementary tests and observations as required by other projects, (such as secci disc measurements of phytoplankton, microscopic identification of harmful algae species, water temperature and salinity) which will be integrated into the toxicity data. Dr. Sherwood Hall of the Office of Seafood, USFDA, has expressed interest in conducting a training session on identification of toxic algae in water samples. He has established several volunteer toxic algae water monitoring programs in the US. The identification and counting of toxic algae in water samples will help in correlating the MIST Alert™ tests results with the shellfish sample test results.

The data generated from this project will be made available on the internet for sharing by various schools (partner sites) around Kodiak Island and further afield.

Background information on the project, selection of the trial sites, establishment of the testing protocols, and development of the data reporting systems and internet protocol will occur during the period in October 00 to March 01.

Also during the period October 00 to March 01, Jellett Biotek research and technical staff will begin R&D on adapting the MIST Alert™ to detecting toxic phytoplankton in water samples. JBL will collaborate with the National Research Council of Canada in accessing their extensive toxic phytoplankton collection to begin this initial work. Parameters such as test selectivity, sensitivity, toxicity profiles, antibody mix and optimal buffer solution will be assessed. Water sample collection and extraction procedures will be optimized in preparation for the field trials in April 01.

The first data collection season will run from April 2001 to end October 2001. It is proposed to take a minimum of two water samples and two shellfish samples at each of the monitoring sites during the data collection period. The samples will be tested by the students on the MIST Alert ™ test kits and the data recorded along with other observations and measurements, particularly the identification and counting of toxic algae.

Upon completion of the field trials, data will be analyzed and the "toxicity map" produced showing shellfish areas that became toxic over time and those that remained free from toxicity. Detailed analysis will be undertaken by JBL staff to correlate the toxicity in the phytoplankton and the shellfish samples as well as temporal and geographical occurrences of the toxicity. Other observed variables will be assessed with statistical analysis to detect correlations.

A detailed report will be produced by December 31, 2001 indicating the areas most suitable for shellfish harvesting and/or potential aquaculture sites.

During the period October 01 to December 01, discussions will be held with the school system to determine if an ongoing monitoring system should be incorporated as part of the school's scientific curriculum. A scientific paper will be prepared on the project and presented at a high profile aquaculture/scientific conference in FY 01.

It is planned to repeat the data gathering in the second year (April 02 to September 02), to ensure consistency of data from year to year. Sites that showed high levels of toxicity over the year may have reduced sampling and other sites may be chosen for the second year.

It is anticipated that JBL will have regulatory approval to use the MIST Alert™ test for biotoxin screening purposes by December 01, thus enabling an ongoing monitoring program to be put in place to ensure the safety of the shellfish resources on Kodiak Island.

B. Cooperating Agencies, Contracts, and Other Agency Assistance

Jellett Biotek plans to manage the project and provide the R&D required to adapt the MIST Alert™ technology to respond appropriately to water samples.

Jellett Biotek will also supply MIST Alert™ kits for both ASP and PSP during the data collection process.

JBL will train project participants in water and shellfish collection and extraction techniques, performance and interpretation of the MIST Alert™ test kits, data recording.

The National Research Council of Canada will be contracted to provide their phytoplankton collection for R&D and to assist in adapting the rapid kits to detect water samples, and to provide analytical back up during the research process. They will also assist with data analysis and modeling of the interaction between toxic algae and toxicity found in shellfish samples. Of particular interest is the minimum number of algal cells per water sample required to detect toxicity.

The Alaska Department of Environmental Conservation Lab will be contracted to perform mouse bioassays on some samples for ongoing quality control checks for the shellfish extractions and for the MIST Alert™ results.

The National Research Council will also provide analytical support in the form of HPLC profile analysis of the toxic shellfish and algae samples.

SCHEDULE

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

October – April:	**Adapting MIST Alert™ to function with water samples** **Collaboration with the National Research Council of Canada** **Background information on project to KIYAW** **Selection of 20 – 25 sampling sites** **Coordination with other projects, initial training**
April 1	**Interim report on efficacy of test kits on water samples** **Report on selected test sites and protocol**
April – October	**Data collection of both water and shellfish samples at selected sites**

	Ongoing analysis of data, broadcast on web site **Additional optimization of test kits for water samples**
December 31	**Report due, production of toxicity map for Kodiak Island**

B. Project Milestones and Endpoints

The following are milestone dates and deliverables by that date:

Date	**Deliverable**
November 30	**Selection of sites for testing. Briefing for KIYAW participants**
December 31	**Initial testing of MIST Alert™ tests with NRC phytoplankton**
April 1	**Interim report on efficacy of phytoplankton extraction, test function with water samples. Selected sites for data collection**
December 31/01	**Project Report on data collected. Provide temporal and geographical toxicity map for Kodiak Island.** **Completed discussions with school regarding incorporation of biotoxin monitoring program into the school curriculum.**

C. Completion Date

This phase of the project will be complete by December 31, 2001.
Please note that this project will span two fiscal years. This is due to the fact that the toxicity season lasts into late fall in the Kodiak Island area, and we would like to have an accurate indication of the full toxicity season when developing the toxicity map.

PUBLICATIONS AND REPORTS

Jellett Biotek staff will prepare a scientific report of the project to be targeted for Toxicon or the Journal of Shellfish Research. The report will be provided to the Trustee Council and community groups as requested, and placed on the internet for maximum distribution.

PROFESSIONAL CONFERENCES

We plan to present the paper at the Interstate Shellfish Sanitation Conference and at least one aquaculture industry conference in FY 01. Specific places and dates are not yet available.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

This project will be closely coordinated with the KIYAW program and other projects that depend upon the KIYAW for field work and data collection. Where practical we will use the same field sites for observations for other project components, as deemed practical. Before commencing the project, discussions will be held with other project (proposors/managers) to determine the type of data to be collected and how the observations or information will be integrated into the overall project. An integrated data reporting system will be developed.

Jellett Biotek has obtained financial support from the Alaska Science and Technology Foundation to help develop and validate the MIST Alert™ rapid tests for PSP to the point that they are ready for field trials. Other project proposors may have access to additional funding sources.

This project may be integrated into the clam bed project currently being undertaken in the affected area through the use of a similar biotoxin-monitoring program.
The project will lay the groundwork for future economic development projects in shellfish harvesting or aquaculture.

EXPLANATION OF CHANGES IN CONTINUING PROJECTS

This project is an expansion of the FY 00 proposal, where we developed the tools (the rapid marine biotoxin tests) and the relationship with the KIYAW to allow a cost effective biotoxin monitoring program to be put in place. This project goes beyond monitoring the safety of shellfish to modifying the rapid test to detect toxicity in water samples, before shellfish become toxic, as well as assessing the correlation between the water tests and eventual shellfish toxicity. This continuing project will collect important data on the presence of these biotoxins from a temporal and geographical perspective around Kodiak Island and may lead to an effective guide to determine where and when biotoxins may occur around Kodiak Island. This information may be used to assess the most likely safe harvest times and also indicate where to site aquaculture operations to minimize the chance of biotoxin contamination.

PROPOSED PRINCIPAL INVESTIGATOR

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PRINCIPAL INVESTIGATOR

Dr. Joanne Jellett, Ph.D., is a marine microbiologist with over 20 years of research experience and is an internationally respected authority on tests for marine biotoxins. She has many innovative scientific developments and publications to her credit. She is president of Jellett Biotek Limited, a company with a mission to develop user friendly, cost effective screening tools for marine and other toxins.

Dr. Jellett developed the Maritime InVitro Shellfish Test (MIST™) for PSP, which is a quantitative cell based assay for PSP. Jellett Biotek is one of only a few companies internationally that has developed the capability to ship live cells.

More recently in collaboration with the National Research Council of Canada, Dr. Jellett developed the MIST Alert™ rapid screening tests for PSP.

Dr. Jellett is a founding member and on the executive of "**ANSWERS**"(**Association of Nova Scotia Women for Education and Research in Science**), a non-profit advocacy group to encourage and mentor young woman to pursue education and a career in science.

She is also a member of the Prime Minister's committee on International Science and Technology and is a policy advisor to the Canadian government.
A detailed resume is attached.

OTHER KEY PERSONNEL

Dr. Allan Cembella, Senior Research Officer, Institute for Marine Biosciences, National Research Council of Canada, has conducted extensive research and is recognized as a world authority on toxic phytoplankton research and has many publications to his credit. Dr. Cembella will provide consulting assistance in optimizing the MIST Alert™ test kits for use on toxic phytoplankton and in developing the correlations between toxic phytoplankton and contamination of shellfish.

Mr. Raymond Roberts, B.Sc., MBA, Director, International Marketing, Jellett Biotek, will act as the project manager. Mr. Roberts has extensive experience in international technology transfer and in developing and managing scientific projects and trials.

LITERATURE CITED

Because the MIST Alert™ rapid test kits have been very recently developed, and there are important intellectual property issues to be protected, there is little published literature yet available.

Dr. Jellett presented a paper on the MIST Alert™ for PSP at the Harmful Algal Bloom 2000 conference in Tasmania in February 2000. This paper will be published in the conference proceedings, edited by G. Hallagraaf.

The title of the paper is as follows:

Detection Limits of MIST Alert™ for Different Paralytic Shellfish Poisoning Toxin Analogues. Laycock, M.V., Jellett, J.F., Belland, E.R., Bishop. P.C., Theriault, B.L., Russell-Tattrie, A.L., Quilliam, M.A., Cembella, A.D., Richards, R.C.

A draft copy of the paper is available upon request.

2000 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 2000

Budget Category:	Authorized FY 2000	Proposed FY 2001	LONG RANGE FUNDING REQUIREMENTS					
Personnel	$13.0	$42.4						
Travel	$11.0	$20.1						
Contractual	$10.0	$26.3						
Commodities	$9.0	$66.0						
Equipment		$5.6						
Subtotal	$43.0	$160.4				Estimated FY 2002		
Indirect	$11.0	$40.5						
Project Total	$54.0	$200.9				$100.0		
Full-time Equivalents (FTE)	1.0	2.0						
	Dollar amounts are shown in thousands of dollars.							
Other Resources	ASTF		$311.0					

Comments: Jellett Biotek received funding from ASTF to help develop the rapid tests. This project is expected to run until December 31, 2000 to allow time to collect data during the toxin season, which is expected to go until the end of October, followed by data analysis and report writing.
The costs indicated in FY 01 represent the completed project expenses.

FY01

Prepared:

Project Number: 01482
Project Title: Establishment of a Biotoxin Monitoring Program in the Kodiak Island, Prince William Sound Area
Name: Jellett Biotek Ltd.

FORM 4A
Non-Trustee
SUMMARY

2000 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 2000

Personnel Costs:			Months	Monthly		Proposed
	Name	Position Description	Budgeted	Costs	Overtime	FY 2001
	J. Jellett	Principal Investigator	2.3	6000.0		13,800.0
	R.Roberts	Project Manager	1.5	6000.0		9,000.0
	M. Laycock	Senior Scientist	1.5	5000.0		7,500.0
	E. Belland	Senior Technician	1.0	3100.0		3,100.0
	P. Bishop	Jr. Technician	1.5	2500.0		3,750.0
	A. Russell	Jr. Technician	1.0	2780.0		2,780.0
	K. Pattenson	Data Analysis	1.0	2500.0		2,500.0
						0.0
						0.0
						0.0
						0.0
						0.0
		Subtotal	9.8	27880.0	0.0	
					Personnel Total	$42,430.0

Travel Costs:			Ticket	Round	Total	Daily	Proposed
	Description		Price	Trips	Days	Per Diem	FY 2001
	Airfare - Halifax to Kodiak - training session (2 JBL employees)		2500.0	2	10	200.0	7,000.0
	Car Rental						500.0
	Travel for KIYAW for Training						2,000.0
	Attend Trustee Coucil Seminar	(PI& Proj. Mgr	2500.0	2	4	200.0	5,800.0
	Present Paper at Trade show						3,000.0
	Training course on Toxic Algae ID (Dr. Sherwood Hall - Washington		800.0	1	5	200.0	1,800.0
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
						Travel Total	$20,100.0

FY01

Prepared:

Project Number: 01482
Project Title: Establishment of a Biotoxin Monitoring Program in the Kodiak Island, Prince William Sound Area
Name: Jellett Biotek Ltd.

FORM 4B
Personnel
& Travel
DETAIL

2000 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 2000

Contractual Costs:	Proposed
Description	FY 2001
Mouse Bioassays Q.C. checks DEC Lab 30@ 125	3,750.0
HPLC profiles of toxic algae and shellfish samples (NRC) 100 samples @ $125	12,500.0
NRC Phytoplankton collection, research services of A. Cembella	10,000.0
Contractual Total	$26,250.0

Commodities Costs:	Proposed
Description	FY 2001
Membranes and reagents for optimizing kits	1,000.0
MIST Alert Tests for ASP, PSP (30 weeks x 25 sites x 4 samples/week @ $20/test	60,000.0
Test strips and reagents for algal culture research	3,000.0
Extraction Materials	500.0
Water collection bottles, reagents	500.0
Courier Services for extracts, water samples	1,000.0
Commodities Total	$66,000.0

FY01

Prepared:

Project Number: 01482
Project Title: Establishment of a Biotoxin Monitoring Program for Kodiak Island
Name: Jellett Biotek Limited

FORM 4B
Contractual & Commodities DETAIL

2000 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 2000

New Equipment Purchases:	Number	Unit	Proposed
Description	of Units	Price	FY 2001
Phytoplankton Nets	10	200.0	2,000.0
Field Microscopes	6	600.0	3,600.0
			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**	$5,600.0

Existing Equipment Usage:	Number	
Description	of Units	

FY01

Project Number:
Project Title:
Name:

FORM 4B
Equipment
DETAIL

Prepared:

Links Between Persistent Oil in Mussel Beds and Predators. (Submitted Under BAA)

Project Number: 01486

Restoration Category: Research

Proposers: Dr. Stan Rice- NOAA Auke Bay Laboratory, ABL Program Manager
NOAA Program Manager: Bruce Wright
Dr. Thomas A. Dean- Coastal Resources Associates, Inc., President
Dr. Stephen Jewett- UAF/SFOS, Research Associate/Professor

Lead Trustee Agency: NOAA

Cooperating Agencies: none

Alaska SeaLife Center: No

Duration: 1st year, 2-year project
Cost FY 01: $199,000
Cost FY 02: $130,000
Cost FY 03: None

Geographic Area: Prince William Sound

Injured Resource/Service: Intertidal communities, sea otters, harlequin ducks

ABSTRACT

Links between oil-contaminated mussel beds and impacts on infauna and vertebrate predators have been inferred, but have not been definitively demonstrated. Significant oil concentrations in some mussel beds have persisted to present, much longer than originally expected, and may explain contemporary observations of vertebrate predator exposure to oil. The possibility that oiled beds are long-term sources of vertebrate contamination was unanticipated, and has implications for future monitoring and response decisions in the event of future spills. In a more holistic approach than in the past, several research groups will examine evidence for links between persistence of *Exxon Valdez* oil in mussel beds, infauna, and in nearshore vertebrate predators.

INTRODUCTION

High concentrations of *Exxon Valdez* oil have persisted in some oiled mussel beds within the spill region for 10 years (Babcock *et al.* 1998, Carls *et al.* 2000). Recent evaluations suggest that average oil concentrations in sediment have declined over the past several years (from 1994 through 1999). However, total polynuclear aromatic hydrocarbon (TPAH) concentrations ≥31 $\mu g\ g^{-1}$ dry sediment still persisted in about 1/3 of oiled mussel beds surveyed in 1999, and projections suggest contamination will persist in some beds for several decades. This persistence was not anticipated when decisions were made in 1989-90 NOT to clean mussel beds, and in fact raises the question of whether a few very persistent mussel beds should now be cleaned.

The relevance of persistent oil in mussel beds is that contaminated beds may be the contemporary source of vertebrate exposure to oil. There is evidence of oil exposure and continued injury to sea otters and harlequin ducks that feed on mussels and associated fauna (Bodkin *et al.* 1999, Esler *et al.* 1999), and more recently to masked greenling (Jewett, personal communication). These, as well as one other species that feed on mussels, Barrow's goldeneye, were exposed to oil as indicated by elevated levels of cytochrome P450-1A (Ballachey *et al.* 1999). Feeding on mussels or other contaminated prey in oiled mussel beds is a likely route of exposure in nearshore vertebrate predators, and exposure to oil is a likely cause for lack of total recovery for these species (Ballachey *et al.* 1999, Bodkin *et al.* 1999, Esler *et al.* 1999). However, there is no direct evidence to link exposure of vertebrates to feeding in oiled mussel beds. These are different mobile species to work with.

The concentrations of oil in some oiled mussel beds in 1999 were also high enough to be of concern to associated infauna. While there is little evidence of impacts of oil on population density or physiology of mussels (Thomas *et al.* 1999) other species in the mussel community are much more sensitive to oil (e.g., Dauvin *et al.*, 1982, 1998, Jewett *et al.* 1999). Benthic communities from sites with concentrations of TPAH in excess of 34 $\mu g\ g^{-1}$ are generally impacted by exposure to oil (Long and Morgan 1990, Long 1992). In 1999, 8 of 26 oiled mussel beds had TPAH concentrations in sediments that were in excess of 34 $\mu g\ g^{-1}$ (Carls, personal communication). Also, subtidal benthic communities at sites that were oiled after the Exxon Valdez oil spill were adversely impacted by the spill (Jewett et. al 1999) yet TPAH concentrations were much lower than observed in oiled mussel beds in 1999 (Jewett et. al 1999). These data suggest that infauna associated with oiled mussel beds may be impacted by continued exposure to oil. However, there has been no direct investigation of the impacts of oil in oiled mussel beds on associated infauna, either in population diversity, or hydrocarbon loads. These data are needed to evaluate interaction and risk with vertebrate predators.

Oiled beds will be chosen from previously studied beds where contamination levels are projected to persist for long periods of time, and within areas where vertebrate predators are expected. Hydrocarbon concentrations in sediment and mussel tissue will be determined at each site. The prey base (species diversity) will be examined, along with hydrocarbon loads in the more common species. Links to vertebrate predators will be examine in two ways: (1) vertebrate predator activity will be recorded in the winter and spring using a remote video system, and (2) mixed function oxidase enzyme activity [cytochrome P450 and ethoxyresorufin 0-deethylase (EROD)] will be measured in masked greenling caught at each site and (3) fluorescent aromatic compounds (FACs) will be measured in selected masked greenling from each site. Based on

recent results, this species now appears to be the most likely to demonstrate a link of vertebrate predators to oiled mussel beds.

Masked greenling still show evidence of exposure, as shown in Figure 1 where elevated EROD activity was measured in both oiled and un-oiled areas of Prince William Sound. This species may not be an ideal species, as it's range is not restricted to mussel beds, but probably has less range than higher profile species such as sea otters and sea ducks. Attempts will be made to link prey species in the diet of masked greenling with infauna prey species collected in the oiled mussel beds. Further, the hdyrocarbon exposure measurements (EROD, and billary FACs) will be repeated, but with the balanced 5-oiled and 5-unoiled to determine if there are differences between oiled areas and non-oiled areas.

Linking vertebrate predators to contemporary oil is a difficult task, which becomes more difficult with each passing year. Some oil persists, in a toxic form, but do vertebrate predators feed in these areas? If so, when? If so, how much? Is that exposure enough? Most of these questions will remain unanswered. This project will likely be the last attempt to link known oiled areas with prey and with vertebrate predator exposure. In some respects, it is a fishing trip of sorts, but the linkage issue is a nagging issue that deserves direct attention, rather than a secondary level of attention. The last effort of this project will by a synthesis of the linkage issue, which will combine the information from this study with the results from the comprehensive general survey for remaining oil in PWS, a separate project proposed for summer 2001.

NEED FOR THE PROJECT

A. Statement of Problem

Several nearshore vertebrate predators and some intertidal communities have failed to show clear signs of full recovery 10 years after the *Exxon Valdez* Oil Spill. The continued injury to several nearshore vertebrate predator species is likely due to continued exposure to *Exxon Valdez* oil. High concentrations *Exxon Valdez* oil persisted in several mussel beds within heavily oiled portions of Prince William Sound as of summer 1999. Several of the injured nearshore vertebrate species (e.g., sea otters and harlequin ducks) and other species for which there is evidence of continued exposure to oil (e.g., Barrow's goldeneyes and masked greenlings) feed on mussels and/or associated fauna (Koehl et al. 1982; Vermeer, 1982; McConnaughey, 1978; Blackburn et al., 1983; Rosenthal, 1983; Jewett, unpubl.). In June 1999, the stomach contents of 23 adult masked greenling collected adjacent to oiled mussel beds were examined. Dominant prey, in decreasing frequency of accurrence, were crabs (*Pagurus, Telmessus, Cancer*), benthic amphipods, and shrimps (*Pandalus*) (Jewett, unpubl.). Some of these prey are also consumed by sea otters and harlequin ducks. Thus, oil in mussels, other associated prey species, or in associated sediments are likely sources of contamination of nearshore vertebrates. For some of these beds, oil is projected to persist for several decades, and hence be a potential source and threat for predators to cope with. Links between oiled mussel beds and predators were never anticipated, and have not been studied directly. Persistence of oil in beds has been studied (last sampled in 1999), and vertebrate species recovery has been monitored, but the link between mussel beds and vertebrate predators is inferential rather than direct. Future decisions to clean some Prince William Sound mussel beds, or to clean beds after potential future spills need further study to support these decisions.

B. Rationale/Link to Restoration

Continued injury of nearshore vertebrate predator species appears to be caused by exposure to oil, and persistent oil in mussel beds is a likely source of contamination. If the hypothesis that mussel beds serve as sources of oil for nearshore vertebrate predators, further cleanup of oiled beds may be warranted as a means of accelerating recovery of the nearshore ecosystem. Future cleanup of oiled mussel beds, or beds after potential future spills can only be justified if natural restoration is inadequate or too slow, and there is a linkage between these beds and other fauna, including predators.

C. Location

The proposed study will be conducted in Prince William Sound.

COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE

The proposed study will extend Trustee-sponsored research conducted during the damage assessment and restoration phases of the *Exxon Valdez* Oil Spill. Past work has been presented at various public meetings sponsored by the council. Manuscripts produced will likely be the basis of future presentations at Trustee sponsored restoration workshops.

PROJECT DESIGN

A. Objectives

For each of 5 oiled and 5 reference mussel beds:

1. Determine hydrocarbon loads:
   a) Sediment and mussel tissue from mussel beds.
   b) Hydrocarbon concentrations in representative infauna prey.

2. Determine impacts on fauna:
   a) Infauna species diversity will be determined in the same 10 mussel beds.
   b) Macrofauna abundance and community structure
   c) Determine growth/size structure of mussels between oiled and unoiled beds.

3. Evaluate potential links to vertebrate contamination:
   a) Measure hydrocarbon exposure in masked greenling by measuring P450 EROD and biliary FACs from the same 10 mussel bed areas.
   b) Record predator utilization of 1-2 beds during the winter and spring. by remote video.

4. Re-evaluate the contribution potential of oiled mussel beds as links to near shore vertebrate predators.

B. Methods

Design Overview

A balanced design approach will be utilized; 5 oiled and 5 un-oiled mussel beds will be examined. Concentrations of total polynuclear aromatic hydrocarbons (TPAH) (in both sediments and mussel tissue) will be determined and correlated with a series of impact measurements ranging from prey contamination, to infauna species diversity, to vertebrate exposure measurments. Infauna associated with mussel beds will be characterized in five oiled mussel beds and five unoiled reference sites within Prince William Sound. These sites will be chosen based on 1999 sediment and mussel hydrocarbon results from the mussel bed restoration project (Figure 2). Hydrocarbon analysis in sediment will typically be completed by ultraviolet fluorescence, and GC/.MS analysis of sediment will be restricted to verification of sources of hydrocarbons at each site. Oiled sites will be chosen from those where 1) sediments and mussel tissue have previously been sampled, 2) sediment TPAH concentrations were above 30 $\mu g\ g^{-1}$ in 1999 (Harris, unpublished data), 3) contamination levels are projected to persist for long (decadal) periods, and 4) vertebrate predator utilization is expected, particularly masked greenling. Reference sites will include one that was sampled in 1999 (Barnes Cove) and 4 additional sites to be selected based on a preliminary survey. Reference sites will be located along unoiled shorelines within the Knight Island/Naked Island region. Sites will be selected that match the oiled mussel beds with respect to physical characteristics other than oil, including slope, exposure, aspect, and substrate type. Video monitoring will be conducted at 1 oiled and 1 reference site to estimate the extent to which these beds are utilized by nearshore vertebrate predators.

The mussel beds at each site will be mapped as described by Babcock *et al.* (1998). In general, selected beds will be about 5 × 5 m (25 m^2) or more in size. Previous sampling at several representative beds indicated that hydrocarbon concentration in sediment can vary up to two orders of magnitude within a few meters, with some correlation with elevation ($r^2 = 0.65$) (Babcock et al. 1998). Accordingly, sample collection will be stratified by elevation, but randomized within elevation.

1. Hydrocarbon loads in sediment, mussel tissue, and crabs

(1a) Sampling of hydrocarbons will be designed to inspect both intra- and inter-bed variation, and allow correlation of sediment, mussels and infauna at specific spots within each bed. Previous research demonstrated some correlation between elevation and oil concentration in sediment ($r^2 = 0.65$, Babcock et al. 1998), thus sampling will be stratified by elevation. Transects will be placed at two vertical elevations spaced in parallel 2 m apart, and 3 spots selected at random along each transect will be sampled from each transect. The samples will be collected and analyzed as described in Babcock *et al.* (1998). A 0.25 x 0.25 m quadrat will be centered on each collection spot. At least 10 g of mussels will be frozen for hydrocarbon analysis. All predatory snails (primarily *Nucella lammelosa* and *Nucella lima*) will be counted within the quadrats. Sediment under the mussel layer will be collected for hydrocarbon analysis, grain size and total organic carbon content.

(1b) Representative samples of amphipods and crabs (primarily *Telmessus cheiragonus*) will be collected from each site for determination of TPAH concentrations within their tissues. The animals will be collected by hand or from sediments shoveled from each site and sieved. All animals will be collected from an area between the mussel bed and MLLW. A sufficient number of animals will be collected to obtain a 10 g gram sample of each species.

2. Oil impacts on fauna.

(2a) Benthic invertebrates will be collected from a 10-cm diameter by 10-cm deep core sample at each randomly chosen spot described above. The cores will be preserved in formalin and returned to the laboratory for sorting and analysis. Samples will be sieved through a 1-mm mesh, and the animals identified and counted. Organisms will be identified to at least the family level, and analyzed to species for more commonly encountered species.

(2b) Larger invertebrate predator species will be counted at each site. A 50-m long stretch of shoreline will be delineated at each site with the mussel bed in the center. Counts will be made during a falling tide to minimize the chance of not counting animals that retreat to the subtidal zone during periods of low tides. The area censused will be measured at each site so that the number of animals per unit area (density) can be determined.

(2c) Mussels (0-5mm grouped for recruitment and >5mm) from the hydrocarbon sampling quadrats (see 1a. methods) will be counted to estimate mussel density and measured to estimate size distributions in each bed at each site.

3. Evaluate potential links to vertebrate contamination

(3a) Masked greenling will be captured by hook and line, baited pots, or seine net at high tide in the vicinity of each selected mussel bed (8 per site) and analyzed for 1) tissue hydrocarbons [by gas chromatograph/mass spectorscopy GC/MS], 2) cytochrome P450A (EROD) activity in liver, 3) hydrocarbon metabolites in bile (fluorescent aromatic compounds, FAC). Bile will be collected and frozen for analyses, and livers will be frozen for analysis. Stomachs will be removed and preserved for prey analysis. Remaining tissues will be frozen for potential GC/MS analysis. These measures of hydrocarbon concentration or exposure will be compared to mean hydrocarbon concentrations in sediment, mussels, and infauna by site to determine possible correlations.

(3b) The utilization of the mussel beds by nearshore vertebrate predators will be examined using a remote video system during winter and spring. This time period was chosen because less is known about vertebrate activity during the winter than in summer months, and because mussel beds are more likely to be important sources of nutrition in the winter when other food sources may be limiting. The system will provide remote access via satellite and the internet for six months without having to purchase equipment. Time-lapse images will be provided at a small bandwidth (8kb; 1 frame/3sec. during daylight hours) with the option of a wider bandwith (30kb; 1hr/day) during times of incresed activity. We expect few direct observations, hence the long-term coverage is needed. Utilization of bed resources will be noted when predators are observed feeding in bed areas. The frequency of feeding per unit time will be determined, and the species involved will be recorded.

Data analysis

We will test the null hypothesis of no significant difference between oiled and reference sites using analysis of variance (ANOVA). Metrics to be tested in this manner will include: 1) hydrocarbon concentrations in sediments, 2) TPAH concentrations in mussels, amphipods, other selected fauna, 3) the density of dominant taxa within core samples, 4) the density of dominant

sea stars and other invertebrate predators, and 5) EROD activity in livers from masked greenling. The analysis of dominant benthic invertebrates may use sediment grain size as a covariate if appropriate.

We will also examine possible correlations between all measured variables. For correlations of mussel TPAH, sediment hydrocarbon concentrations, and density of dominant benthic invertebrates within cores we will conduct separate analyses using both cores and sites as sampling units. Correlation between bile FAC and EROD assays will be done using individual fish as the sampling unit. For all other metrics, site means will be used as sampling units.

A time series of mussel and sediment hydrocarbon concentrations will be plotted for each site for which there are historical data (all five oiled sites and one reference site). In addition, concentrations averaged across beds will be determined to describe regional trends and the average 'half-life' of oil in these mussel beds.

Personnel and project management

The project will be conducted by a team of scientists who have been directly involved in the studies of the nearshore system in Prince William Sound since 1989. The work will be coordinated by Dr. Stanley Rice of the NOAA Auke Bay Laboratory. Dr. Thomas Dean, President of CRA will serve as project leader for fish and invertebrate studies. Pat Harris will direct studies of contamination in mussels and sediments. Dr. Steve Jewett will direct the laboratory workup of benthic invertebrates in core samples and the processing of fish tissues. Mandy Lindeberg will direct remote video staging and data analysis, Jeff Short will oversee hydrocarbon analyses, Mark Carls who will assist with sampling design, analyses and writing and Dr. John Stegemann will be responsible for P450 analyses in fish tissue.

Responsibilities for each of the contractors is as follows:

NOAA Auke Bay Laboratory (PI J. Rice, P.Harris, M. Lindeberg)
- Manage and Direct the Project
- Assist in manuscript preparation
- Provide for all logistical support for field sampling efforts
- Conduct all hydrocarbon analyses

Coastal Resources Associates, Inc. (PI Dean)
- Manage field sampling
- Assist in sampling and data analysis
- Assist in manuscript preparation

University of Alaska, Fairbanks (PI Jewett)
- Assist in sampling
- Do laboratory analysis of benthic samples
- Prepare, catalogue, ship, and enter fish tissue data
- Assist in manuscript preparation

C. Cooperating Agencies, Contracts, and Other Agency Assistance

This proposal is being submitted by NOAA. However, a portion of the funding will probably be directed to under BAA by Coastal Resources Associates, Inc. and to the University of Alaska (with contract administration for that portion of the contract conducted by Alaska Department of Fish and Game).

SCHEDULE

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

Aug/Sept 2000	Remote video site selection
January 2001	Annual Workshop, finalize sampling design
January 2001	Initiate remote video setup and activation
June 2001	Terminate remote video monitoring
July 2001	Complete sample collection
October 2001	Progress report.
March 2002	Complete chemical, infauna, and masked greenling analyses
June 2002	Complete statistics
August 2002	Complete report

B. Project Milestones and Endpoints

All field work will be completed by July 2001, and all field data will be entered and databases established by September 30, 2001. Laboratory analysis of benthic infauna, hydrocarbon and CYP1A data will be completed by March 1, 2002. A draft final report will be submitted by July 1, 2002. Results of this study will be presented at the annual EVOS workshop in Jan 2003 and that manuscripts will be finalized in FY2003.

C. Completion Date

Except for peer-reviewed publication and presentation at the annual EVOS workshop, the project will be complete by September 2002.

PUBLICATIONS AND REPORTS

A progress report will be submitted to the Trustee Council in October 2001 summarizing field sampling efforts of the previous summer.

Three manuscripts will be prepared and will serve as the final report for the project. Anticipated titles, authorship, and journals for submission are as follows:

Oiled mussel beds: a source of continued contamination of nearshore vertebrates 12 years after the *Exxon Valdez* Oil Spill. S Rice, T Dean, S Jewett, M Carls, P Harris, M Lindeberg, (anticipated submission to Marine Ecology Progress Series or Marine Pollution Bulletin).

Altered communities in oiled mussel beds 12 years after the *Exxon Valdez* oil spill. T Dean, S Jewett, and P Harris (anticipated submission to Marine Ecology Progress Series or Marine Pollution Bulletin).

Linking oiled mussel beds as a persistent source of contamination to predators and their prey 12 years after the *Exxon Valdez* oil spill - S Rice, T Dean, S Jewett, M Carls, P Harris, M Lindeberg, J Stegemann. (anticipated submission to Marine Ecology Progress Series or Marine Pollution Bulletin as a synthesis).

PROFESSIONAL CONFERENCES

No funding is being requested for attendance at professional conferences in FY00.

NORMAL AGENCY MANAGEMENT

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

This project has been developed through collaboration of NOAA, private sector, and the University of Alaska scientists. None of the proposers have management responsibility. However, it is anticipated that publications produced will be widely utilized in future management decisions.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

The scientists involved in the preparation of manuscripts have worked collaboratively in previous Trustee funded investigations of injury and recovery in coastal habitats.

EXPLANATION OF CHANGES IN CONTINUING PROJECTS

None

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BIOGRAPHICAL SKETCHES FOR PRINCIPAL INVESTIGATORS

Dr. Stanley Rice, GM-14 physiologist, has been Habitat Program Manager of NOAA/NMFS/Auke Bay Laboratory since 1986. Dr. Rice has conducted and managed *Exxon Valdez* damage assessment and restoration sudies since 1989 including cooperative projects with other agencies, and providing critical reviews and input in agency decisions. He has over 20 years experience researching oil effects encompassing a wide variety of organisms and conditions.

Dr. Thomas A. Dean is President of the ecological consulting firm Coastal Resources Associates, Inc. (CRA) in Vista, CA. Dr. Dean has over 20 years of experience in the study of nearshore ecosystems, and has authored over 30 publications, including several dealing with impacts of the *Exxon Valdez* oil spill on nearshore plants and animals. He has extensive experience in long-term monitoring studies, and has played a major role in both intertidal and subtidal EVOS investigations since 1989.

Dr. Stephen C. Jewett has been a Research Associate at the School of Fisheries and Ocean Science, University of Alaska Fairbanks, since 1975. He currently serves as Research Professor. During this time he has been involved in numerous benthic and intertidal investigations throughout Alaska that emphasize assessment and/or monitoring. He has authored more than 30 publications in scientific journals and books. He has been the coordinator of the federal/state EVOS shallow subtidal investigations in Prince William Sound (1989-1994). He is concluding an EVOS investigation on lingering effects of the spill to nearshore fishes (Project 00379).

Patricia M. Harris has been involved in *Exxon Valdez* oil spill research since March 1989; as a co-principal investigator for NRDA project Subtidal 3, Mussel bed monitoring and restoration, and Pristane monitoring in mussels, she has been responsible for study design, field logistics, sample collection and assisted in data analysis and proposal and report preparation.

Mandy R. Lindeberg has been involved in *Exxon Valdez* oil spill research for the last 10 years. Her research includes intensive studies on intertidal invertebrates and seaweeds, mussel populations, and currently she is a co-principal investigator of spot shrimp populations in Prince William Sound..Her responsibilities include quality control of field and laboratory sample processing, data analysis, graphics, and proposal and report preparation.

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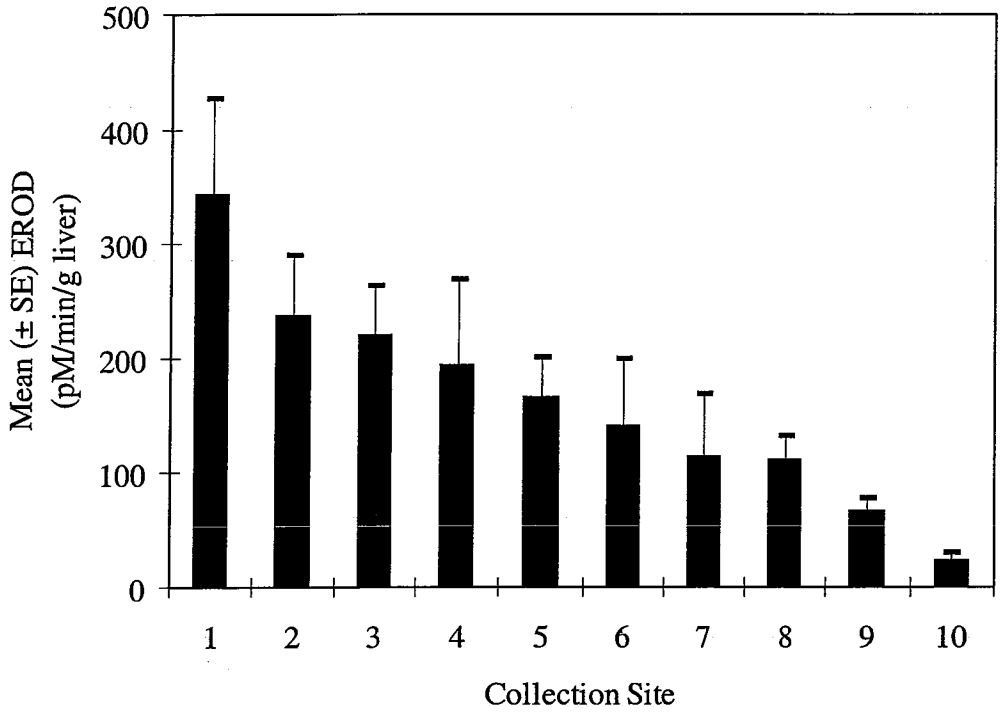

Figure1. Inter-site differences in mean EROD values in masked greenling, Prince William Sound 1999. P-values are presented and values significantly different are in bold.

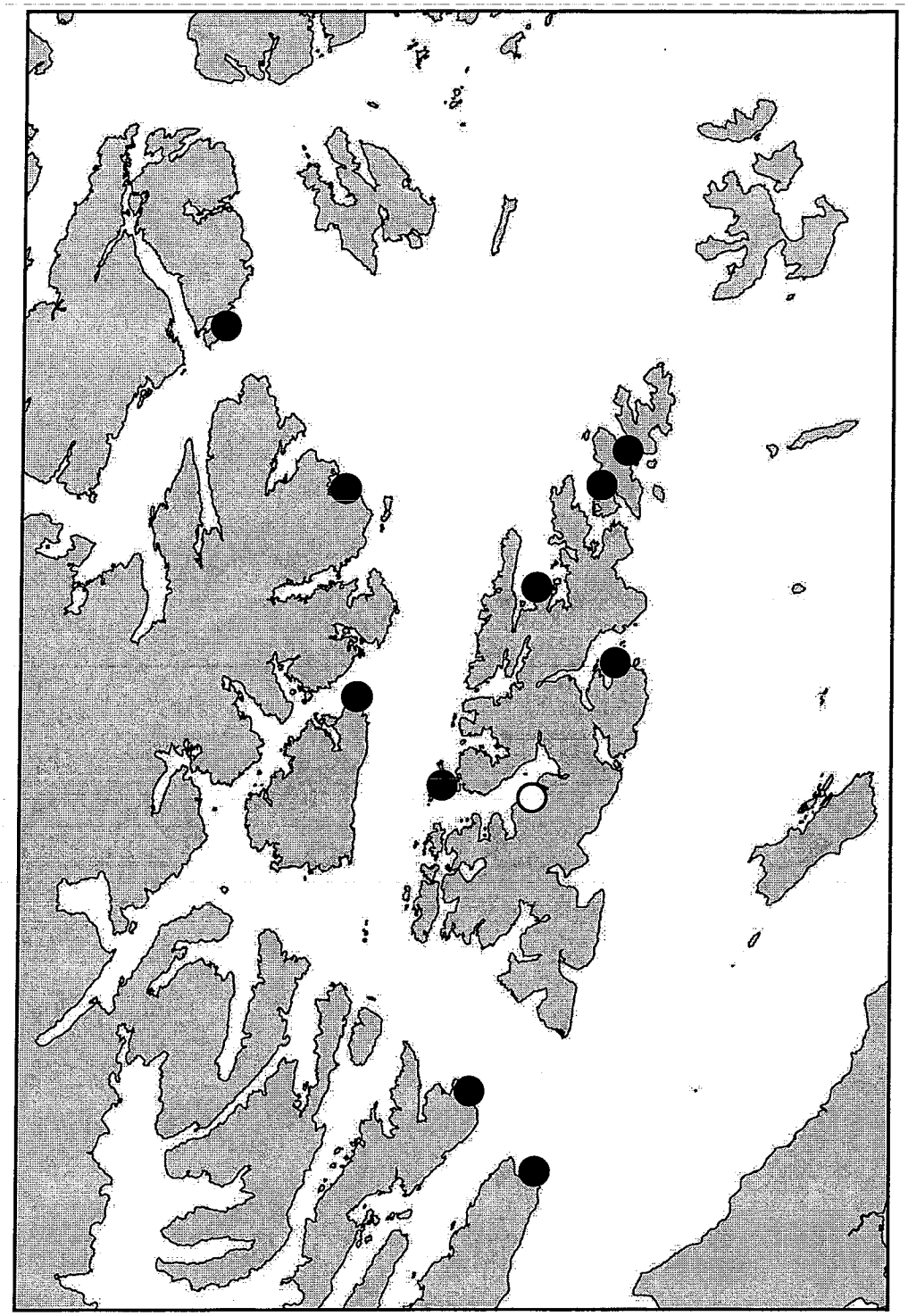

Figure 2. Oiled mussel beds in PWS to be used as candidates for sampling.

BUDGET SUMMARIES By task and affiliation (without GA)

Task	NOAA		CRA		UAF		SeeMore WS	
	FY01	FY02	FY01	FY02	FY01	FY02	FY01	FY02
1a	$33.1	$28.7	$1.0	-	-	-	-	-
1b	-	$15.6	$4.0	-	-	-	-	-
2a	-	-	-	-	$16.4	-	-	-
2b	-	-	$5.3	$3.7	-	-	-	-
2c	$4.0	$5.1	-	-	-	-	-	-
3a	-	$4.7	-	-	$25.8	$9.8	-	-
3b	$17.3	-	-	-	-	-	$25.0	-
4	$11.2	$16.3	$13.8	$17.8	$0.6	$10.4	-	-
Total	$65.6	$70.4	$24.1	$21.5	$42.8	$20.2	$25.0	-

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Budget Category:	Authorized FY 2000	Proposed FY 2001
Personnel		$26.8
Travel		$5.8
Contractual		$149.4
Commodities		$2.5
Equipment		$0.0
Subtotal	$0.0	$184.5
General Administration		$14.5
Project Total	$0.0	$199.0
Full-time Equivalents (FTE)		0.3
Other Resources		

LONG RANGE FUNDING REQUIREMENTS					
			Estimated FY 2002		
			$130.0		

Dollar amounts are shown in thousands of dollars.

Comments:

Affiliation Costs (w/oGA):

NOAA: $65.6
CRA: $40.4
UAF: $53.5
SWS: $25.0

NOAA Contributions:

J. Rice (0.5 mos =$6.1); J. Short (0.5mos =$5.0); M. Carls (0.5mos =$4.1)

Other:

FY01

Prepared: 4/12/00

Project Number: ~~00xxx~~ 01486
Project Title: **Links between Persistent Oil in Mussel Beds and Predators**
Agency: NOAA

FORM 3A
TRUSTEE
AGENCY
SUMMARY

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 2001
						0.0
Jeep Rice	Toxicologist	GS-14/0	0.5	12.1		6.1
Jeff Short	Chemist	GS-13/8	0.0	10.1		0.0
Mark Carls	Fisheries Research Biologist	GS-12/6	0.5	8.2		4.1
Pat Harris	Zoologist	GS-11/3	1.0	6.4		6.4
Mandy Lindeberg	Fisheries Research Biologist	GS -9/4	2.0	5.1		10.2
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		4.0	41.9	0.0	
					Personnel Total	$26.8

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 2001
					0.0
RT Juneau/ Cordova	0.4	3	6	0.2	2.4
RT Anchorage to PWS	0.8	2	4	0.2	2.4
					0.0
					0.0
RT Juneau/ Anchorage Trustee Workshop	0.6	1	2	0.2	1.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$5.8

FY01

Prepared: 4/12/00

Project Number: 00xxx
Project Title: Links between Persistent Oil in Mussel Beds and Predators
Agency: NOAA

FORM 3B
Personnel
& Travel
DETAIL

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Contractual Costs:			
Description			Proposed FY 2001
4A Linkage CRA			40.4
4A Linkage UAF			53.5
4A Linkage SeeMore Wildlife Systems			25.0
Vessel Charter:	$1500/day	15 days	22.5
Plane Charters:	3	$300/hr	4.0
Temporary Labor (NOAA)			4.0
When a non-trustee organization is used, the form 4A is required.		**Contractual Total**	$149.4

Commodities Costs:	
Description	Proposed FY 2001
Chem Lab supplies for analyses (solvents, glassware, gasses)	2.0
Remote video supplies and freight	0.5
Commodities Total	$2.5

FY01

Prepared: 4/12/00

Project Number: 00xxx
Project Title: Links between Persistent Oil in Mussel Beds and Predators
Agency: NOAA

FORM 3B
Contractual & Commodities
DETAIL

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

Existing Equipment Usage: Description	Number of Units	Inventory Agency
computer, printer	4	NOAA
GC/MS	1	NOAA
HPLC	1	NOAA
GPS	1	NOAA
UVF radio	1	NOAA
camera	1	NOAA
freezer	1	NOAA
skiff/outboard	1	NOAA

FY01

Prepared: 4/12/00

Project Number: 00xxx
Project Title: Links between Persistent Oil in Mussel Beds and Predators
Agency: NOAA

FORM 3B
Equipment
DETAIL

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

Existing Equipment Usage: Description	Number of Units	Inventory Agency
computer, printer	4	NOAA
GC/MS	1	NOAA
HPLC	1	NOAA
GPS	1	NOAA
UVF radio	1	NOAA
camera	1	NOAA
freezer	1	NOAA
skiff/outboard	1	NOAA

FY01

Prepared: 4/12/00

Project Number: 00xxx
Project Title: Links between Persistent Oil in Mussel Beds and Predators
Agency: NOAA

FORM 3B
Equipment
DETAIL

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Budget Category:	Authorized FY 2000	Proposed FY 2001
Personnel		$19.7
Travel		$3.8
Contractual		$0.0
Commodities		$0.6
Equipment		$0.0
Subtotal	$0.0	$24.1
Indirect		$16.3
Project Total	$0.0	$40.4
Full-time Equivalents (FTE)		0.3
Other Resources		

LONG RANGE FUNDING REQUIREMENTS					
			Estimated FY 2002		
			$38.7		

Dollar amounts are shown in thousands of dollars.

Comments:
Indirect costs calculated as follows:
Indirect costs = Overhead + General and Administrative costs + Fee
Overhead = 59.5% of personnel costs
G&A = 12.85% of personnel + overhead + other direct (excluding contractual)

FY01

Prepared: 4/12/00

Project Number: 00xxx
Project Title: Links between Persistent Oil in Mussel Beds and Predators
Name: Coastal Resources Associates, Inc., submitted under BAA

FORM 4A
Non-Trustee
SUMMARY

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Personnel Costs:			Months	Monthly		Proposed
Name	Position Description		Budgeted	Costs	Overtime	FY 2001
T.A. Dean	Senior Scientist, P.I.		2.0	8.0	0.0	16.0
D. Jung	Field Operations Manager		1.0	3.7	0.0	3.7
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		3.0	11.7	0.0	
					Personnel Total	$19.7

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 2001
					0.0
RT San Diego-Anchorage Trustee Workshop	1.0	1	2	0.15	1.3
					0.0
RT San Diego-PWS field work	1.1	2	2	0.15	2.5
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$3.8

FY01

Prepared: 4/12/00

Project Number: 00xxx
Project Title: Links between Persistent Oil in Mussel Beds and Predators
Name: Coastal Resources Associates, Inc., submitted under BAA

FORM 4B
Personnel
& Travel
DETAIL

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Contractual Costs:	Proposed FY 2001
Description	
Contractual Total	$0.0

Commodities Costs:	Proposed FY 2001
Description	
Misc. field supplies	0.4
Shipping costs	0.2
Commodities Total	$0.6

FY01

Prepared: 4/12/00

Project Number: 00xxx
Project Title: Links between Persistent Oil in Mussel Beds and Predators
Name: Coastal Resources Associates, Inc., submitted under BAA

FORM 4B
Contractual & Commodities
DETAIL

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FY 2001
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			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

FY01

Prepared: 4/12/00

Project Number: 00xxx
Project Title: Links between Persistent Oil in Mussel Beds and Predators
Name: Coastal Resources Associates, Inc., submitted under BAA

FORM 4B
Equipment
DETAIL

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Budget Category:	Authorized FY 2000	Proposed FY 2001
Personnel		$29.8
Travel		$1.8
Contractual		$10.4
Commodities		$0.8
Equipment		$0.0
Subtotal	$0.0	$42.8
Indirect		$10.70
Project Total	$0.0	$53.5
Full-time Equivalents (FTE)		0.3
Other Resources		

LONG RANGE FUNDING REQUIREMENTS					
			Estimated FY 2002		
			$25.3		

Dollar amounts are shown in thousands of dollars.

Comments:

Indirect costs calculated as follows: Total Cost + GA
(GA = 25%)

FY01

Prepared: 4/12/00

Project Number: 00xxx
Project Title: Links between Persistent Oil in Mussel Beds and Predators
Name: UAFsubmitted under BAA

FORM 4A
Non-Trustee
SUMMARY

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Personnel Costs:			Months	Monthly		Proposed
	Name	Position Description	Budgeted	Costs	Overtime	FY 2001
	S. Jewett	Research Associate/Professor	2.0	9.8	0.0	19.6
	M. Hoberg	Technician	2.0	5.1	0.0	10.2
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
		Subtotal	4.0	14.9	0.0	
					Personnel Total	$29.8

Travel Costs:		Ticket	Round	Total	Daily	Proposed
	Description	Price	Trips	Days	Per Diem	FY 2001
						0.0
	RT Fairbanks- PWS	0.5	2	2	0.12	1.2
						0.0
	RT Fairbanks-Anchorage Workshop	0.4	1	2	0.12	0.6
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
					Travel Total	$1.8

FY01

Prepared: 4/12/00

Project Number: 00xxx
Project Title: Links between Persistent Oil in Mussel Beds and Predators
Name: UAF submitted under BAA

FORM 4B
Personnel
& Travel
DETAIL

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Contractual Costs:	Proposed FY 2001
Description	
P450 , EROD analysis (80 samples @ $130ea)	10.4
Contractual Total	$10.4

Commodities Costs:	Proposed FY 2001
Description	
Misc. field supplies	0.5
Shipping costs	0.3
Commodities Total	$0.8

FY01

Prepared: 4/12/00

Project Number: 00xxx
Project Title: Links between Persistent Oil in Mussel Beds and Predators
Name: UAF submitted under BAA

FORM 4B
Contractual & Commodities
DETAIL

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

New Equipment Purchases:	Number of Units	Unit Price	Proposed FY 2001
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
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		

FY01

Prepared: 4/12/00

Project Number: 00xxx
Project Title: Links between Persistent Oil in Mussel Beds and Predators
Name: UAF submitted under BAA

FORM 4B
Equipment
DETAIL

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Budget Category:	Authorized FY 2000	Proposed FY 2001
Personnel		$0.0
Travel		$0.0
Contractual		$20.0
Commodities		$0.0
Equipment		$0.0
Subtotal	$0.0	$20.0
Indirect		$5.00
Project Total	$0.0	$25.0
Full-time Equivalents (FTE)		0.0
Other Resources		

LONG RANGE FUNDING REQUIREMENTS					
			Estimated FY 2002		
			$0.0		

Dollar amounts are shown in thousands of dollars.

Comments:

Indirect costs calculated as follows: Total Cost + GA
(GA = 25%)

FY01

Prepared: 4/12/00

Project Number: 00xxx
Project Title: Links between Persistent Oil in Mussel Beds and Predators
Name: SeeMore Wildlife Systems

FORM 4A
Non-Trustee
SUMMARY

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Personnel Costs:			Months	Monthly		Proposed
	Name	Position Description	Budgeted	Costs	Overtime	FY 2001
						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 2001
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
					Travel Total	$0.0

FY01

Prepared: 4/12/00

Project Number: 00xxx
Project Title: Links between Persistent Oil in Mussel Beds and Predators
Name: SeeMore Wildlife Systems

FORM 4B
Personnel
& Travel
DETAIL

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Contractual Costs:	Proposed FY 2001
Description	
SeeMore Wildlife Systems collect video data of predators near oiled mussel beds	20.0
Contractual Total	$20.0

Commodities Costs:	Proposed FY 2001
Description	
Commodities Total	$0.0

FY01

Prepared: 4/12/00

Project Number: 00xxx
Project Title: Links between Persistent Oil in Mussel Beds and Predators
Name: SeeMore Wildlife Systems

FORM 4B
Contractual & Commodities
DETAIL

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

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

Existing Equipment Usage: Description	Number of Units	

FY01

Prepared: 4/12/00

Project Number: 00xxx
Project Title: Links between Persistent Oil in Mussel Beds and Predators
Name: SeeMore Wildlife Systems

FORM 4B
Equipment
DETAIL

Can Kittiwakes Be Used to Predict Future Trends in Adult Herring Abundance?

Project Number:	01490
Restoration Category:	Research
Proposer:	U.S. Fish and Wildlife Service
Lead Trustee Agency:	DOI
Cooperating Agencies:	None
Alaska SeaLife Center:	No
Duration:	2 year
Cost FY 01:	$18.3K
Cost FY 02:	$7.0K
Cost FY 03:	$0
Geographic Area:	Prince William Sound
Injured Resource/Service:	Pacific Herring

ABSTRACT

Because the reproductive success and ultimately the population dynamics of many seabird species are strongly linked to marine productivity, seabirds are commonly promoted as useful indicators of change in the marine environment. Whereas these relationships are of ecological interest, the trophic associations are primarily viewed in hindsight. A more proactive use of seabirds as indicators would be to predict future trends in prey populations. Moreover, if a prey species is of commercial importance, this predictive power could provide valuable information to resource managers. We propose that such a predator-prey relationship with predictive potential exists in Prince William Sound, Alaska, between Black-legged Kittiwakes (*Rissa tridactyla)*, a colonial breeding seabird, and Pacific herring (*Clupea pallasi*), a prey species of commercial importance. The reproductive success of kittiwakes nesting at the two largest, most productive colonies in the Sound appears to be regulated by the abundance of age-1 herring. If kittiwake reproductive parameters could be used as a proxy for the relative abundance of age-1 herring, could we then predict future trends in herring recruitment and adult population size? Our initial review of a 14-year data record of kittiwake reproductive success and age-3 herring abundance provides evidence of such predictive power. In this project we propose a much more detailed analysis to evaluate this relationship and the possibility of including kittiwake data in herring stock recruitment models.

INTRODUCTION

Black-legged Kittiwakes colonies are located throughout PWS. Studies in PWS over the past 10 years have demonstrated that the availability of high quality forage fish is critical to the reproductive success of these birds (Irons 1992, Suryan et al. 2000). In particular, the diet and success of kittiwakes nesting in northern PWS appear to be strictly regulated by the abundance of age-1 herring. For example, in northeast PWS, the age structure of juvenile herring as determined by hydroacoustic sampling (Haldorson et al. 1999; Fig. 1A) was reflected in the age composition of herring consumed by kittiwakes at the Shoup Bay colony (Fig. 1B). Additionally, the years of low age-1 herring abundance resulted in reduced reproductive success for kittiwakes at Shoup Bay (Fig. 1C).

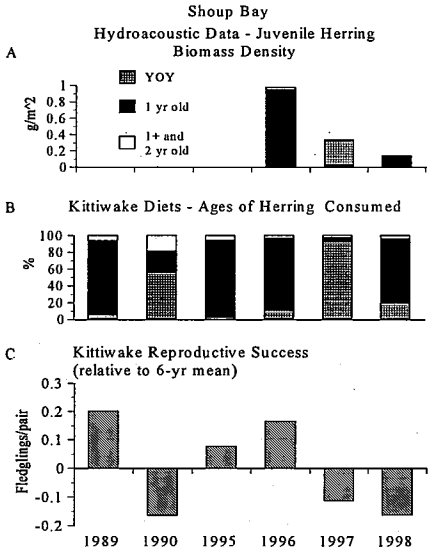

Figure 1.

To evaluate long-term relationships between kittiwakes and herring, we used a 14-yr record (1984 - 1997) of kittiwake reproductive success from the two largest colonies in PWS, Passage Canal (northwest, near Whittier) and Shoup Bay (northeast, near Valdez), and estimates of age-3 herring abundance for all of PWS (Alaska Department of Fish and Game unpubl. data). Based on the evidence in Fig. 1, we considered reproductive success of kittiwakes to be a proxy for the relative abundance of age-1 herring. We then assessed if kittiwake reproductive success reflected abundance trends of age-3 herring two years in the future. We, indeed, found a highly significant linear relationship between kittiwake reproductive success and the abundance (log_{10}) of age-3 herring two years into the future, with one caveat (Fig.2). This relationship excludes four outlying years prior to 1989 (possible explanations are discussed below). Nonetheless, in 10 of 14 years (and in all years since 1989), kittiwake reproductive success has accurately reflected future trends in adult herring biomass (Fig. 3).

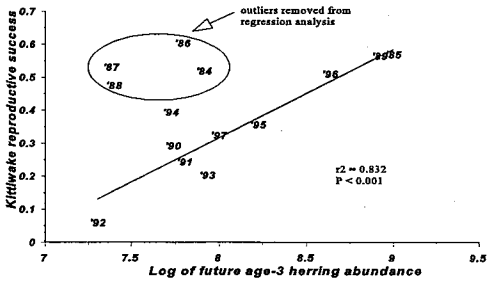

Figure 2.

Discrepancies between the kittiwake and herring data during four of five years prior to 1989 result from kittiwake reproductive success being high while future age-3 herring abundance was low. Possible explanations for discrepancies during the four years include: 1) differences in herring abundance between northeast and northwest PWS; 2) prey items other than herring (e.g. sand lance, *Ammodytes hexapterus*, or capelin, *Mallotus villosus*) were available to kittiwakes; 3)

differential mortality of age-2 and age-3 herring; 4) greater energetic content of juvenile herring prior to 1989. With this project, we propose to conduct a more detailed analysis to address these and other questions. For example, the "outlier" years that we identified could potentially be explained by including additional kittiwake reproductive parameters (e.g. diets, laying success, energy acquisition rates, etc.) in the relationship, taking a multivariate approach. The relationship between kittiwakes and herring in PWS could be an example of seabird data contributing to fish stock assessment models as championed by Cairns (1992).

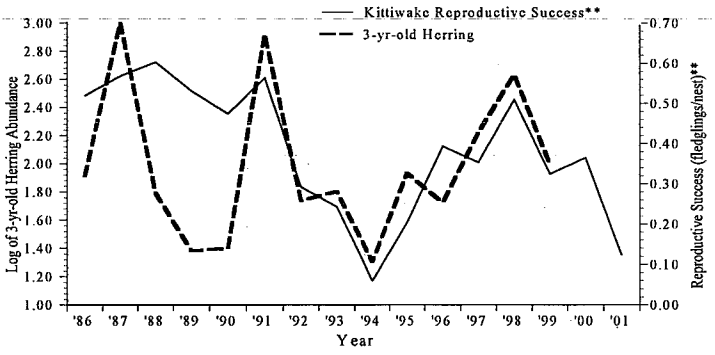

Figure 3.

NEED FOR THE PROJECT

A. Statement of Problem

Herring population sizes exhibit dramatic, often natural, fluctuations through time (Wepestad and Gunderson 1991). Between 1947 and 1982 for example, Atlantic herring (*Clupea harengus*) recruitment in the Gulf of Maine varied 20-fold (Anthony and Fogarty 1985). Additionally, it is often only a single strong year-class that supports a large adult population and the associated commercial fishery (Anthony and Fogarty 1985, Pearson et al. 1999). Therefore, predicting the recruitment of a strong or weak year-class into the commercially exploitable adult population is of paramount importance to resource managers.

Pacific herring in PWS also have exhibited "boom" and "bust" population trends. During the 1970s and 1980s, Funk and Sandone (1990) reported that a strong year class occurs in PWS about every four years. The most recent strong year classes in PWS were from 1984 and 1988. These strong year classes supported record biomass estimates and harvests in the late 1980s and early 1990s until 1993, when the population crashed and the fisheries were closed (Paine et al. 1996, Spies et al. 1996). Viral hemorrhagic septicemia virus (VHSC) was detected in the herring population and may have contributed to the decline (Meyers et al. 1994). However, determination of reasons for such large mortality and recovery time for the population was complicated by a paucity of life history information for the PWS population (Meyers et al. 1994, Paine et al. 1996). Schweigert and Noakes (1991) noted that in short-lived pelagic species such as Pacific herring, new recruits or first time spawners may comprise 10% to over 50% of the total spawning run; recruitment, therefore, can be a major factor determining fluctuations in population abundance.

Stokesbury et al. (in review), noted that little is known of juvenile herring mortality and spatial distribution (Blaxter and Hunter 1982, McGurk 1993). In fact, most fisheries assessments contain no recruitment predictors other than the long term mean (Cairns 1992). Clearly, studies

that focus on "pre-recruits" (sub-adults in most cases) of commercially important species (e.g. the SEA project and juvenile herring in PWS) are more widely needed in the management of fisheries. However, it is the absence of such programs, the general lack of knowledge about early life stages, and the tendency for seabirds to prey on these juvenile fishes that has led Cairns (1992) and others to propose seabirds as potential predictors of recruitment in commercial stocks. By no means can seabirds replace detailed investigations of juvenile fish population and environmental factors controlling them, but under some circumstances seabird-based indices may be useful supplements to currently running programs without concurrent early-life stage components (Cairns 1992).

In PWS, black-legged kittiwakes may be a valid supplement for periods when studies of juvenile herring are not occurring. In 1989, for example, herring in the diet of kittiwakes at Shoup Bay was dominated by age-1 fish and their reproductive success was high (Fig. 1), reflecting the strong 1988 herring year class and good overwinter survival of the young-of-year (YOY) fish. The 1988 herring year class later supported healthy commercial fishing seasons. In 1990, however, kittiwake diets lacked age-1 herring and their reproductive success suffered (Fig. 1), indicating a weak 1989 year class and/or poor over-winter survival. Moreover, throughout the early 1990s kittiwakes showed no indication of a strong year class to augment declining adult herring populations (Fig.3), thereby providing accurate clues (two years in advance!) to the question of "When will the herring population recover following the 1993 crash." Unfortunately, after a few years of optimistic trends, data from kittiwakes indicate that a decline in the herring population is again occurring. In fact, the recent continuous decline in kittiwake reproductive success is similar to that corresponding to the adult herring population crash of the early 1990s and will continue until at least 2001 (Fig. 3).

B. Rational/Link to Restoration

Herring are an important link for a healthy PWS ecosystem. They have provided a resource for the commercial fishing industry as well as a nutrient source for other animal populations that are important for traditional and recreational uses. These activities were greatly impacted by the early 1990's crash in the herring population and lack of recovery. Hence, the EVOS Trustee Council has identified the herring population as an injured resource and identified the associated commercial, recreational, and subsistence activities as lost or reduce human services. Herring populations were eventually listed as recovering, however, given the data described above, their recovery still may be hampered.

Since herring is such an important resource, managers need a variety of tools to assess and predict population trends. The Alaska Department of Fish and Game (ADFG) has a multi-faceted program to accurately monitor abundance trends in the adult herring population. The ability to predict these trends is very limited, although studies of juvenile herring over recent years have contributed greatly (e.g. Stokesbury in review). However, limited funds may curtail or prevent the use intensive studies of juvenile fish for long-term monitoring. If data from kittiwakes in PWS prove to be a reliable proxy for the abundance of age-1 herring and a valuable indicator of future trends in recruitment, they may provide an inexpensive, long-term monitoring

tool and valuable index to supplement current stock recruitment models.

C. Location

This project involves data collected in Prince William Sound. Results of our work and the potential for long-term monitoring apply to the herring population in the Sound.

COMMUNITY INVOLVEMENT AND TRADITIONAL KNOWLEDGE

Since this project involves retrospective analysis of previously collected data, there is little potential involvement of community members. However, we imagine that important (particularly positive) results would be of interest to commercial fishing and subsistence user groups. If that is the case, we would be pleased to meet and discuss our findings with local communities or provide easy to read information sheets summarizing our results and conclusions.

PROJECT DESIGN

A. Objectives

1. Identify parameters of kittiwake diets, reproduction, and foraging activities that provide the most accurate prediction of future trends in recruitment in adult herring populations.
2. Evaluate the utility of using kittiwake data to monitor and predict herring recruitment trends. If results are positive, then
3. Develop or contribute to currently developed models of stock recruitment for the PWS herring population.

B. Methods

We will be using existing data sets collected primarily by the U.S. Fish and Wildlife Service (FWS) and ADFG. The following is a brief description of the methods used in collecting the data and anticipated methods of analysis.

Kittiwakes

Data for this study come from two colonies in PWS, Passage Canal and Shoup Bay. We chose these two colonies for several important reasons:

1. Adults from these colonies regularly feed in bays (Irons 1992, Suryan et al. 2000), which are known to be important nursery areas for YOY and age-1 herring (Stokesbury 2000).
2. They are located in northern PWS where age-1 herring in particular have been identified as critical to kittiwake reproductive success (Suryan et al. 2000, Suryan and Irons unpubl. data)
3. Since 1984, they have produced between 50% and over 95%($\bar{x}$ = 75%) of the fledglings

in PWS.

4. They are large colonies (3,000 to nearly 8,000 breeding pairs) and, therefore, are less susceptible to the relative effects of egg and chick predators ("predator swamping;" Gochfeld 1982, Wilkinson and English-Loeb 1982) that can influence reproductive parameters at colonies in PWS independent of food supply (Suryan and Irons in review; Suryan and Irons unpubl. data).

Since 1984, the annual reproductive success (fledglings/pair) of kittiwakes at Passage Canal and Shoup Bay has been determined using the following method. We first determined breeding population size by counting nests (i.e. breeding pairs), regardless of contents or an attending adult, in June or early July. We later counted nestlings in early August, just prior to fledging, to estimate annual reproductive success (fledglings/pair). Each colony was divided into plots . Counts of individual plots represented a census of each colony and were repeated until there was a 5% or less error in precision. Observers used binoculars (7X to 10X) and conducted counts from a boat (7.6 m). In addition to reproductive success, diet, foraging, and more detailed reproductive parameters have been collected at the Shoup Bay colony since 1988 and are listed in Table 1. Diet samples were collected as regurgitations from nestlings. Regurgitation samples were collected from chicks throughout the colony and the entire chick-rearing period. Diet samples were stored frozen or in isopropyl alcohol for later identification. Most foraging parameters were determined by tracking individually radio-tagged kittiwakes during feeding trips (data available for seven years). Energy provisioning rates of nestlings was determined by monitoring feeding rates at selected nests and calculating the average meal size and energy density (kj/g), the latter involving laboratory analyses (data available for five years). Additional details of calculating foraging parameters can be obtained from APEX (EVOS project 163) detailed project descriptions or published literature (Irons 1998, Anthony et al. in press). Data used to calculate reproductive parameters were collected from plots (n = 13-18) that were located in accessible areas of the colony. Each plot contained 10 to 30 nests. Contents of each nest was checked every three days during the breeding season, prior to egg laying in early June and until chicks were at least 32 days old or had fledged, usually by mid-August. Chick growth rates were measured at 20 to 60 nests located throughout the colony. Nests were visited every five days and chicks were measured to the nearest gram using 100g, 300g, or 500g Pesola spring scales. In some years the age of chicks was not known, therefore growth rates were calculated for the near-linear portion of the growth curve (i.e. 60 - 300 g) by dividing the weight gain by the number of days.

Table 1. Parameters collected at the Shoup Bay kittiwake colony.

Diet	Foraging	Reproduction
species	trip duration	clutch size
age-class	trip distance	laying success
% occurrence	time budgets	hatching success
% mass	# feeding attempts	brood size
	energy provisioning	fledging success
		chick growth
		fledge mass

Abundance of Age-3 herring

Age-structured abundance estimates of the adult herring population in PWS are determined annually by the ADFG. These estimates are derived from a model that requires a variety of measured input variables from aerial- and ship-based sampling platforms that we will describe only superficially herein. Aerial surveys were conducted to estimate the total kilometers of

herring spawn deposited along the shoreline of PWS. A strong relationship ($r^2 = 0.892$) exists between the km of spawn and the number of adult herring. This relationship can, therefore, be used to reliably estimate total adult herring biomass (tonnes) from spawn deposition (this method is preferable in most cases since the light color of spawn is easier to detect during aerial surveys than the dark color of herring schools). Ship-based work involved both net sampling to determine age and size composition and hydroacoustic sampling to estimate age-structured biomass of the spawning population. These measures and others (e.g. mortality estimates) are incorporated into the model to produce the final age-structured biomass estimates for the Sound. Since juvenile herring first recruit into the adult population at age-3, we used the biomass of this age group in our preliminary analyses. Mark Willette (ADFG) provided valuable guidance in selecting the appropriate data and educated us a bit on the methods behind the numbers. However, any errors in the above description are certainly our own.

In using kittiwakes to predict recruitment trends of adult herring, we assume the greatest mortality of juvenile herring occurs during the first year of life and that is what determines a strong year class (i.e. significant mortality does not occur between age-1 and recruitment into the adult population). This may not always be true due to unpredictable mortality of older juveniles or adults caused by disease or other factors. Therefore, some skepticism will always exist if kittiwakes indicate a strong year class recruitment, however, less skepticism may occur if kittiwakes indicate a poor recruitment trend.

Analysis

In previous investigations, fishery biologists have estimated recruitment in fish populations using models described by Fournier and Archibald (1982) and/or Ricker stock-recruitment models (Ricker 1975). For example, Stocker et al. (1985) used a multiplicative, environmental-dependent Ricker spawn-recruitment model to test for significant environmental variables affecting herring recruitment in the Strait of Georgia, Canada. It may be feasible to include kittiwake parameters as environmental variables in the above models. Additional analytical techniques include multispecies models. Cairns (1992) suggested the use of Multispecies Virtual Population Analysis (MSVPA, Shepherd 1988, Pope 1989) for applying seabird data to fish stock assessments.

In our cursory review of the kittiwake and herring data to date, we have used simple linear regression and curve fitting to demonstrate significant relationships and trends. The next step is to select appropriate kittiwake parameters to include in the final model. This will likely be accomplished using logistic regression (binomial data) and analysis of covariance (multinomial data). At this point, we honestly do not know which of the above mentioned stock recruitment models or other potential analysis methods are most appropriate for incorporating multiple parameters of kittiwake reproduction into herring stock assessment models in PWS. Our proposed project includes research to determine appropriate statistical models to apply. A portion of this effort will include discussions with ADFG personnel who are developing and applying the current stock assessment models for herring in PWS and discussions with marine ornithologists who have successfully integrated seabird and fishery data in other regions.

C. Cooperating Agencies, Contracts, and Other Agency Assistance

None

SCHEDULE

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

In FY 01:

January 16 - 26:	Attend Annual Restoration Workshop
February 1:	Complete initial analyses to determine which kittiwake parameters significantly contribute to predicting recruitment trends
April 15:	Determine which stock recruitment models are appropriate for our use

FY 02:

January:	Present results at the Annual Restoration Workshop
April 15:	Submit final report and manuscript for publication.

B. Project Milestones and Endpoints

FY 01 Objectives (from PROJECT DESIGN)

February 1:	Identify parameters of kittiwake diets, reproduction, and foraging activities that provide the most accurate prediction of future trends in recruitment in adult herring populations.
April 1:	Evaluate the utility of using kittiwake data to monitor and predict herring recruitment trends. If results are positive, then

FY 02 Objectives (from PROJECT DESIGN)

April 15:	Develop or contribute to currently developed models of stock recruitment for the PWS herring population.

C. Completion Date

FY 02

April 15:	Submit final report and manuscript to Restoration Office

PUBLICATIONS AND REPORTS

We will submit a final report and manuscript for publication in a peer reviewed journal no later than April 15, 2002. A draft title for the manuscript is:

Black-legged kittiwakes as predictors of future trends in herring recruitment and their role in stock assessment models. Potential target journals include: ICES Journal of Marine Science, Fishery Bulletin.

PROFESSIONAL CONFERENCES

During FY 01, we will attend the EVOS restoration workshop. During FY 02, we will present our results at the EVOS restoration workshop and one other national or international conference.

NORMAL AGENCY MANAGEMENT

The proposed project includes some data from basic monitoring activities conducted by the FWS. The analysis completed to date was for our own interest while working on related APEX funded data. However, the proposed analyses, potential integration of data with fisheries models, and publication is beyond our APEX funding and that of the FWS.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

The project will require coordination between the project leaders and fishery biologists with the ADFG. So far we have primarily worked with Mark Willette (ADFG). We have also discussed these data sets with Evelyn Brown (University of Alaska Fairbanks) and will draw on the wealth of information obtained during the SEA juvenile herring project. We will also use some data collected by APEX investigators. In an attempt to maintain a low budget, we have not included salary money for biologists in other agencies that we will need to coordinate with. However, pending further collaborations, we may need to re-evaluate the distribution of proposed funds. Additionally, we intend to petition the FWS for a small amount of financial support for this project.

PROPOSED PRINCIPAL INVESTIGATORS

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PRINCIPAL INVESTIGATORS

Robert M. Suryan received a B.S. degree in wildlife management at Humboldt State University (1989), a M.S. degree in marine science at Moss Landing Marine Laboratories (1995), and has 15 years of experience in field biology. He has conducted studies of terrestrial and marine birds and mammals, involving population assessment, habitat use, foraging ecology, diving behavior, and effects of human disturbance. For the past five years, Rob has been a co-project leader for APEX component 163E and has conducted studies of the foraging ecology, reproductive biology, and population dynamics of Black-legged Kittiwakes in Prince William Sound, Alaska.

Selected Reports and Publications

Suryan, R.M., D.B. Irons, and J. Benson. 2000. Prey switching and variable foraging strategies of Black-legged Kittiwakes and the effect on reproductive success. Condor 102:375-385.

Suryan, R.M. and D.B. Irons. In review. Colony and population dynamics of Black-legged Kittiwakes in a heterogeneous environment. Auk.

Suryan, R.M. and D.D. Roby. 1996. Management of Human Impacts. *In:* Warheit, K.I., C.S. Harrison, and G.J. Divoky (*eds.*) *Exxon Valdez* Oil Spill Seabird Restoration Workshop. *Exxon Valdez Oil Spill Restoration Final Report, Project 95038*. Technical Publication Number 1. Pacific Seabird Group, Seattle.

Suryan, R.M. and J.T. Harvey. 1998. Tracking harbor seals (*Phoca vitulina richardsi*) to determine dive behavior, foraging activity, and haul-out site use. Mar. Mamm. Sci. 14(2):361-372.

Suryan, R.M. and J.T. Harvey. 1999. Variation in reaction of harbor seals to disturbance. Fish. Bull. 97(2) 332-339.

Ostrand, W.O., G.S. Drew, R.M. Suryan, and L.L. McDonald. 1998. Evaluation of radio-tracking and strip transect methods for determining foraging ranges of Black-legged Kittiwakes. Condor 100:709-718.

David B. Irons received his Ph. D. from the U. of CA, Irvine in 1992. His dissertation was on the foraging ecology and breeding biology of the black-legged kittiwake. The field work for this study was conducted in Prince William Sound. David received his M. S. from Oregon State University in 1982 where he studied foraging behavior of glaucous-winged gulls in relation to the presence of sea otters. David conducted marine bird and sea otter surveys in PWS in 1984 and 1985. He has been studying kittiwakes in PWS for 12 years and completed the EVOS kittiwake damage assessment study. David has overseen several seabird studies in the past few years including marine bird and sea otter surveys in PWS, Cook Inlet, and SE Alaska, a seabird monitoring study on Little Diomede Island, a cost of reproduction study on kittiwakes, a seabird/forage fish interactions study, and various population and reproductive studies on pigeon guillemots and marbled murrelets.

Selected Publications:

Irons, D.B. 1998. Foraging area fidelity of individual seabirds in relation to tidal cycles and flock feeding. Ecology 79(2):647-655.

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Golet, G. H. and D. B. Irons. 1999. Raising young reduces body condition and fat stores in black-legged kittiwakes. Oecologia 120:530-538.

Golet, G.H., D.B. Irons and J.A. Estes. 1998. Survival costs of chick rearing in black-legged kittiwakes. J. Anim. Ecol. 67:827-841.

Golet, G. H., K. J. Kuletz, D. D. Roby, and D. B. Irons. 2000. Adult prey choice affects chick growth and reproductive success in Pigeon Guillemots. Auk 117:82-91.

Hatch, S.A., G.V. Bryd, D.B. Irons, and G.L. Hunt. 1993. Status and ecology of kittiwakes in the North Pacific Ocean. Pages 140-153 *in* editors, K. Vermeer, K.T. Briggs, K.H. Morgan, D. Siegel-Causey, The status, ecology, and conservation of marine birds of the North Pacific. Can. Wildl. Serv. Spec. Publ., Ottawa, Canada.

Vermeer, K., and D.B. Irons. 1991. The Glaucous-winged Gull on the Pacific Coast of North America. Acta Twentieth Congressus Internationalis Ornithologici:2378-2383.

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Irons, D. B. 1992. Aspects of foraging behavior and reproductive biology of the Black-legged Kittiwake. PhD. Dissertation. Univ. of California, Irvine. 143 pp.

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2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Budget Category:	Authorized FFY 2000	Proposed FFY 2001
Personnel		$15.5
Travel		$0.0
Contractual		$0.0
Commodities		$0.5
Equipment		$0.0
Subtotal	$0.0	$16.0
General Administration		$2.3
Project Total	$0.0	$18.3
Full-time Equivalents (FTE)		0.2
Other Resources		

LONG RANGE FUNDING REQUIREMENTS

Estimated FY 2002	Estimated FY 2003		
$7.0	$0.0		

Dollar amounts are shown in thousands of dollars.

Comments:

FY 01

Prepared: 1 of 4

Project Number: 01 490
Project Title: Can Kittiwakes Be Used to Predict Future Trends in Adult Herring Abundance?
Agency: DOI - FWS

FORM 3A
AGENCY
PROJECT
DETAIL

4/14/00

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Personnel Costs:			GS/Range/	Months	Monthly		Proposed
PM	Name	Position Description	Step	Budgeted	Costs	Overtime	FY 2001
	Suryan	Co-Project Leader	GS11 - 5	2.5	6,200		15.5
	Irons	Co-Project Leader	GS12 - 6	0.0	6,700		0.0
		Subtotal		2.5	12,900	0	
Those costs associated with program management should be indicated by placement of an *.						**Personnel Total**	$15.5

Travel Costs:		Ticket	Round	Total	Daily	Proposed
PM	Description	Price	Trips	Days	Per Diem	FY 2001
Those costs associated with program management should be indicated by placement of an *.					**Travel Total**	$0.0

FY 01

Project Number: 01_____
Project Title: Can Kittiwakes Be Used to Predict Future Trends in Adult Herring Abundance?
Agency: DOI - FWS

FORM 3B
Personnel
& Travel
DETAIL

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Contractual Costs:	Proposed FY 2001
Description	
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$0.0

Commodities Costs:	Proposed FY 2001
Description	
Computer equipment/software upgrades	0.5
Commodities Total	$0.5

FY 01

Project Number: 01_____
Project Title: Can Kittiwakes Be Used to Predict Future Trends in Adult Herring Abundance?
Agency: DOI - FWS

FORM 3B
Contractual & Commodities
DETAIL

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

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

FY 01

4 of 4

Project Number: 01_____
Project Title: Can Kittiwakes Be Used to Predict Future Trends in Adult Herring Abundance?
Agency: DOI - FWS

FORM 3B
Equipment
DETAIL

4/14/00

Were Pink Salmon Embryo Studies in PWS Biased?

Project Number:	~~00~~ 01492
Restoration Category:	Research
Proposer:	John Thedinga, Mark Carls, Ron Heintz, NMFS, Auke Bay Laboratory ABL Program Manager: Dr. Stanley Rice NOAA Program Manager: Bruce Wright
NMFS Auke Bay Laboratory	
Lead Trustee Agency:	NOAA
Alaska SeaLife Center:	No
Cooperating Agencies:	
Duration:	2 years
Cost FY01:	$103,400
Cost FY02:	$27,900
Geographic Area:	Laboratory studies: Retrospective analysis-PWS samples Field studies: Little Port Walter on Baranof Island, Auke Creek Hatchery (Southeast Alaska)
Injured Resource/Service:	Pink salmon

ABSTRACT

Effects of the *Exxon Valdez* oil spill on wild pink salmon embryo survival in Prince William Sound are disputed among government- and industry-sponsored researchers. Exxon contends the government's conclusions that reduced embryo viability in oiled streams was caused by persistent oil contamination were biased because sampling times were earlier in oiled streams than in reference streams. We propose a combination of retrospective and experimental studies to determine if estimates of pink salmon embryo survival were accurate or biased by conducting a historical review of past sampling procedures and experimentally determining the ability to discriminate eggs killed by sampling (shock mortality) and previously dead eggs.

INTRODUCTION

The Trustee Council view of damage to pink salmon in Prince William Sound (PWS) is different than that of Exxon (Rice et al. 1999; Brannon and Maki 1996; Brannon et al. 1999). One controversial issue has been embryo mortality in oiled vs. non-oiled streams. Bue (1998) found that oiled streams had significantly higher pink salmon embryo mortality than non-oiled streams and Heintz et al. (1999) confirmed that incubation in oiled substrate can cause damage to embryos. Brannon (1996), however claimed that increased mortality in oiled streams was an artifact of sample design due to shocking and bias from sampling timing. Collins et al. (2000) showed that hydraulic sampling of embryos can cause mortality that can bias mortality estimates upward if not accounted for.

After 11 years, the questions remain- -was there bias in the sampling because of run timing differences between oiled and non-oiled streams? Were egg counters able to separate new mortalities caused by shocking during the sampling, and did they account for the sampling mortalities? Is it possible to account for the mortalities? These questions are basic to the assessment of damage to pink salmon from the spill, and to restoration strategies that should result. This project examines this continuing controversy with a combination of retrospective and experimental studies.

Several different retrospective efforts will be conducted in this study. The analyses of the run timing issue by both ADFG (Craig et al. 1999) and Brannon et al. (1999) will be examined statistically in detail. Key to the issue is whether shock induced mortalities were caused, how they were counted, and if they were accounted for. The quality of the mortality data will be evaluated by interviewing supervising and technician personnel to determine what the sampling protocols were, if they were used, and if they were adequate. Sampling error by mis-identification of live/dead eggs can also be independently assessed by re-examination of the preserved live and dead eggs collected in 1990 and 1991. Auke Bay laboratory has received the preserved egg samples from all four zones sampled from 15 control and 10 oiled streams in 1990 and 1991 (several thousand eggs). The potential for error can be assessed by measuring the degree of necrosis in the preserved specimens, and also by identification of the life stage at the time of collection.

Experimental studies will focus on the ability to separate live eggs and dead eggs from newly shocked eggs. This will be done first in a controlled laboratory situation (hatchery) with a series on known life stages. A field test will also be conducted to test the relationship between run timing and susceptibility of eggs to pumping damage. For the field test, we will need a uniform stream that can be re-sampled periodically during the run; the spawning channel at Lovers Cove Creek near Little Port Walter (LPW) will be used for the field study. A proportion of the eggs in these experiments will be repeatedly viewed by several observers to test discrimination of recent and past mortality as a function of time.

Ultimately, a model will be developed to examine the possibility that ADF&G data collected

from 1989-1993 in oiled and reference streams had uni-directional biases in spawn timing, processing time, and recognition of shock mortality. Data from both the retrospective and field studies and from ADFG's egg pumping studies will be synthesized to determine if results were biased.

Spawning for pink salmon begins in August and September; Auke Bay Laboratory will provide in kind funds to facilitate initiation of this project in late fy2000 so that it can be fully functional for FY 2001.

NEED FOR PROJECT

A. Statement of problem

There is an ongoing dispute between government and industry researchers concerning the impact of the Exxon Valdez oil spill on pink salmon in PWS. Government researchers concluded that pink salmon embryo survival was lower in oiled streams than in non-oiled streams from 1989-1993. Industry researchers allege that government sampling in oiled streams was earlier than in reference streams relative to run timing, thus biasing estimates of egg survival, because early egg stages are more susceptible to mechanical damage caused by hydraulic pump sampling than later stages. Industry researchers further contend that government observers failed to discriminate between previously dead eggs and those killed by sampling, thereby compounding the problem. The controversy continues after 11 years; This study attempts to clarify the controversy if possible and will use several lines of investigation. The controversy continues to cloud estimates of damage, restoration strategies, the impact of long term damage, and the definition of full recovery for this species.

B. Rationale/Link to Restoration

Pink salmon are listed as a recovering species, but before they can be added to the list of recovered species we need to know if persistent oil caused increased mortality of pink salmon embryos in PWS streams. Controversy over how sampling techniques and run timing affected the results of past embryo mortality studies needs to be resolved in order to determine the extent of possible damage from EVOS. Recent studies have shown that oil still exists near natal habitats and that pink salmon embryos are significantly more sensitive to oil exposure than previously believed (Heintz, et al. 1999a, b). If embryos are continuing to be exposed to oil in streams then the extent of damage needs to be understood. Understanding the damage that oil can cause to pink salmon embryos is also important in realizing potential risks associated with future oil spills.

C. Location

The retrospective portion of this project will use pink salmon eggs pumped from PWS streams

from 1990-1991. ADFG personnel that participated in the egg pumping studies in PWS will be interviewed. The field portion of the project will take place at Lovers Cove Creek near the Little Port Walter field station (LPW) in Southeast Alaska and at Auke Creek Hatchery in Juneau. Lovers Cove Creek provides a uniform spawning channel and an intertidal spawning population of pink salmon that allows repeated sampling. This location is appropriate because the streams physical characteristics are conducive to this type of project and it close to LPW which provides the necessary logistical and infrastructure support.

COMMUNITY INVOLVEMENT AND TRADITIONAL KNOWLEDGE

Scientists involved in this study will regularly present progress reports and results in scientific and public forums, including the annual workshop. They will be available to talk with interested public and will provide information for Trustee Council newsletters and annual reports as appropriate.

PROJECT DESIGN

A. Objectives

The primary objective is to determine if time-series estimates of pink salmon embryo survival in streams oiled by the Exxon Valdez oil spill were accurate or biased. Several steps are required to achieve this objective:

Retrospective study

1. Determine if there was potential for bias:
   Did sampling times differ in oiled and non-oiled streams relative to mean spawning time?
   a. Evaluate ADFG's (Bue 1998; Craig et al. 1999) results of PWS pink salmon embryo mortality data and Brannon et al.s (1999) interpretation of ADFG's results.

2. Determine if observers accounted for mortality induced by sampling procedures.
   a. Document standard operating procedures. Specifically, determine if instructions were given to egg counters to discriminate eggs killed by pumping from previously dead eggs.
   b. Document what data were actually collected by field crews. Determine if observers followed protocol.

3. Determine if standard operating procedures were adequate.
   a. Determine if egg observers kept up with egg pumpers or fell behind: determine the average and range of times between egg collection and egg

observation.

b. Determine if there were differences between oiled and reference streams in lag times between egg pumpers and observers. Were the number of eggs to count different between oiled and un-oiled streams?

4. Determine the developmental stage of preserved eggs that were sampled by ADFG in 1990-1991 from oiled and non-oiled streams.
   a. Determine if there is evidence of errors in the identification of live and dead eggs.
   b. Visually examine live and dead eggs to determine if there is a difference in the life stage at mortality between oiled and non-oiled streams.

Experimental study

1. Develop models to relate previous field work to known life stages , run timing, and observer accuracy.
   a. At a hatchery, experimentally determine the period of time observers are able to discriminate between eggs of known age killed by shocking and previously dead eggs. This test will be repeated at different egg developmental stages.
   b. Collect time series of egg shock data by pumping samples from a pink salmon stream over time. Relate mortality to run timing.

Synthesis

1. Develop a model to examine the possibility that ADF&G data collected from 1989-1993 in oiled and reference streams had uni-directional biases in processing time, recognition of shock mortality, and spawn timing.

2. Discuss and compare results and conclusions to those reached by Brannon and Maki (1996).

B. Methods

Retrospective study

ADFG personnel (supervisors, technicians) that supervised hydraulic egg sampling in PWS following EVOS will be interviewed to determine what egg sampling protocols existed and what protocol were given to field samplers. Personnel that sampled eggs will be interviewed to determine what data they actually collected and what sampling protocols were followed. We will determine if the number of eggs counted differed between oiled and nonoiled streams which could affect the time between egg collection and egg observation. A statistician will analyze pink salmon embryo and sampling timing data reported by Bue (1998) and Craig et al (1999) and challenged by Brannon et al. (1999). The findings in each report will be evaluated and if additional data exists it will be made available by ADFG and incorporated into the analysis.

Results will be synthesized and a conclusion to whether the results are biased or not will be made.

The developmental stage of the eggs at the time of death will be assessed by visual estimating egg condition of preserved eggs sampled from PWS streams in 1990-1991. Visual estimates will confirm the amount of necrosis in both live and dead eggs. Live eggs that were killed by sampling will appear partially necrotic. All dead eggs with visible chorion will be of an earlier stage of development than eggs in the live samples. The collection of eggs is from each of the four zones sampled from 15 control and 10 oiled streams in 1990 and 1991(Tables 1, 2).

Experimental study

Hatchery: To determine the period of time observers are able to discriminate between shock mortality and previously dead eggs, eggs will be incubated in the Auke Creek hatchery and assessed for shock mortality at three times after fertilization. Eggs from two adult pink salmon from Auke Creek from three portions of the run will be fertilized and incubated. Eggs from each group will be assessed 1, 10,20,30,40, and 50 days after fertilization. For assessment, 50 eggs from each sampling period will be shocked at three shock intensities; eggs will be shocked by dropping them into water from a distance of 1/4, 1, and 2 meters. Eggs will be assessed 5, 15, 30, 60, and 90 minutes after shocking independently by two observers. A subset of eggs will preserved in 5% acetic formalin immediately after pumping for verification of live and dead eggs.

Field: Eggs will be pumped at Lovers Cove Creek where repeated sampling over a spawning run is feasible. Lovers Cove Creek was modified into an experimental spawning channel in the 1970's (Martin 1973), and today it is an intertidal stream channel with uniform width and spawning gravel and consistent stream flow. The 50 m channel will be partitioned into 25 transects 2 m apart. Care will be taken to avoid walking in other areas of the stream outside the sampled transects to avoid damaging embryos. Eggs will be pumped using standard egg pumping procedures in randomly selected transects to identify live and dead eggs and those killed by pumping. Pumping will begin the end of September and end the first week of November. Approximate sampling dates are Sept. 30, Oct. 5, 10, 20, and Nov. 2. To ensure adequate sample size, five transects will be sampled each day, and five plots will be sampled at each transect for a total of 25 samples each sample date.

Eggs collected from each plot will be placed in separate plastic trays and assessed 10 minutes after pumping. Eggs will be classified into four groups: translucent, translucent eyed, dense opaque, and partially opaque. Translucent eggs will be considered live. Translucent eyed eggs that show eye pigmentation through the chorion will be considered live. Opaque eggs are those that contain coagulated yolk and appear white and will be considered to have died prior to sampling. Eggs that are partially opaque or are in the process of turning opaque will be considered fatalities or shock mortalities because the viteline membrane has ruptured and the yolk has begun coagulating. Samples of eggs that were assessed as shock mortalities will be

preserved in 5% acetic formalin for later microscopic examination of embryo development.

To test the effect of time after collection on identifying shock mortality, eggs will be classified at several times following collection. At one of the transect each sample date, live and dead eggs will be assessed independently by two samplers after collecting the eggs. Handling of eggs will be minimized to reduce the chance of further inducing egg shock mortality. Eggs will be assessed 10, 30, and 60 minutes after pumping.

Run timing at Lovers Cove Creek will be monitored prior to and during egg pumping to determine run timing. Beginning in mid-August, the spawning channel at Lovers Cove Creek will viewed every other day to determine the onset and number of spawners. Egg pumping will begin when most fish have spawned.

Synthesis

We will develop a model to examine the possibility that ADF&G data collected from 1989-1993 in oiled and reference streams had uni-directional biases in processing time, recognition of shock mortality, and spawn timing. We will use data from both the retrospective and the field studies for the model.

In order to determine what level of misinterpretation of egg condition (live or dead) would bias the results of the embryo mortality study we model the PWS embryo data from 1989 - 1993. Based on Bue's (1996) data, we modeled the number of eggs counted in the oiled and control streams in PWS to account for the misidentification of eggs shocked and killed by the egg pumping procedure. We used a GLM two factor model based on the height above intertidal where the eggs were collected and compared the oiled vs. non-oiled streams. The difference in egg mortality between the oiled and non-oiled streams became non significant ($P = 0.05$) when 9.5% of eggs in all of the oiled streams were incorrectly counted as dead, but were actually killed by egg pumping and should have been counted as live. Whereas in the non-oiled streams, 11.3% of dead eggs would have to be incorrectly counted as live before mortality between oiled and non-oiled streams was no longer significantly different.

C. Cooperating agencies, contracts and other agency assistance

ADFG will provide historic egg sampling data, eggs, and run timing information. Contracts will be awarded to analyze preserved eggs from PWS and to evaluate Bue's (1998) pink salmon embryo mortality results and Brannon et al.'s (1999) rebuttal of the results. NMFS will pump eggs in the field, test egg shock mortality recognition in the hatchery, and conduct the retrospective analysis. In order to sample eggs from this years pink salmon run, this project will need to be started in FY 2000. NMFS will facilitate the start of the experimental portion of this project by making preparations this summer for sampling in September 2000.

SCHEDULE

A. Measurable tasks for FY00 (October 1, 1999 - September 30, 2000)

September:	Field: Begin pumping eggs at Lovers Cove Creek Incubate eggs at LPW

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

Oct. - Nov.:	Field: Pump eggs at Lovers Cove Creek Hatchery: Assess shocked eggs at Auke Creek Hatchery
Winter:	Begin analysis of egg pumping and egg shocking data from FY 01 field season Begin retrospective study Analyze preserved eggs
Spring:	Complete data analysis Complete retrospective study and analysis of egg pumping and shocking data Present results of field project at Pink Chum Workshop
Summer/: fall	Complete two manuscripts

A. Measurable tasks for FY02 (October 1, 2001 - September 30, 2002)

Spring :	Complete final report and synthesis manuscript

B. Project Milestones and Endpoints

Fall	2000:	Initiate and complete field studies
Winter	2001:	Initiate retrospective study, egg pumping, and egg shocking data analysis
Spring	2001:	Complete data analysis
Summer/ fall	2001:	Complete two manuscripts
Spring	2002:	Complete final report and synthesis manuscript

C. Completion Date

Two manuscripts on egg shocking will be submitted Sept 30, 2001.

Final report will be submitted April 15, 2002.
Synthesis manuscript will be submitted April 15, 2002.

PUBLICATIONS AND REPORTS

Final report

peer-reviewed manuscripts: Thedinga, J. T. et al. Detection of pink salmon eggs killed by hydraulic sampling. Journal unknown.

Carls, M. G. et al. Ability of observers to discriminate shock mortality in pink salmon eggs as a function of time after shock. Journal unknown.

Thedinga, J. T. et al. Pink salmon embryo studies in Prince William Sound: Did oil affect mortality or were sampling techniques biased?

PROFESSIONAL CONFERENCES

No conferences planned in FY 2000, travel to 2001 oil spill symposium and 2001 Pink chum workshop is included.

NORMAL AGENCY MANAGEMENT

This project seeks to address the hypothesis that the effects of oil in streams on pink salmon embryo mortality was confounded by time of sampling through a cooperative relation ship between NMFS and the Trustees. NMFS would not be conducting this project if the oil spill had not occurred. NMFS proposes to make a significant contribution to the operation of this project, making it a cooperative venture with the Trustee Council.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

The design of this project has been coordinated with work performed in the past by ADFG. NMFS will coordinate with the Trustees by providing labor requirements and laboratory overhead.

PROPOSED PRINCIPAL INVESTIGATOR

Name	John Thedinga
Affiliation	NMFS
Address	Auke Bay Laboratory
	11305 Glacier Hwy
	Juneau, AK 99801
Phone	907-789-6025
Fax	907-789-6094
E-mail	john.thedinga@noaa.gov

PRINCIPAL INVESTIGATOR

GS-12 Fisheries Research Biologist - John F. Thedinga. BS Fisheries and Wildlife Management, University of North Dakota (1975); MS Fisheries Science, University of Alaska (1986). He has been employed by the National Marine Fisheries Service, Auke Bay Laboratory since 1978 specializing in research on the effects of logging on salmon and freshwater habitat. He has been principle investigator and co-investigator on several projects. Recently he was co-investigator of Trustee project 98076 and principal investigator of Trustee project 00163A. He has published over 20 scientific papers.

CO INVESTIGATORS

GS-12 Fisheries Research Biologist - Mark G. Carls Received BA (1975) in Biology from Gustavus Adolphus College, St. Peter, MN, and MS (1978) in Biological Oceanography from Dalhousie University, Halifax, Nova Scotia. Mark has been employed at the Auke Bay Fisheries Laboratory since 1979. His principal involvement has been in research of petroleum hydrocarbon toxicology to marine fish and invertebrates, including egg, larval, and adult life stages. Mark has published 17 papers, and has 5 Exxon Valdez damage assessment papers in preparation or pending publication. Since 1989, he has been involved as a principal investigator and co-investigator on several studies resulting from the Exxon Valdez oil spill involving Pacific herring, pink, and chum salmon, and mussels.

GS-12 Fisheries Research Biologist - Ron A. Heintz Education: BS Ecology, University of Illinois (1979); MS Fisheries Science, University of Alaska (1986). Ron has been involved in examining the effects of Exxon Valdez oil on pink salmon since 1992. He has published 4 peer-reviewed papers and has another in press on this topic. To date his work has identified the sensitivity of pink salmon embryos to low concentrations of oil, demonstrated the existence of delayed effect on marine survival and the persistence of oil in stream deltas in Prince William Sound. He is currently working on two other EVOS projects related to this same topic.

OTHER KEY PERSONNEL

GS-12 Fisheries Research Biologist - Adam Moles will assist with the analysis of the preserved egg samples.

GS-9 Fisheries Research Biologist - Jacek M. Maselko will assist in setting up the experiments, collecting data, and analyzing data.

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incubating downstream from weathered Exxon Valdez crude oil. Environ. Toxicol. Chem. 18(3):494-503.

Martin, R. M. 1973. Hydraulic modification of intragravel streambed flow as a means of improving egg-to-fry survival. Masters thesis, California State University, Humboldt.

Rice, S. D., R. E. Thomas, R. A. Heintz, A. Moles, M. Carls, M. Murphy, J. W. Short, A. Wertheimer. 1999. Synthesis of long term impacts to Pink Salmon following the Exxon Valdez oil spill: persistence, toxicity, sensitivity, and controversy. Final Report: project 99329, Exxon Valdez Trustee Council.

Table 1. Location, date, and number of jars of preserved live and dead eggs sampled in 1990 in oiled and non-oiled (control) streams in Prince William Sound by ADF&G.

		Number of jars of eggs at each intertidal zone and upstream							
Creek	Date	6- 8' Live	8-10' Live	10-12' Live	Upstream Live	6-8' Dead	8-10' Dead	10-12' Dead	Upstream Dead
					Non-oiled				
Koppen Creek	24-Sep	2	0	2	2	1	0	1	1
McClure Creek	25-Sep	2	1	2	2	1	1	1	1
Mink Creek	25-Sep	2	1	2	2	1	1	1	1
West Finger Creek	26-Sep	2	2	2	2	1	1	1	1
Totemoff Creek	28-Sep	2	2	2	2	1	1	1	1
Port Audrey	29-Sep	2	2	2	2	1	1	1	1
Cathead Bay	1-Oct	2	2	2	2	1	1	1	1
Brizgaloff Creek	2-Oct	2	2	2	2	1	1	1	1
Erb Creek	2-Oct	2	2	2	2	1	1	1	1
Bernard Creek	8-Oct	1	2	2	2	1	1	1	1
Cabin Creek	9-Oct	2	1	2	2	1	1	1	1
Wilby Creek	9-Oct	2	1	2	2	1	1	1	0
Kelez Creek	10-Oct	2	2	2	2	1	1	1	1
O'Brien Creek	11-Oct	2	2	2	2	1	1	1	1
Falls Creek	12-Oct	2	1	2	2	1	1	1	1
Bainbridge Creek	14-Oct	0	2	2	2	1	1	1	1
Claw Creek	14-Oct	2	2	2	0	1	1	1	0
Hogg Creek	15-Oct	2	1	2	2	1	0	1	1
Cook Creek	18-Oct	2	2	2	2	0	1	1	1
Halverson Creek	18-Oct	2	1	2	2	1	1	1	1
					Oiled				
Junction	28-Sep	2	1	2	2	1	1	1	1
Herring Bay	30-Sep	2	1	2	2	1	1	1	1
Loomis Creek	30-Sep	2	1	2	2	1	1	1	1
Point Countess	3-Oct	2	1	2	2	1	1	1	1
Bjorne Creek	4-Oct	2	2	2	2	1	1	1	1
Hayden Creek	12-Oct	2	1	2	2	1	1	1	1
Hogan Bay	13-Oct	1	0	2	2	1	0	1	1
Shelter Bay	13-Oct	2	1	2	2	1	1	1	1
Snug Harbor	16-Oct	2	1	2	2	1	1	1	1
Sleepy Bay	30-Oct	2	1	2	2	1	1	1	1
Chenega	1-Oct	2	1	2	2	1	1	1	1
Canoe Pass	1-Oct	2	2	2	2	1	1	1	1

Table 1. Location, date, and number of jars of preserved live and dead eggs sampled in 1991 in oiled and non-oiled (control) streams in Prince William Sound by ADF&G.

		Number of jars of eggs at each intertidal zone and upstream							
Creek	Date	6-8' Live	8-10' Live	10-12' Live	Upstream Live	6-8' Dead	8-10' Dead	10-12' Dead	Upstream Dead
					Non-oiled				
Moffitoffskiloff	1-Oct	1	1	1	1	1	1	1	1
Bernard Creek	23-Sep	0	1	1	1	0	1	1	1
Koppen Creek	23-Sep	0	1	1	1	0	1	1	1
Cabin Creek	24-Sep	1	1	1	1	0	1	1	1
Cook Creek	24-Sep	0	1	1	1	0	1	1	1
Kelez Creek	25-Sep	1	1	1	1	3	1	1	1
Wilby Creek	25-Sep	1	1	1	1	0	1	1	1
Falls Creek	28-Sep	1	1	1	1	1	1	1	1
Hogg Creek	28-Sep	1	1	1	1	1	1	1	1
O'Brien Creek	28-Sep	1	1	1	1	1	1	1	1
Halverson Creek	29-Sep	1	1	1	1	1	1	1	1
Claw Creek	31-Sept	1	1	1	1	1	1	1	0
Port Audrey	2-Oct	1	1	1	1	1	1	1	1
McClure Creek	8-Oct	1	1	1	1	0	1	1	1
West Finger Creek	8-Oct	1	1	1	1	0	1	1	1
Mink Creek	9-Oct	1	1	1	1	1	1	1	1
Erb Creek	10-Oct	1	1	1	1	1	1	1	1
Totemoff Creek	10-Oct	1	1	1	1	1	1	1	1
Bainbridge Creek	11-Oct	1	1	1	1	1	1	1	1
Brizgaloff Creek	11-Oct	1	1	1	1	1	1	1	1
Cathead Bay	10/1,10/2	1	1	1	1	1	1	1	1
					Oiled				
Sleepy Bay	25-Sep	1	1	1	1	1	1	1	1
Snug Harbor	26-Sep	1	2	2	2	1	2	2	2
Bjorne Creek	27-Sep	1	1	1	1	1	1	1	1
Hogan Bay	27-Sep	1	0	0	0	1	0	0	0
Shelter Bay	27-Sep	0	1	1	1	0	1	1	1
Point Countess	9/29-9/30	1	1	1	1	1	1	1	1
Junction	1-Oct	0	1	1	1	0	1	1	1
Herring Bay	7-Oct	1	1	1	1	1	1	1	1
Loomis Creek	9-Oct	1	1	1	1	1	1	1	1
Hayden Creek	12-Oct	1	2	1	1	1	1	0	1

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Budget Category:	Authorized FY 2000	Proposed FY 2001
Personnel		$34,460.0
Travel		$10,194.0
Contractual		$37,800.0
Commodities		$13,000.0
Equipment		$2,000.0
Subtotal	$0.0	$97,454.0
General Administration		$5,937.5
Project Total	$0.0	$103,391.5
Full-time Equivalents (FTE)		0.4

LONG RANGE FUNDING REQUIREMENTS					
			Estimated FY 2002		
			28k		

Dollar amounts are shown in thousands of dollars.

Other Resources								

Comments:

This project addresses the controversy between government and industry -sponsored researchers over the effect of oil on pink salmon embryo mortality in Prince William Sound streams.

NOAA Contribution FY00: Principal Investigator - John Thedinga 2 mo. @ 16K
Co-PI - Mark Carls1 mo. @ 8.2K
Jacek Maselko 2 mo. @ 10.5K

NOAA Contribution: Habitat Investigation Program Manager, S. Rice,1 mo @ $12.1K
Principal Investigator - John Thedinga 4 mo. @ 32K
Co-PI - Mark Carls 3 mo. @ 24.6K
Co-PI - Ron Heintz 1 mo. @ 7.7K,
Little Port Walter Research Facility, Auke Creek Hatchery

FY01

Prepared: 4/14/00

Project Number: ~~00~~ 01492
Project Title: Pink salmon embryo shocking study
Agency: National Oceanic & Atmospheric Administration

FORM 3A
TRUSTEE
AGENCY
SUMMARY

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

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 2001
John Thedinga	PI	GS12/4	3.0	8000.0		24,000.0
Jacek Maselko	Fishery Research Biologist	GS9/3	2.0	5230.0		10,460.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		5.0	13230.0	0.0	
					Personnel Total	$34,460.0

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 2001
Juneau to Anchorage (Restoration Workshop/Thedinga)	444.0	1	3	150.0	894.0
Cordova - data review and interview	350.0	2	2	150.0	1,000.0
Juneau - LPW roundtrip	1800.0	4		0.0	7,200.0
Juneau - Seattle roundtrip (Pink/Chum workshop)	600.0	1	4	125.0	1,100.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$10,194.0

FY01

Prepared: 4/14/00

Project Number: 00
Project Title: Pink salmon embryo shocking study
Agency: National Oceanic & Atmospheric Administration

FORM 3B
Personnel
& Travel
DETAIL

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Contractual Costs:	Proposed
Description	FY 2001
Statistical analysis of pink salmon run timing data from PWS	11,000.0
Histological analysis of preserved pink salmon eggs from PWS streams	10,000.0
NOAA Contract labor (Experimental hatchery and field studies)	
1 x $4.2k/month - @ 1 months(Hatchery shocking experiment)	4,200.0
2 x $4.2k/month - ea 1.5 months (Hatchery shocking experiment)	12,600.0
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$37,800.0

Commodities Costs:	Proposed
Description	FY 2001
Egg shocking supplies for hatchery study	1,000.0
Film, report reproduction costs, software upgrade,	1,000.0
Gas, oil for outboards and LPW maintenace	4,000.0
Groceries	3,000.0
Egg pumping equipment	2,000.0
Tent, tarps, pink salmon observation platform	2,000.0
Commodities Total	$13,000.0

FY01

Prepared: 4/14/00

Project Number: 00
Project Title: Pink salmon embryo shocking study
Agency: National Oceanic & Atmospheric Administration

FORM 3B
Contractual & Commodities DETAIL

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

New Equipment Purchases:	Number	Unit	Proposed
Description	of Units	Price	FY 2001
Hydraulic egg pump	1	2000.0	2,000.0
			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**		$2,000.0

Existing Equipment Usage:	Number	Inventory
Description	of Units	Agency
Auke Creek hatchery equipment (heath trays, water heaters, hatchery facility)		
Boats and outboard motors	2	
Little Port Walter Research Station		

FY01

Prepared: 4/14/00

Project Number: 00
Project Title: Pink salmon embryo shocking study
Agency: National Oceanic & Atmospheric Administration

FORM 3B
Equipment
DETAIL

User Guidelines and Environmental Education To Reduce Impacts of Recreation and Tourism on Injured Species in Prince William Sound

Project Number:	01494
Restoration Category:	General Restoration
Proposer:	Alaska Wilderness Recreation & Tourism Association (AWRTA) Sarah Leonard - Executive Director; Chris Beck - Project Manager
Lead Trustee Agency	
Cooperating Agencies	
Alaska Sea Life Center:	No (although materials from this program would be made available to the Sea Life Center)
Duration:	1 year project (possible 2nd year to be determined later)
Cost FY 01:	$32,500
Cost FY02:	
Geographic Area:	Prince William Sound
Injured Resource or Service:	Archeological Resources, Black Oystercatcher, Clams, Common Murre, Intertidal Communities, Marbled Murrelet, Mussels, Pacific Herring, Pink Salmon, Sea Otter, Common Loon, Cormorants, Harbor Seal, Harlequin Duck, Killer Whale, Pigeon Guillemot

ABSTRACT

Tourism and recreation use is large and growing in Prince William Sound. Nearly all this activity is focused on the marine and inter-tidal environments of Prince William Sound. Recreation and tourism activities can create a variety of impacts on the species and habitats using these environments, ranging from disturbance of nesting or resting animals, to direct degradation of habitats. The first component of this project will therefore produce guidelines for responsible recreation in the Sound. Guidelines will be based on solid scientific knowledge, and will include an explanation of the "whys" behind recommended behavior. The second project component will present the user guidelines and the stories behind the guidelines, in a more detailed, entertaining format. This work will help create exhibits and other information so visitors, school kids and adults better understand the Sound's natural environment, helping to reinforce and magnify the impact of the guidelines on recreation behavior. This project will be led by AWRTA (the Alaska Wilderness Recreation and Tourism Association), working cooperatively with NOLS (the National Outdoor Leadership School), the USFS, the State Department of Natural Resources, and other parties. This project will take the wealth of scientific data collected through the EVOS process and other research initiatives, and use this information to change the behavior of the tourists and recreationists to support the EVOS Trustee Council's restoration objectives.

RECEIVED
APR 14 2000
EXXON VALDEZ OIL SPILL
TRUSTEE COUNCIL

INTRODUCTION

"With every living system on the earth in decline, can we create profitable, expandable companies that do not destroy, directly or indirectly, the world around them? The radical answer: business is not just a reasonable agent for such change; it is the only mechanism powerful enough to reverse global environmental and social degradation." Paul Hawken

This is a two-part program sponsored by the Alaska Wilderness Recreation and Tourism Association (AWRTA) designed to reduce impacts of growing recreation and tourism use on species injured by the Exxon Valdez Oil Spill. The primary component of the proposal is a set of user guidelines for a broad range of recreation and tourism activities in the Sound; the second part is a set of environmental education materials for visitor information centers, museums and similar facilities designed to explain and reinforce the messages of the guidelines.

The Alaska Wilderness Recreation and Tourism Association (AWRTA) is a 501(c)-3 business trade group whose mission is to support stewardship of the wild in Alaska and healthy, diverse travel businesses and communities, by linking business, community and conservation interests. AWRTA members include over 200 tourism businesses, plus agencies, community organizations, and recreational users from across the State. AWRTA has over 35 member businesses who operate in the Prince William Sound area, and whose business success is directly dependent on the continuing ecological health of the Prince William Sound region.

User guidelines and environmental education materials related to PWS have been produced in the past, including materials by partners in this project. This proposal would take advantage of this past work and increase its impact. This increased effectiveness will come through several strategies, summarized below:

- Improved application of EVOS and other scientific data, to ensure the guidelines are based in good science, and to explain the "why" behind the recommended behavior guidelines.
- Partnership with the National Outdoor Leadership School (NOLS), and their "Leave No Trace" program, which provides a respected, nationally known approach to managing recreation and tourism activities
- Partnership with the USFS and DNR, who have primary management authority over public resources of the Prince William Sound area.
- Effective coordination with other entities - agencies, businesses, Native organizations and communities - with a stake in the environmental health of the region
- AWRTA's connections with tourism businesses in the region, who will have a major role in defining and implementing the user guidelines

As a result of this cooperative approach, AWRTA will be able overcome the challenges that have hindered past efforts to influence visitor and recreationist behavior.

NEED FOR PROJECT

A. Statement of Problem

More than mining, logging, or even oil spills, recreation and tourism will shape the future of Prince William Sound. Stan Senner, quoted in the Wall Street Journal (4/5/00) regarding the

imminent opening of the Whittier Road, said, "The State has not thought what the real ramifications of opening the road are. The long term impact of the road will make the Exxon Valdez pale in significance." The author of the article says, "Mr. Senner isn't minimizing the Valdez catastrophe. He cautions, however, that environmental damage can ultimately be greater from the cumulative effects of everyday leaks from gasoline docks and outboard motors than from a one-time disaster." Says Senner, "we're basically inviting a permanent source of pollution into the Sound."

Opening of the Whittier Road is projected over 15 years to increase annual visitors to the Western Sound by 1.5 million people (State DOT/PF EIS, 1994). Other factors driving increased tourism and recreation in PWS include:

- New deep water cruise ship dock planned for Shepard Point in Cordova
- Development of many dozens of small private in-holdings outside the control of public land managers
- Major investments in large volume tourism businesses by CIRI, Ahtna, Goldbelt and other private parties
- New recreation technologies and products, such as jet skis, helicopter-based hiking and sightseeing, improved snowmachines, and floating store/fuel sales stations
- Dramatic increase in cruise travel. Cruise companies are investing over $15 billion worldwide in new ships, and a significant portion of this capacity is expected to be directed to Alaska, already the world's third most popular cruise destination.

An extensive research literature documents the potential impacts of recreation and tourism on wildlife, water quality, and habitat. Categories of impacts occurring or likely to occur in Prince William Sound in the future include:

- Water quality impacts of use of boats, particular personal watercraft (e.g. discharge of oil and gasoline during normal operations, plus leaks and spills, discharge of ballast water)
- Local water quality impacts associated with disposal of human waste
- Disturbance of species such as marine mammals, oyster catchers and other birds by a range of recreation activities, including sightseeing boats who seek out such species, and more inadvertent disruption, by visitors on foot, and in boats, planes, and kayaks
- Direct impacts of activities along the shore line, including trampling of spawning beds, trampling of vegetation in heavily used camping areas
- Disruption of commercial fishing and subsistence activities
- Impacts of wakes of powerboats on shorelines
- Impacts on sensitive inter-tidal species and inter-tidal habitats such as eel grass, resulting for example, from boats anchoring in these areas, or repeating landing of boats.

This project will address two main problems. The first dimension is summarized above – the large and growing impacts of recreation and tourism. The second dimension of the problem is institutional in nature – the lack of effective existing resources and management tools to reduce or eliminate these impacts. There are three major challenges in this second category:

1. Lack of agency authority over many aspects of recreation and tourism activity (for example, neither the USFS or DNR currently believes they can exert regulatory authority over the use of ocean waters in PWS)
2. Challenges of reaching and persuading diverse user groups (visitors "don't all walk through same turnstile" to enter the Sound – they come by many different modes, from many different locations)

3. Limited agency resources (budgets for all the state and federal resource management agencies USFS and DNR Division of Lands)

Another part of the project context is the $300,000,000 plus dollars of research from the EVOS process, including extensive information on impact of pollutants, the location of sensitive environments, and the life histories of PWS species. This information could help form the foundation for guidelines and education programs to influence the behavior of residents, visitors and tourism businesses using the Sound.

This heart of this project – and the way this project responds to these challenges – is to develop a coordinated public-private strategy that takes full advantage of the resources of businesses, communities and agencies. Past experience has shown none of these parties can solve these issues independently; together we believe we can get the job done. This project will work to take the wealth of scientific data collected through the EVOS process, and other research initiatives, and use these data to change the behavior of the tourists and recreationists who will be in the Sound in ever-growing numbers.

B. Rationale/Link to Restoration

This project will contribute to general restoration, by improving the rate of natural recovery by managing human uses and reducing pollution. The primary measurable outcome of the project will be changed behavior among recreation and tourism users. Like most other restoration activities, we would also like to predict a measurable impact on the health and numbers of individuals of injured species. While there are too many variables for to directly measure this outcome, the changed behaviors that will derive from those project will measurably reduce the numbers of times tour boats disrupt nesting birds or sleeping marine mammals, anglers walk through the spawning beds of pink salmon, boat operators discharge oily water into sensitive estuaries and other behaviors known to harm injured species and their habitats.

Collectively, these changes will either help speed injured species recovery, or help reduce the impacts that would have otherwise occurred in the absence of these actions.

The project has two components that will create these restoration benefits:

1. Ecological Information and Guidelines for PWS Tourists, Recreationists, Tourism Businesses
Growth in tourism and recreation in PWS is inevitable. The impact of this use on injured species will vary dramatically, however, depending on how people choose to behave. This component of the project will therefore produce guidelines for responsible recreation in the Sound. Guidelines will be based on solid scientific knowledge, and will include an explanation of the "whys" behind recommended behavior. For example, instead of just telling people to stay back from shorebird rookeries, the information will include a short lesson on shorebird life, and explain how forcing birds into flight contributes to bird mortality by exposing eggs to predators, and consuming the limited energy reserves of nesting adults.

2. Education Programs/New Nature-Based Attractions for PWS Communities
The second component of this project will present the user guidelines and the stories behind the guidelines, in a more fleshed out, entertaining format. This work will help create exhibits and other information so visitors, school kids and adults better understand the Sound's natural environment, helping to reinforce and magnify the impact of the guidelines on recreation

behavior. Information will be prepared for written presentation in brochures or websites; however, the project will focus on exhibits for community information centers and small museums. This gives visitors more reasons to spend time and money in PWS communities, and gives businesses, chambers of commerce, and city councils more reasons to advocate healthy natural environments (because it keeps their cash registers & city coffers full).

Information will be prepared for two targets: individual recreators (e.g., people in kayaks, motor boats) and tourism businesses (e.g., day and overnight cruiseboats, kayak drop off charter boats and sportfishing charter boats). Information for motorized tourism activity will also be applicable to commercial fishing.

C. Location

The project will address recreation and tourism in Prince William Sound. The project will focus on water-based and shoreline recreation. Issues to be addressed include sensitive inter-tidal areas such as eel grass; sensitive species including marine mammals, oystercatchers and other birds; salmon spawning habitat; disposal of human waste; camping practices; and boating practices such as impact of wakes and handling oil and gas. Communities that will be affected include those communities whose residents and businesses rely on the sound for recreation, subsistence and commercial activities. These include: Valdez, Whittier Cordova, Chenega, Tatitlek, plus outlying communities such as Anchorage, Seward and Fairbanks.

COMMUNITY INVOLVEMENT AND TRADITIONAL KNOWLEDGE

To be successful, this project must work closely with the residents, businesses and recreation users of Prince William Sound. As outlined in more detail in the project design section, the project is structured to do this in three main ways:

- Hold workshops in each community (Valdez, Whittier, Cordova, Chenega, Eyak, Anchorage) to better understand views of residents and locally-based businesses regarding the nature and impacts of local recreation and tourism activity
- Hold workshops in each community to review proposed guidelines
- Prepare on-shore exhibits that give more background to guidelines

Traditional local knowledge will be incorporated through interviews with key informants within the communities. We will work with Hugh Short and Henry Huntington of the EVOS staff to identify key individuals.

PROJECT DESIGN

A. Objectives

1. Educate Prince William Sound tourists and recreation users and tourism business operators, so camping, boating, fishing, sightseeing & related activities do less damage to injured species and their habitats
2. Increase general public understanding have the value and vulnerability of PWS resources; increased the odds that people will become defenders of wilderness by sparking their curiosity about the Sound.

While not directly linked to the EVOS restoration goals, this project includes secondary goals that help create more linkages between economic health and the health of species injured by the spill. While seemingly abstract, if the success of local business is tied to the chance to see whales, seals, otters and birds, the odds get better that businesses will support conservation measures.

1. Improve "infrastructure" that encourages tourism that is both profitable and sustainable, such as attractions like science centers, science camps for kids and teachers, and nature-based interpretive programs
2. Encourage tourism and recreation that strengthens and diversifies the economies of PWS communities, without damaging the qualities that attract visitors and residents.

B. Methods

The work program to carry out this project is outlined below. The structure and methods of this project are designed to respond to the challenges outlined above.

1. Complete compilation of existing standards and guidelines for recreation and tourism activity, and environmental education materials. We absolutely don't want to recreate work that has already been done. A number of different user guidelines have previously been prepared for coastal recreation in Alaska and the Pacific Northwest. We will begin by reviewing these documents (e.g. advisory standards re fuel, marine mammals, camping, disposal of waste). NOLS, for example, has already prepared a guidebook for temperate coastal environments; this document can be used as a base for developing guidelines more specifically tailored to the characteristics of PWS.

2. Define targets user groups, points of origin for which guidelines will be prepared (or explicitly will not be prepared)

User Groups (preliminary, comprehensive)
Summer boat-based recreational users (hunting, fishing, sightseeing, camping)
Summer fixed wing, heli-based sightseeing (includes tours that land and let visitors walk on beach)
Personal watercraft users
Non-motorized recreation users (e.g., kayak users)
Guided commercial trips (motorized, non-motorized)
Charter kayak drop-off
Charter fishing
Day tour boats
Overnight tour boats (small- less than 100 people)
Overnight tour boats (large)
Coastal tourism and recreation facilities (lodges, campgrounds, docks)

Points of Origin (preliminary, comprehensive)
Whittier, Valdez, Cordova, Tatitlek, Chenega
Anchorage, Seward (by charter boat, by air)
Out-of-State Cruise Ships (e.g. Princess and Holland America Lines cruises coming across the gulf from SE Alaska and Vancouver.)

3. Hold workshop in Anchorage with key partners. In this step we will meet with NOLS, AWRTA business members, USFS, ADF&G, and the DNR Division of Parks and Outdoor Recreation. The workshop will be used to refine and finalize project responsibilities, agree on target markets, ensure existing guidelines are all known. We will review past methods and strategies for the format of educational materials and the means of distributing guidelines materials, and discuss options for improved, future strategies. Reach preliminary conclusions regarding which guidelines can/should be formally adopted as law, and which should remain as advisory. Reach realistic conclusions about the scale and type of resources available to implement project goals, such as options for USFS and/or State rangers to operate dockside orientation programs.

4. Prepare project summary for public review, including nature and severity of environmental issues to be addressed, preliminary categories of guidelines, means of distribution.

5. Hold workshops in each Sound community and in Anchorage. Explain purpose of project (using materials from Task 4). Gain a better understanding of the views of residents and locally based businesses regarding the nature and impacts of local recreation and tourism activity. Discuss local views on solutions.

6. Prepare draft guidelines materials, distribution and funding/implementation strategy.
   Options for materials – brochures, annotated maps, videos, school program, materials to accompany licensing papers, etc.
   Options for distribution – with USFS rangers on boats, displays at dockside information kiosks, required visitor orientation program, workshops for businesses, etc.

7. Prepare preliminary on-shore exhibits that give more background to guidelines. Work with prospective partners where this information is to be displayed to understand format, space needs, and to take advantage of expertise of these groups. Examples include: PWS Science Center, Valdez and Cordova Chamber/Visitors information Center, Harbormaster's Buildings, information kiosks at dockside such as exist in Whittier, Valdez and Cordova.

8. Hold workshops in each community to review proposed guidelines. Meet with general public and also with groups of like businesses, such as charter boat operators. Review work with groups such as the Coast Guard, DEC and other agencies with specific responsibilities for recreation and tourism activities, and/or environmental quality.

9. Finalize guidelines and environmental education materials, based on comments from public, business and agencies. Finalize distribution program, including, where needed, formal agreements between organizations such as AWRTA or NOLS and agencies for implementation responsibilities. Formalize structure for on-going funding of program.

10. Implement program

Necessary additional steps, outside the immediate objectives of this project:

11. Monitor use patterns – carry out surveys and other actions to determine where are visitors going, in what numbers, and what they are doing

12. Monitor health of habitats and species – carry out necessary surveys and field investigations to determine:

a. What is the ongoing status of injured species?
b. How are recreation and tourism activities influencing recovery?

13. In light of results of Tasks 11 and 12, revise, if needed, structure of guidelines and environmental education program. If for example, if guidelines on marine mammal viewing are widely ignored, develop a different approach.

C. Cooperating Agencies, Contracts, and Other Agency Assistance

This project will succeed in reaching its ambitious goals only through close partnerships with other parties working on similar issues, as described below:[1]

1. Recreation/Tourism Guidelines The National Outdoor Leadership School (NOLS) has a long history of operations in the Sound, and a well-established international environmental education program, called *Leave No Trace*. Rather than attempting to create new guidelines, AWRTA will use this grant to work with NOLS to develop *Leave No Trace* materials specifically for Prince William Sound, using NOLS's existing set of Coastal Temperate Rainforest standards.

Success requires developing an efficient, affordable means of disseminating this information. Options include brochures, work sessions for tourism businesses, displays at information centers, presentations on ferries and at airports, and required orientation sessions for users. This grant will allow AWRTA to bring together the many parties who, if they work collaboratively, could carry out this program. Partners include AWRTA member businesses currently operating in the Sound (over 50 businesses), other PWS tourism businesses, the USFS, the EVOS Trustee Council, recreation user groups and local communities, Alaska Pacific University, and Native organizations.

2. Environmental Education Information, Programs and Exhibits

The project will focus on developing materials that ultimately will be suited for presentation in each of the five Sound communities: Cordova, Valdez, Whittier, Tatitlek, and Chenega. Given the modest size of this grant, in the near-term, environmental education materials will be prepared specifically for Cordova. Ongoing public involvement has shown the town to strongly support low impact, nature-oriented tourism. Cordova has several specific venues interested in adding these materials to their existing programs, including the USFS Cordova Ranger District Office, the Prince William Sound Science Center, Chamber of Commerce, and the Eyak Tribe. If this program is deemed successful in Cordova, additional funds will be sought to prepare materials in these other communities.

SCHEDULE

A. Measurable Project Tasks

Timing	Task
October 2000	1. Complete compilation of existing standards and guidelines for recreation and tourism activity, and environmental education materials
November	2. Refine, finalize user group targets, information distribution points
November	3. Hold workshop in Anchorage with key partners to refine and finalize

[1] AWRTA has contacted and received statements of support from all the parties listed as examples in this section.

	project responsibilities
Dec	4. Prepare project summary for public review
January 2001	5. Hold workshops in each community
Jan	If requested, make presentation at annual Restoration Workshop
Feb- Mar	6. Prepare draft guidelines materials, distribution and funding/implementation strategy
Feb-Mar	7. Prepare preliminary on-shore exhibits that give background to guidelines
April	8. Hold workshops in each community to review proposed guidelines
May	9. Finalize guidelines and environmental education materials
June-August	10. Implement Program
Sept	11. Hold debriefing with partners, communities. Submit summary report to Trustee Council.

B. Project Milestones and Endpoints

The project is designed to be done in September of 2001. By this point in time the guidelines and environmental education materials will have been completed, an initial summer season of distribution will have been completed, and a summary report will be done.

June 2001	User guidelines collateral material completed (e.g. brochures, standardized education programs)
June 2001	informational exhibits completed, placed in locations for public and businesses to see in Cordova

C. Completion Date

The project will be completed in FY 01. During the course of the project a decision will be made to move forward with a second phase, in FY 02.

PUBLICATIONS AND REPORTS

1. Summary report, describing the steps and outcomes of the project (by Sept 15, 2001)
2. Examples of user guidelines
3. Description of distribution methods
4. Examples and/or photos of environmental education displays.

PROFESSIONAL CONFERENCES

Interim results of this project will be presented at the two major, annual tourism conferences that take place in Alaska each year: the AWRTA ecotourism conference in February 2001, and the Alaska Tourism Industry Association conference in October.

NORMAL AGENCY MANAGEMENT

Portions of this work are the responsibility of the USFS, DNR and other agencies with responsibilities for Sound resources. This project will add to complement the work of these groups, by bringing in business and community partners, and helping to coordinate and increase the impacts of current activities.

COORDINATION AND INTEGRATION OF RESEARCH EFFORT

For this project to be most successful requires coordination with two other categories of work: 1) monitoring of the amount, character and location of recreation use and, 2), monitoring the status of injured species, and the impacts of recreation and tourism activities on recovery. Some of this work is underway or proposed to begin in the future. Ideally, this AWRTA project would be done as one component of an integrated system of projects, with use monitoring helping to identify issues, a program like this one providing guidelines to reduce impacts, and then impacts monitoring to evaluate the efficacy of the guidelines. Monitoring could provide feedback that would reveal problems that were not being solved or new problems that were developing. This information could in turn be used to revise the structure of the guidelines program.

We have begun discussions of this more complete environmental management program with the parties currently undertaking monitoring programs (such as APU) and those submitting a proposal for future monitoring under the GEM process (David Sale et al). We look forward to working further with these groups, and with EVOS Staff, to set up this more complete, inter-connected resource information and management system.

PROPOSED PRINCIPAL INVESTIGATOR

Sarah Leonard - Executive Director, AWRTA
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fax 907 258 3851
email info@awrta.org

Chris Beck - Project Manager
1786 Forest Park Drive Anchorage, Alaska 99517
tel 907 272 6365
fax 907 272 6391
email chrisabeck@aol.com

PRINCIPAL INVESTIGATOR

Chris Beck has diverse skills in project management, tourism and community planning, environmental education and natural resource management. Information on

OTHER KEY PERSONNEL

Gerry Sanger- AWRTA Board Member, currently developing marine mammals guidelines for the PWS

Eleanor Huffines – NOLS Environmental Education National Coordinator

BUDGET

Due to a variety of problems, some within and some outside of the control of the submitting party, the budget information here is not presented on the required form. This problem will be corrected, and the correct information submitted, on Monday next. Information below is a place-holder to give a general sense of budget numbers.

Budget Category	Proposed FY 2001
Personnel	$22,500
Travel (2 sets of workshops)	$6,000
Contractual	
Commodities (contribution to printing & production)	$4,000
Equipment	
Subtotal	
Indirect	
Project Total	$32,500

Reinstating / Restoration
of
Oil as Petrochemical

Project Number: 01498

Restoration Category:

Proposer: Power Alternative

Lead Trustee Agency:
Cooperative Agencies:

Alaska SeaLife Center:

Duration: 1 year project

Cost FY 01: $ 80,000

Geographical Area:

Injured Resource/Services: Commercial fishing
Passive uses
Recreation and Tourism
Subsistence

ABSTRACT

Funding will support development of effective alternative energy systems applicable for power and/or propulsion in effort to mitigate or terminate dependence on oil as 'fuel'.

INTRODUCTION

"The Spill" from Exxon Valdez has public focused on the ills, and calamities of oil, whereby; every infraction from tanker, platform or pipeline and even bilge discharge of Ocean Liner is brought to forefront to be criticized. Regretfully, remedial efforts will carry-on for many years even decades to come, and this project proposes to develop an innovative energy system (tool) that will support researchers at remote sites and/or reduce fuel expenditures for 'Restoration Program'.

NEED FOR THE PROJECT

A. Statement of Problem

Oil should not be a resource for energy. It's use as fuel is an unrecoverable cost factor and has no redeeming quality for restoration efforts. In a century of progress, it our oil consumption that has impact the environment, destroyed floral and threatens fauna. We brought upon ourselves the problems we face; we 'spilled it' and continue to 'burn it'. There is public outcry to protect environment, lessen air pollution, saving energy (fuel?) and offset gas prices. Whereas, a couple double-hull tankers are in service, you **can not save** gas by making engines more fuel efficient, reducing toxic emissions or improving aerodynamic design.

Fuel cost will never decrease; therefore, it is not cost effective for Commercial Fishing, Passive Uses, Recreation and Tourism nor Subsistence. It's a limited resource, so it is not conducive to sustain any future demand, for global resource is projected to depleted before next century by trend of (combustion) consumption.

B. Rational/Link to Restoration

Developing multi-medium energy conversion systems as engine to implement in modes of conveyance for all human services and power supply for general restoration directly intends to for human to manage without (oil) and thus reduce pollution. In perspective of future research & monitoring projects (related or not to this spill), altering technology from using oil will contribute to conserving resource as commodity for fabricating petroleum-based products that are more essential to our standard of living, quality of life and, too, preserving the environment.

C. Location

Though project will be conducted in Anchorage, the aim is to provide a viable non-petroleum (diesel) electric power generation system and effective motor machine for vehicle and/or craft that can be implemented affordably in any communities of Alaska and Circumpolar region.

COMMUNITY INVOLVEMENT AND TRADITIONAL KNOWLEDGE

Provided approval by Ouzinkie Tribal Elders, Power Alternative would like to deliver one or both energy system(s) to their community. Power Alternative intends to make this is single year request, therefore, should any future systems be developed for community of Ouzinkie, or any eligible community, they will make their request for funding.

However, Power Alternative would make suggestion to Ouzinkie to develop a facility in their community to manufacture ATEC systems and the hybrid product for future contractors in Restoration Program needing power generators and/or propulsion machines either for lease or purchase.

PROJECT DESIGN

A. Objectives

1. Develop and demonstrate an Ambient Thermal Energy Conversion, ATEC, electric cogeneration system. Prove the capability that this innovative adaptation of simple heat pump technology is viable means to produce electric power for demand.
2. Develop a hydraudynamic engine, a hybrid electric engine for vehicle or vessel using modified ATEC system and secondary power supply or emergency back up.

B. Methods

Model on hand will evaluate theoretical application to accomplish power production within thermal parameters dictated by this Arctic environment. Probability for success as endorsed by Natural Energy Laboratory of Hawai'i (attached) is based solely on fundamental principles applied reflective of their study.

First to acknowledge key factors for this case study.

i. Primary function in 'energy conversion' process is to produce sufficient fluid dynamics (potential energy) of given medium and convert it into kinetic energy.
ii. Best mediums for ATEC are low boiling liquids.
iii. Innovative turbine design is distinguishing component of ATEC and its hybrid converters.
iv. Thermodynamic properties of Ammonia, NH_3 as working medium is preferred, whereas, optimum thermal difference necessary to maintain in heat exchanging components are 72°F and 52°F.

52°F is easily obtained from *ambient* temperature in Alaska, hence designation as *ambient thermal energy conversion.* Problematic to man's living environment established in this Arctic region is that there is waste energy. Same physics of convection, radiance and conduction to heat his premises incurs energies that go unused, is useless or becomes unusable. Various methods are used to heat a home or facility to maintain comfortable living or working environment. It would be from those methods of heating that heat source of 72°F would be captured or reutilize for ATEC system. Whereby, proper insulation and efficiencies to improve collection of heat necessary to complement ATEC process usable electric energy will be produced effectively.

Closed-cycle ATEC system [Fig 1]

1} Liquid NH_3 is drawn from reservoir by compressor.

2} Compressor delivers liquid 70 psi to help overcome est. friction loss 10psi per transfer within system.

3} 70psi NH_3 pumped into evaporator, 72°F heat promotes liquid vapor expansion (boil). Vapor expansion increases pressure by 115psi, combined with 60psi equates 175psi. high-pressure NH_3 vapor expels from evaporator through sprayer nozzle as jet stream of vapor at 165psi directly into turbine rotor (again less 10psi friction loss by sprayer).

4} Turbine's (theoretical) optimal operating pressure is 125psi of propellant force. Whereas, dynamic flow of propellant energy anticipated through turbine rotor is 165psi, kinetic action is expected. Then as jet velocity of vapor drives turbine, and once rotary inertia achieves momentum for horsepower to support transmission is engaged to run generator. Original turbine machine delivered 100hp with 125psi steam pressure; the modified turbine in ATEC propelled by NH_3 vapor jet stream of 175psi, hopes to do same.

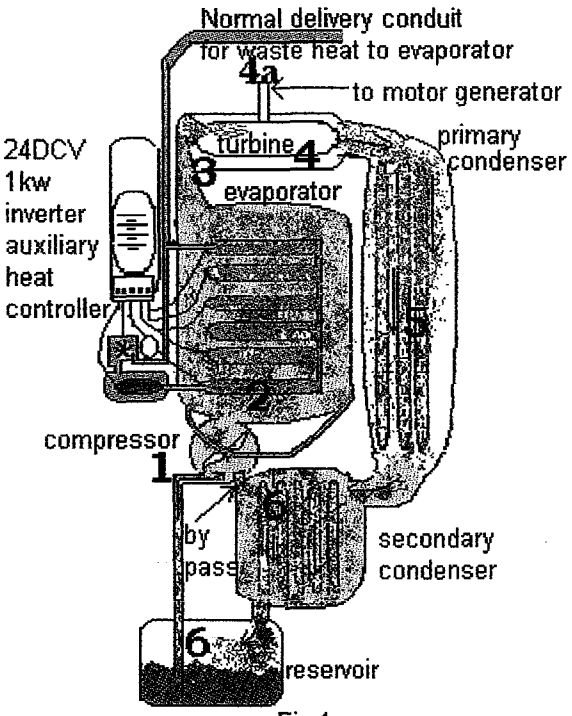

Fig 1
Model ATEC

(4a) Thus, assuming that 100 hp would be developed and using predetermined formula of 2hp/kW; a 50kW generator could be engaged to the turbine motor shaft. Provide generator with horsepower at prescribed rpm and designated electric output will be produced.

5} Opposite from high-pressure inlet into turbine chamber, medium exits as low-pressure vapor into the condenser, cooling vapor back to liquid.

6} The cooled NH_3 liquid; thus, returns into reservoir until 1} compressor draws upon it again and again for reprocessing through system.

C. Cooperating Agencies, Contract and Other Agency Assistance

Not limited to Spill affected communities this project is in review by tribal council in Ouzinkie on Kodiak Island. There are a board range of benefits that will result by this project, it will be necessary to have systems developed to reveal them. Therefore, I would contract any and all whom could be technically being able to use ATEC or its hybrids.

Should proposal be approved by Exxon Valdez Oil Spill Trustees Council and Ouzinkie not want involvement, then EVOST will be beneficiary of the system(s) developed from funding or be repaid those funds with interest, should Power Alternative have first rights of retain possession of the system(s).

Notice: 1:45pm April 14, 2000, Mr. Thomas Quick Utility Manager of Ouzinkie has called to express his interest in ATEC application. He has asked for more information for review.

SCHEDULE

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

Principle investigator will have nearly completed Associates degree program of Charter College and will receive Level I Certification in Design.

October 01, 2000:	Verify what systems will be developed and whom are to be beneficiary of those systems.
October 07, 2000:	Have ordered all small components from out-of-state (if necessary) heat exchangers and micro pumps. 250 kW or 500 kW Generators will be received at best freight cost.
October 12, 2000:	Receive those small components ordered
October 13, 2000:	Confirm booth for exhibit at Fur Rendezvous Festival 2001and pay fees for participation in Parade.
October 15, 2000:	Commence fabrication of ATEC processing system and 1 hybrid.
October 18-27 2000:	Would like to participate in World Solar Challenge, Australia. Road Rally from Perth to Adelaine.
January 01, 2001:	Charge system for test run, to determine integrity and adequacy of horsepower. When all tests affirm ATEC system safety. Schedule for demonstration of both ATEC turbine machine and a hybrid by end of month.
February 11, 2001:	Premiere ATEC and hybrids in Fur Rondy Parade.
February 11- 19 2001:	Have exhibition of for public view during Fur Rendezvous Festival Solicit to Golden Wheel Amusements a 650hp ATEC system to replace current engine of diesel genset.
February 15, 2001:	Balance due for Saturday Market.
February 28, 2001:	Should have received Generators.
March 01, 2001:	Purchase transmission mechanism to complete ATEC cogeneration system. Confirm who is to take delivery.
March 01, 2001:	Pay fee to participate in American Tour De Sol '2001 (annual Alternate energy road rally sponsored by Northeast Sustainable Energy Association, NESEA.)
March 15, 2001:	If allowed, inquire about exhibition run in 'Iron Dog Race'
March 31, 2001:	Confirm who is to take delivery of 500kW ATEC cogenerator.
April 2001:	Deliver 500 kW ATEC cogenerator.
July 4, 2001:	Participate July 4th Parade in Seward.
August 19, 2001:	Exhibit at Alaska Landscape
August- Sept 2001:	Exhibit Alaska State Fair.
September 30, 2001:	Report to EVOST.

B. Project Milestones and Endpoints

Due to current efforts Power Alternative hopes to have ready tested and have in operation a model 50kW ATEC cogeneration system. Likewise, a hydraudynamic energy converter (HEC) complete for Solar Challenge Race in Australia. Depending on, IF, desired funds are received before funding requested of 'Restoration Proposal', all personal Milestones will have been met and this project if approved, would actually be expanding on ATEC and developing better quality systems specific for 'Restoration Projects'.

That is IF desired fund are received before this 'Restoration Proposal', this project will be additional milestones by systems specifically designed for research and monitoring station or community involved or affected by the Spill. End points would be in accordance to those dates of demonstration scheduled in *Measurable Project Tasks.*

Important Endpoints being in October by Solar Challenge for HEC and by end of January for both ATEC and HEC specific for 'Restoration Project'.

C. Completion Date

Completion is expected as scheduled September 30, 2001.

PUBLICATIONS AND REPORTS

Manuscripts titled: True Energy Reinstated by ATEC and HEC: A 'Green Machine' will have compiled all evidence and technical data from project. To whom they are to submitted for peer-review is at discretion of EVOST.

It would be in investigation honor to prepare manuscript for publication at no additional expense to EVOST. If these funds are approved it would be publication and time would be inclusive cost covered by tuition for education. Any follow on report will be from those whom have applied ATEC and HEC systems, whereas, in appreciation for funding from EVOST, Power Alternative like to be considered a component for future 'Restoration Efforts' as clarified in *Explanation of Changes of Continuing Projects.*

PROFESSIONAL CONFERENCES

There will be professional conferences held locally and aboard. Travel funds will not be necessary due to spouse being Station Manager of major International Airline.

NORMAL AGENCY MANAGEMENT

Not applicable at this time. However, an agency could be developed (see *Explanation)*

COORDINATION AND INTEGRATION OF RESTORATION EFFORTS

Whereas, this proposal has not designated Category it is again subject for EVOST to assign a coordinator.

EXPLANATION OF CHANGES IN CONTINUING PROJECTS

Power Alternative mission is: "To promote alternatives beneficial for reducing energy consumer's dependence on oil as fuel for power and/or propulsion." Its sole objective is to empower efforts to mitigate oils affect to environment as result of its 'by products of combustion'. It would be intended from success of ATEC and HEC developed, that green technology agencies will be borne. Greater ATEC systems, called EcoPlaza, are unique as they can become self financed for further expansion, and income stream generated is intended to become resource for public or organization needs to finance project implementing green energy systems and/or projects that are aligned with mission of Power Alternative.

Power Alternative aspires to achieving an environment standard by which man can maintain quality of life without deteriorating planet's vitality of life to sustain man, for future trend of progress must be ecologically sound if there's to be any future progress at all.

PRINCIPAL INVESTIGATOR

Name: Jon Barlow
Affiliation: Power Alternative
Mailing Address: P.O. Box 240565
Anchorage, Alaska 99524
Phone number: (907) 562-0391
Fax: (907) 563-1055
E-mail: poweralternative@alaska.com

Principal investigator is originator of ATEC and all HEC concepts. He is now taking classes to obtain Associates degree and Level I Certification in Design.

OTHER KEY PERSONNEL

Not applicable at this juncture.

LITERATURE CITED

Endorsement from Natural Energy Laboratory of Hawai'i.

Budget Form.

Budget Category	Proposed FY 2001
Generator (500kw)	$ 50,000.00
Components	$ 10,000.00
Subtotal	$ 60,000.00
Indirect (Tuition)	$ 20,000.00
Project total	$ 80,000.00
Comments: If funding is approved no other request will be made. Any shortage shall be principal responsibilty	
FY 01 Reinstating / Restoration of Oil as Petrochemical Prepared by: Jon Barlow	Form 4A Non-Trustee SUMMARY

The Natural Energy Laboratory of Hawaii

May 31, 1989

Mr. John Barlow
3209 Wyoming Drive
Anchorage, Alaska 99517

Dear Sir/Madam,

Mr. Barlow has requested this letter in support of his application for research funding for an Ambient Thermal Energy Conversion (ATEC) system he has devised for conditions present in Alaska. Although this is not a notice of co-signing, co-investing or for providing financial support, the Natural Energy Laboratory of Hawaii (NELH) would like to endorse the ATEC concept as a potentially viable energy resource.

It is my opinion, based on the review of diagrams and schematic drawings presented to me on July 29, 1988, that this system could produce usable net energy. In 1979, our laboratory demonstrated to the world that the Ocean Thermal Energy Conversion (OTEC) concept could produce net electrical power. The ATEC cycle is an adaptation of the low-pressure, Rankine engine that we operated using warm surface and cold seawater as sources for alternately boiling and condensing the ammonia working fluid. The project was named "Mini-OTEC", produced 10 kilowatts (net) of useable electric power and, was recognized by the National Society of Professional Engineers as one of the ten outstanding engineering achievements in the United Stated (14th annual competition, 1980).

Further, although I am not aware of Mr. Barlow's educational background, his resourcefulness to recognize and obtain knowledge pertaining to this proposed project, demonstrates his committment and concern for alternate energy development. If given the chance to persue the ATEC concept, I am sure that he will obtain valuable information towards waste heat reutilization and recovery. We have provided him with specific information and data on OTEC and will maintain a cooperative relationship during the development of the ATEC program. He has our assistance and support as needed.

I wish Mr. Barlow well in this endeavor and in the persuit of alternate energy concepts. We need this type of refreshing approach towards devorcing our dependencoe on fossil fuels. Please feel free to contact us further if NELH can be of assistance.

Sincerely,

Jan C. War

Jan C. War
Operations Manager

☐ 220 South King Street, Suite 1280 • Honolulu, HI 96813 • (808) 548-7017
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Worms in oil: overlooked biota in the restoration processes of the nearshore

Project Number:	01499
Restoration category:	Research
Proposer:	University of Alaska Fairbanks
Lead Trustee Agency:	ADF&G
Cooperating Agency:	none
Alaska SeaLife Center:	no
Duration:	One year
Cost FY01:	$64,800
Geographic Area:	Prince William Sound
Injured Resource/Service:	Intertidal and Subtidal Communities

ABSTRACT

Marine oligochaetes occurred in high abundance in the coarse sediments of oiled beaches following EVOS. In 1990, ADEC made a limited survey of oiled/unoiled intertidal areas in PWS with the specific objective of assessing this population. Preliminary results indicated these animals were the most abundant macrofauna on both treated/untreated oiled beaches with population densities reaching thousands m-2. The data have never been analyzed or published but contain documentation of a major pathway for moving oil into the nearshore food web and information on a control of the bioremediation process. This project will analyze the historical data, investigate the current status of populations in the oiled intertidal zone and model the potential role of these animals in the nearshore.

INTRODUCTION

Worms in the sea are common; worms in oil are an unusual story. The true marine worms are members of the annelid class polychaeta. This group comprises more than 10000 species grouped in some 1600 genera, all marine (Hartman 1964). They are found in every type of bottom habitat and some are wholly pelagic. The concern here though is for species in a very different class of annelids, the oligochaeta. These worms are commonly found in terrestrial or freshwater habitats but a small number of species occur in special marine habitats. In the latter group there are fewer than 20 genera with exclusively marine species (Giere & Pfannkuche 1982). While polychaetes are common components of marine benthic communities, oligochaetes occur only in special situations but in such circumstances in very high densities. Typical oligochaete habitats are the wrack zone of the shore where large quantities of decaying seaweed accumulate and in organically enriched habitats. Here, we are not concerned with the smallest oligochaetes of the meiofauna (species of Family Tubificidae), rather the larger animals of the enchytraeid family that are included in the macrofauna. Enchytraeid worms are small (2-4 mm long and <1 mm in diameter) but where they occur they usually dominate in abundance all other community members. The earliest report of such organisms in Alaska was nearly 100 years ago by naturalists of the Harriman Expedition who found worms in the seaweed of the wrack zone on beaches in Southeast Alaska, Prince William Sound and Kodiak Island (Eisen 1910). With but few published records in between, the next report in Alaska is from the *Exxon Valdez* oil spill investigations (Houghton et al. 1993), and this was but a casual mention.

Marine oligochaetes are known components of benthos associated with oil in the sea. In the sediments surrounding the natural oil seeps in Santa Barbara Channel, Spies and Davies (1979; Davis & Spies 1980) found oligochaetes to be the most abundant macrofauna taxa, with densities greater than that of nematodes in a comparable habitat away from the oil seep. These authors found that the worms occurred only in the oxic sediments but were apparently not harmed by oil toxicity. They considered the nutritional source for the worms to be the bacteria that were thriving on the oil.

Oligochaetes are wholesale deposit feeders. In laboratory studies when worms were given oiled *Fucus*, they fed intensively on it and thereby incorporated quantities of oil into their intestinal tract (Giere & Pfannkuche 1982). However, worm nutrition is based largely on microorganisms and the oil passes through their gut.

In August and October of 1990 personnel from ADEC conducted a field sampling program specifically to quantitatively assess the population of marine oligochaetes in the intertidal of Prince William Sound. This investigation was prompted after the discovery (personal observations) that these worms were very abundant in oiled areas but were mostly not noted in the reports of intertidal sampling. Why not? The problem was sampling procedure. First, the 1 mm sieve mesh routinely used for sample processing did not effectively catch worms. For example, Giere & Pfannkuche (1982) report that in an experimental study this sieve size retained fewer than 25% of the worms present. More important, worms must be individually removed from fresh samples. Freezing or cold storage for even a few hours results in dead animals that rapidly become slime. Because of these problems, the role of worms in recovery processes following the oil spill has been underestimated if not totally overlooked.

The samples collected by ADEC were processed for abundance and biomass of individuals in relation to the degree of oiling of the habitat and amount of bioremediation fertilizers added. The preliminary results indicated abundance of several thousand animals m-2 with highest densities in the sites treated for bioremediation. For whatever reasons, a decision was made not to pursue the work or use the data on this component of the nearshore ecosystem and its over all contribution to the restoration process.

What is/was the role of these animals in the overall impact and recovery of the PWS intertidal? The feeding behavior of oligochaetes is to swallow the substrate wholesale to digest the bacteria living on the organic material. This requires habitats with large amounts of organic matter such as the wrack zone or the oiled beaches of Prince William Sound. The potential capability of worms to process substrate should not be underestimated; it was Darwin (1881) who first calculated that the whole of England had passed many times through the intestinal canals of worms.

NEED FOR THE PROJECT

A. Statement of the Problem

The role of marine oligochaetes constitutes one of the gaps in understanding the overall processes involved in the recovery of oiled and treated intertidal communities. These organisms are a vehicle to transport oil directly to surface and subtidal predators, including birds, fish, mammals, and invertebrates. Worms through their consumption of bacteria and microorganisms also can reduce the impact of bioremediation fertilizers on beach hydrocarbons. Because of inappropriate sampling procedures during the intense period of sampling following the spill, the marine oligochaetes were largely ignored; consequently, there is no information concerning whether there is a longer lived persistent population associated with the oiled sites in Prince William Sound.

B. Rationale/Link to Restoration

The preliminary data indicated that the bioremediation program carried out by ADEC increased the abundance of the worms, suggesting a direct link to the bacteria that degrade hydrocarbons. Furthermore because oligochaete worms swallow bulk oil (these are close kin to earthworms) to remove microorganisms, they are a vehicle to transfer oil to upper trophic level species such as fish and birds. For example, such information may help explain the pattern of impact and recovery in several birds (Day et al. 1995). The transfer of oil to predators may even account for the slow recovery of some species in regions where oil persists.

C. Location

The field work will be done in western Prince William Sound. I will first return to the sites sampled by ADEC in 1990 and then expand the scope to include additional sites. The original sites were in Bay of Isles on Knight Island and Shelter Bay on Evans Island. I will use the results of recent intertidal surveys by ADEC to dictate the location of specific field sites, especially to seek places where there is persistent oil in the sediments.

COMMUNITY INVOLVEMENT AND TRADITIONAL KNOWLEDGE

Residents in western PWS, especially in the Chenega area, will be contacted for local knowledge of worms in the intertidal.

PROJECT DESIGN

A. Objectives

The specific objectives of this study are:

1. To analyze the archived data set collected by ADEC for a paper in the scientific literature.
2. To determine if there are persistent populations of oligochaete worms in PWS.
3. To measure abundance, biomass and isotope ratio of worms it they are present.
4. To evaluate the role of worm population in oil spills and their recovery through a model of carbon flow.

B. Methods

1. **Data analysis**--ADEC collected samples from about 50 sites in Bay of Isles on Knight Island and Shelter Bay on Evans Island in August and October 1990. Intertidal zones were classified as no oil (Drier Bay), oil with no attempts at clean-up, heavy oil with bioremediation fertilizers added and light oil with bioremediation fertilizers added. The data set includes number, dry weight and carbon isotope ratio of worms in addition to bulk oil measurement of the sediments. The data for the different types of sites will be compared and tested statistically for trends in relation to oil content and treatment. A scientific paper will be written from these data.

2. **Field Studies**--Filed studies will be carried out to determine if there is a persistent worm population the oil impact area. The first effort will be a reconnaissance to be completed as early as possible to determine if worms are present. If warranted, an intensive sampling effort will be done in early summer to acquire a data set comparable to that collected in 1990. However, there will be no samples collected for bulk hydrocarbon analyzes as was done in 1990. In addition a broader survey will be made of sites that retain oil to sample worm populations if present. This will be coordinated with survey current work by ADEC.

   The ADEC filed procedure 1990 consisted of sampling each beach type by establishing a transect across the intertidal normal to the water line and collecting a minimum of 5 replicates in the mid and upper tidal levels. In this study samples will be collected with a 10 x 10 cm quadrat with 5 samples from each site. Samples of sediments will be sorted in the field for fauna and flora; representative specimens of the community will be saved for isotope analysis, only the oligochaetes will be assessed quantitatively. Collected animals will be dried after separation and then frozen. Laboratory processing will involve identifying taxa (here, if necessary, I rely on my colleagues at UAF) using preserved specimens.

   Isotope Measurements--Biota from sample sites and prepared for determination of stable isotopes of carbon and nitrogen. These data will be used to understand the energy and food web relations in these communities (Petersen 1999). Specimens of intertidal biota

will be collected for $\delta^{13}C$, $\delta^{15}N$ determinations and using mass spectrometry. Organisms will be stored frozen (-20°C) until analysis. In the laboratory sample processing and results are incorporated into a rigorous in-house quality control and assurance program (D. Schell, personal communication). Working standards are powdered whale baleen and peptone. A sample is analyzed in a Europa 20/20 continuous flow isotope ratio machine to determine $\delta^{13}C$ and $\delta^{15}N$ of the organism. Analytical replicability is ±0.10 ‰ for $\delta^{13}C$, and ±0.09 ‰ for $\delta^{15}N$ over the procedure.

As a check for the presence of oil in the food web a few samples will be analyzed for the presence of 14C. Unequivocal confirmation of oil carbon comprising a significant fraction of the oligochaete biomass would be via measurement of 14C abundance in the tissues. Since crude oil has no 14C content, the depression in 14C content in the worms relative to other biota from the food chain would be directly proportional to the amount of oil carbon in the tissue make-up. The relatively high cost of accelerator 14C analysis requires the use of this methodology for confirmatory analysis. Samples will be run at either Woods Hole Oceanographic Institute or at Lawrence Livermore labs where accelerator analysis is available for outside samples. We anticipate a cost of approximately $350/sample.

4. **Modeling--** To evaluate the role of worms in the intertidal, a carbon flow model will be constructed based on the field data on biomass and abundance with literature values for metabolism.

COOPERATING AGENCIES, CONTRACTS AND OTHER AGENCY ASSISTANCE

I will seek cooperation with appropriate personnel in ADEC and ADF&G.

SCHEDULE

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

October 10-15:	Field reconnaissance
November:	Analyze archive data
January 16-26:	Attend Annual restoration Workshop
February:	Arrange field season logistics
April 15:	Submit annual report & renewal
May:	Prepare for field work
June 7-17:	Sample collection in PWS
July:	Sample analysis
August:	Sample & data analysis
September:	Report preparation

2. Project Milestones and Endpoints

October 00:	Field Surveys

January 01:	Historical Data Analysis
May 01:	Draft manuscript
June 01:	Intensive Field Sampling
August 01:	Data analysis
September 01:	Formulate Model

3. Completion Date

This project will be completed during fiscal year 2001. New data from field work could lead to a second phase of the study.

PUBLICATIONS AND REPORTS

I anticipate preparing a manuscript base on the archived data set. Other papers will be written as data warrants.

PROFESSIONAL CONFERENCES

The EVOS workshop is the only meeting envisioned at this phase of the project.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

This project will be coordinated with the current ADEC surveys of the oil spill area and use appropriate shared field sites where possible.

PRINCIPAL INVESTIGATOR

C. Peter McRoy
School of Fisheries & Ocean Sciences
University of Alaska Fairbanks 99775
Voice: 907-474-7783
FAX: 907-474-5863
Email: ffcpm@uaf.edu

THE PRINCIPAL INVESTIGATOR

C. Peter McRoy

Education:
University of Alaska - Ph.D., Marine Science, 1970
University of Washington, M.S., Biological Oceanography, 1966
Michigan State University, B.S., Fisheries and Wildlife, 1963
Member:
American Association for the Advancement of Science
American Geophysical Union
American Society of Limnology and Oceanography
Arctic Institute of North America (life member)
Ecological Society of America
International Association of Aquatic Vascular Plant Biologists
International Association of Ecology
The Oceanography Society
Societas Internationale Limnologie
Western Society of Naturalists
Positions Held:
Professor, Institute of Marine Science, University of Alaska ,Fairbanks, 1979-present
Luminary Visiting Professor, Department of Botany, University of Hawaii, 1991
Chief Science Advisor, Oil Spill Response Office, Alaska Department of Environmental Conservation, 1990-1991
Visiting Professor (invited), Ocean Research Institute, University of Tokyo, Japan, 1988
Distinguished Visiting Professor (invited), Tiburon Center for Environmental Studies, San Francisco State University, 1987
Director, Office for International Programs, University of Alaska Fairbanks, 1984-1987
Visiting Scientist (invited), Institute of Ecology and Genetics, University of Aarhus, Denmark, 1984
Associate Professor, Institute of Marine Science, University of Alaska, Fairbanks, 1974-1979
Visiting Assistant Professor (invited), Marine Science Institute, University of Texas, Port Aransas, 1975
Assistant Professor, Institute of Marine Science University of Alaska, Fairbanks, 1970-1974
Post Doctoral Fellow, Department of Zoology, University of Georgia, 1971-1972
Research Interests:
Productivity and dynamics of pelagic and benthic marine ecosystems.
Selected Publications (96 total):
Eslinger, D.L. R.T. Cooney, C.P. McRoy, A. Ward, T. Kline, E.P. Simpson, J. Wang and J.R. Allen. In press. Plankton dynamics : observed and modeled responses to physical forcing in Prince William Sound, Alaska. Fish. Oceanog.

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McRoy, C. P. 1988. Natural and anthropogenic disturbances of the ecosystem level. Chapter 13. In D. G. Shaw and M. J. Hameedi (eds.), Environmental Studies in Port Valdez, Alaska Springer-Verlag, Berlin, Heidelberg.

Dean, K. G., C. P. McRoy, K. Ahlnås, and A. Springer. 1989. The plume of the Yukon River in relation to the oceanography of the Bering Sea. Remote Sens. Environ. 28:75-84.

Grebmeier, J. M. and C. P. McRoy. 1989. Pelagic-benthic coupling on the shelf of the northern Bering and Chukchi Seas. III. Benthic food supply and carbon cycling. Mar. Ecol. Prog. Ser. 53:71-91.

Springer, A. M., C. P. McRoy and K. R. Turco. 1989. The paradox of pelagic food webs in the northern Bering Sea - II. Zooplankton communities. Cont. Shelf Res. 9:359-386.

Grebmeier, J. M., C. P. McRoy and H. M. Feder. 1988. Pelagic-benthic coupling on the shelf of the northern Bering and Chukchi Seas. I. Food supply source and benthic biomass. Mar. Ecol. Prog. Ser. 48:57-67.

Phillips, R.C. and C.P. McRoy (eds.) 1990. Seagrass Research Methods. Monographs on Oceanic Methodology UNESCO, Paris.

Cooper, L.W. and C.P. McRoy. 1988. Stable carbon isotope ratio variations in marine macrophytes along intertidal gradients. Oecologia 77:238-241.

Cooper, L.W. and C.P. McRoy. 1988. Anatomical adaptations of the surfgrass *Phyllospadix* spp. to rocky marine substrates. Aquatic Bot. 32:365-381

OTHER PERSONNEL

Technical support will be necessary for assistance with sample collection in the field and preparation and analysis of samples in the laboratory. It is anticipated that this will involve different individuals depending on the task.

LITERATURE CITED

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Day, R.H., S.M. Murphy, J.A. Weins, G.D. Hayward, E.J. Harner, and L.N. Smith. 1995. Use of oil-affected habitats by birds after the *Exxon Valdez* oil spill. Pp. 726-761 in P.G. Wells, J.N. Butler and J.S. Hughes, eds., Exxon Valdez Oil Spill: fate and effects in Alaskan waters. ASTM STP 1219Amer. Soc. Test. Materials. Philadelphia.

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Petersen, B.J. 1999. Stable isotopes as tracers of organic matter input and transfer in benthic food webs: A review. Acta Oecologica 20:479-487.

Spies, R.B. and P.H. Davis. 1979. The infaunal benthos of a natural oil seep in the Santa Barbara channel Mar. Biol. 50:227-237.

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Budget Category:	Authorized FY 2000	Proposed FY 2001	LONG RANGE FUNDING REQUIREMENTS					
					Estimated	Estimated		
Personnel		$0.0						
Travel		$0.0						
Contractual		$60.6						
Commodities		$0.0						
Equipment		$0.0						
Subtotal		$60.6						
General Administration		$4.2						
Project Total		$64.8						
Full-time Equivalents (FTE)		0.6						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments:

FY01

Prepared:

Project Number: 01499
Project Title: Worms In Oil: Overlooked Biota in the Restoration Processes of the Nearshore in Prince William Sound
Agency: Alaska Department of Fish and Game

FORM 3A
TRUSTEE
AGENCY
SUMMARY

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Budget Category:	Authorized FY 2000	Proposed FY 2001						
Personnel		$39.3						
Travel		$3.6						
Contractual		$3.7						
Commodities		$1.9						
Equipment		$0.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal		$48.5			Estimated	Estimated		
Indirect		$12.1						
Project Total		$60.6						
Full-time Equivalents (FTE)		0.6						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments:

The indirect rate is 25% TDC, as negotiated by the Exxon Valdez Oil Spill Trustee Council with the University of Alaska.

FY01

Prepared:

Project Number: 01499
Project Title: Worms In Oil: Overlooked Biota in the Restoration Processes of the Nearshore in Prince William Sound
Name: C. Peter McRoy

FORM 4A
Non-Trustee
SUMMARY

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Personnel Costs:			Months	Monthly		Proposed
Name	Position Description		Budgeted	Costs	Overtime	FY 2000
Dr. C. Peter McRoy	PI, Professor		1.0	11.4		11.3
TBA	Technician		6.0	4.7		28.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		7.0	16.1	0.0	
					Personnel Total	$39.3

Travel Costs:		Ticket	Round	Total	Daily	Proposed
Description		Price	Trips	Days	Per Diem	FY 2000
1 R/T Fairbanks to Anchorage		0.2	1	3	0.1	0.6
2 R/T Fairbanks to Valdez		0.4	2	20	0.1	3.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
					Travel Total	$3.6

FY01

Prepared:

Project Number: 01499
Project Title: Worms In Oil: Overlooked Biota in the Restoration Processes of the Nearshore in Prince William Sound
Name: C. Peter McRoy

FORM 4B
Personnel & Travel
DETAIL

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Contractual Costs:	Proposed
Description	FY 2000
Publications and page charges	0.2
Boat Charter (10 days at $200/day)	2.0
Isotope Analysis (150 samples at $10/sample)	1.5
Contractual Total	$3.7

Commodities Costs:	Proposed
Description	FY 2000
Project Supplies	0.2
Field Gear & Miscellaneous	0.8
Chemicals and Sample Containers	0.9
Commodities Total	$1.9

FY01

Prepared:

Project Number: 01499
Project Title: Worms In Oil: Overlooked Biota in the Restoration Processes of the Nearshore in Prince William Sound
Name: C. Peter McRoy

FORM 4B
Contractual & Commodities DETAIL

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

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

FY01

Project Number: 01499
Project Title: Worms In Oil: Overlooked Biota in the Restoration Processes of the Nearshore in Prince William Sound
Name: C. Peter McRoy

FORM 4B
Equipment
DETAIL

Prepared:

Orca Inlet Restoration

Project Number:	01503
Restoration Category:	Enhance/Replace Subsistence Resources
Proposer:	Native Village of Eyak
Lead Trustee Agency:	Native Village of Eyak, a Federally Recognized Tribal Government.
Cooperating Agencies:	DOI, ADFG, NMFS, EPA & CRRC.
Duration:	1st year of a five year project.
Cost FY 01:	$100,000
Cost FY 02:	$150,000
Cost FY 03:	$150,000
Cost FY 04:	$150,000
Cost FY 05:	$150,000
Geographic area:	Orca Inlet, Prince William Sound.
Injured Resource/Service	Subsistence

Abstract:

Orca Inlet has become barren over the years. While it used to supply many of the Subsistence resources to the residents of Eyak/Cordova, in recent years it has supplied very little. As result of the Processors dumping their fish waste and the Earthquake, the Inlet is dying. We need to come up with a plan to restore Orca Inlet to what it was when we were children.

NATIVE VILLAGE OF EYAK
P.O. Box 1388, Cordova, Alaska 99574
Tel 907-424-7738 Fax 907-424-7739

April 14, 2000

Molly McCammon
Executive Director
Exxon Valdez Oil Spill Trustees Council
645 G Street, Suite 401
Anchorage, Alaska 99501-3451

Dear Molly

Enclosed is a restoration proposal to restore Orca Inlet. This project will restore Orca Inlet to the way it was when many of us were children. Orca Inlet is being smothered by the discharge of fish waste from the prossesors. Due to the increase in the salmon runs and the polleck and cod fisheries, the amount of fish waste is far greater then it was in the past. Much of our Subsistence used to come from Orca Inlet. If we can restore the damage done to the inlet over the years, then we again use it for a large part of our subsistence needs.

We are requesting technical assistance from EVOS for this proposal.

Sincerely yours

Bob Henrichs
President
Native Village of Eyak
Traditional Council

Nuchek Subsistence Camp proposal

Project Number:	01507
Restoration Category:	Enhance/Replace Subsistence Resources
Proposer:	Native Village of Eyak
Lead Trustee Agency:	Native Village of Eyak, a Federally Recognized Tribal Government.
Cooperating Agencies:	DOI, ADFG, NMFS & CRRC.
Duration:	One year.
Cost FY 01:	$125,000
Geographic area:	Nuchek, Hinchenbrook Island, Prince William Sound.
Injured Resource/Service	Subsistence

Abstract:

As result of the Exxon Valdez Oil Spill the availability of subsistence foods has changed. The residents of the Oil Spill Region are spending more time gathering Traditional Subsistence foods. A Subsistence Camp at Nuchek would allow the Youth and Elders to address these changes. Many of the people in the Region trace the ancestry back to Nuchek. As Chugach Alaska Corporation has built a facility at Nuchek and holds annual Spirit Camps, this would be an appropriate location for this Subsistence Camp.

RECEIVED
APR 14 2000
EXXON VALDEZ OIL SPILL
TRUSTEE COUNCIL

01507

NATIVE VILLAGE OF EYAK
P.O. Box 1388, Cordova, Alaska 99574
Tel 907-424-7738 Fax 907-424-7739

April 14, 2000

Molly McCammon
Executive Director
Exxon Valdez Oil Spill Trustees Council
645 G Street, Suite 401
Anchorage, Alaska 99501-3451

Dear Molly

Enclosed is a restoration proposal for a Youth/Elders Subsistence Camp at Nuchek. As result of the Exxon Valdez Oil Spill, the harvest of subsistence foods is changing in the Oil Spill region. This proposal would allow the Youth and Elders of the Region to address these changes.

We are requesting technical assistance from EVOS for this proposal.

Sincerely yours

Bob Henrichs
President
Native Village of Eyak
Traditional Council

Copper River Salmon Run Data Infrastructure Project

Project Number:	01508
Restoration Category:	Enhance/Replace Subsistence Resources
Proposer:	Native Village of Eyak
Lead Trustee Agency:	Native Village of Eyak, a Federally Recognized Tribal Government
Cooperating Agencies:	DOI, ADFG, NMFS, CRRC
Alaska Sea-Life Center:	No
Duration:	1st year, 5 year project

Cost FY 01:	$ 525.3
Cost FY 02:	$ 2,336.1
Cost FY 03:	$ 893.1
Cost FY 04:	$ 937.8
Cost FY 05:	$ 984.7
Cost FY 06:	$ 1,033.9

Geographic Area:	Copper River Watershed
Injured Resource/Service:	Subsistence

Abstract:

Project will protect and enhance the Salmon Runs on the Copper River to replace the lost subsistence resources in Prince William Sound. The project will install modern automated run monitoring and data collection equipment on all significant Copper River tributaries and will develop a base line data index to existing data systems over a five year period (a test year with a 5 year full data set over a full run cycle). The Copper River fishery is at risk because of a shift in resource use patterns. Harvest of Salmon, on or near spawning tributaries is increasing rapidly. This project will provide Salmon count data systems on the Copper River that can distinguish between species, provide genetic separation, monitor tributaries and transmit data in real time.

Introduction:

The restoration effort being proposed is to replace and prevent further loss of subsistence resources. The Copper River salmon runs have been used for tens of thousands of years to support our families. These resources are used to replace lost subsistence resources in Prince William Sound. Currently, the use of the Copper River salmon by subsistence and commercial fishermen is threatened by increased allocations for sport fishing and personal use fishing without adequate data systems to monitor this activity. A data management plan with the equipment to collect and maintain the run data based on professional scientific methods and the traditional knowledge of our elders is needed.

Need for the Project:

A: Statement of the Problem:

The Copper River salmon runs have been used for tens of thousands of years to support our families. These resources are used to replace lost subsistence resources. Currently, the use of the Copper River salmon by subsistence and commercial fishermen is threatened by increased allocations for sport fishing and personal use fishing by growing urban populations connected to the Copper Basin by the road system. If the use of the Copper River salmon runs for subsistence and commercial fishing is impaired either by over fishing in the up river spawning areas or by a shift in allocation because of the increased political power of the urban areas, the Native Village of Eyak will lose a major source of subsistence resources and commercial fishing income that has been used to replace the resources on Prince William Sound that have been damaged by the Exxon Valdez Oil Spill. Fish run data collection systems are weak from a standpoint of breaking out total sonar count fish to their tributaries of origin and distinguishing between Kings and Reds. This lack of data has forced managers to restrict the early and the most valuable commercial fishing time on the flats. Subsistence fishing at the mouth of the Copper is being further restricted. At the same time commercial fishing is being restricted, a much more liberal management policy is being implemented in the up river fisheries. Sport fishing on the Gulkana and Klutina have rapidly increasing participation and harvest rates. Personal use fishing in the Chitina area is also experiencing rapid expansion in both participation and harvest. There is not a comprehensive real time data system for the Copper River tributaries to manage the increased harvest in these areas. There needs to be a better data collection system at the mouth of the river and it needs to be coordinated with accurate systems on each of the major tributaries. This will allow for better management of individual runs and better protection for the diversity of the runs.

Threat of loss of the Copper River Run as a Result of Management Decisions Based on Inadequate Data:

The threat to the runs on the Copper and their use as a subsistence resource is very real as demands for the fish on all areas of the River increase from personal use and sport fishermen. With management data only collecting total fish and not distinguishing between Kings and Reds and individual runs, there is a real threat that smaller populations can be wiped out inadvertently by over fishing on the spawning beds, in the Chitina area, or by miscalculating an opener on the Copper River Flats. The risk of error increases as the fishing pressure from new fisheries up river continues to expand.

The popular dipnet fishery has become more organized and powerful. In 1997 they demanded and received an additional 100,000 fish. The Copper River Management Plan is up for review again this year and Federal takeover of management is also coming this year.

Even though the runs recently have been high on the Copper, many individual runs have been wiped out before Statehood, during the previous Federal management. According to Native elders, many of these individual runs have not recovered. Federal Management will again change the methods of decision making and the Native Village of Eyak needs to have a good data collection system that monitors not just total fish entering the river. The system needs to distinguish between species and be able to track actual arrival of genetically diverse runs on individual tributaries and be able to account for and monitor the effects of harvest activities on the spawning beds.

The Copper River fishery is the only fishery left for many people in the oil spill area since many of the other runs traditionally fished were impacted by the spill.

The Need for Better Management Data on the Copper River System:

The management of the Copper River Salmon Run is considered a model for success. Its success however, may be one of the biggest problems of the system. With increasing pressure on the up river areas due to increased support for promoting sport fishing opportunities, there is a great need for better data on the system. The lack of sonar data on the tributaries and data that distinguishes between Kings and Reds, has caused the fishery managers to increasingly restrict commercial and subsistence use. Because of increased demands on the up river fishery especially for Kings, this has resulted in even more restrictions on commercial fishing openings and subsistence fishing at the mouth of the Copper. The most valuable time of the harvest from a commercial and subsistence standpoint is the early openings. Managers are increasingly under pressure to close early openings for commercial fishing. Since subsistence fishing at the mouth of the Copper has been restricted to only times when the commercial fishery is open, this has restricted the subsistence harvest.

The sonar counting of the fish at Miles Lake and Wood Canyon count the main run at its source. The amount of fishing pressure on individual stocks in various tributaries is difficult to manage with our existing data system. Sonar data on the significant tributaries of the Copper is needed over a full run cycle of the Copper. This will give a baseline to correlate the Miles Lake sonar. This will greatly enhance the ability of managers to estimate run sub-populations. In addition, sonar equipment that can distinguish fish size and shape will be useful in collecting data on not just total run counts, but also on distinguishing Reds from Kings on the tributaries. This data will be very useful in determining the total King run and harvest levels of Kings. The issue of the total King harvest is one that the sport fishermen have used to support restrictions on early commercial fishing at the mouth. Better data on the total run, and how the run is harvested will allow better knowledge on the total escapement to the spawning beds and provide better data to manage the fishery at all points on the system. It may also show how the increased sport harvest of King Salmon is affecting the run and may allow the management of the fishery to better target harvest of particular species thus maintaining the resource sustainability.

B. Rationale/Link to Restoration

The work should be done because the Copper River salmon runs are a major subsistence and commercial resource that has been used by the Native Village of Eyak to maintain family food supplies and incomes in the wake of the loss of other opportunities in Prince William Sound as a result of the Oil Spill. Access by Native People to the Copper River run is now threatened by changes in resource use policy and the need for improved data collection technology. This proposal will protect the access to this resource by addressing the gaps in data needed for better run management.

C. Location

The project will be undertaken on the Copper River Watershed. The Native Village of Eyak will coordinate with the other seven Tribal Councils on the River Watershed for assistance with setting up data collection stations on the major tributaries.

Community Involvement and Traditional Ecological Knowledge:

Tribal governments will be involved by participating in the project in their areas. The Native Village of Eyak has been involved with the Trustees Council for many years.

Research and scientific data will be reported to the Villages on the Copper River through a newsletter an annual meeting of the Tribes along the Copper River, and our annual report to EVOS.

Project Design:

A. Objectives:

This project has one objective:

1: Develop a baseline Salmon run data set for Kings and Reds for every major tributary on the Copper River Watershed over a complete five year run cycle and index it to existing data systems.

B. Methods:

Specific Hypotheses to be tested:

1: Sub Populations of Salmon on the Copper River system can be better managed and the total run management can provide better sustained yield if good run data on all major tributaries is available in a real time manner that distinguishes between Kings and Reds.

Methods used:

Establish automated sonar counters with electronic recording and data transmission capabilities that can distinguish fish count and electronically interpret and record estimated fish size and shape at the following river systems:

Tasnuna, Bremner, Tiekel, Chitina, Tonsina, Klutina, Tazlina, Gulkana, Gakona, Sanford, Chistochina, Indian, Ahtel Creek, Slana, Tanada Creek (and Copper above).

The data from each sonar will be recorded and transmitted to a central data base. This will be used with other statistical sampling, test fisheries, sport fish creel census, harvest ticket reports, commercial catch data and tag recovery data. This data will be correlated to the Miles Canyon sonar, the Wood Canyon sonar and other current data collection systems such as end of season aerial surveys. This will be used to determine individual drainage run timing and how to index each run at the Miles Canyon sonar counter and other existing data systems.

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

We plan to coordinate this project with the Alaska Department of Fish and Game and/or National Marine Fisheries, US Fish and Wildlife Service (DOI), and BIA (DOI) Depending on who is involved with the management of the Copper River fishery during the five year project period.

We are not planning to contract a significant portion of the work to the private sector. We will hire fisheries biologists as employees and/or consultants.

Schedule:

A. Measurable Project Tasks for FY 00 (10/1/00 to 9/30/01):

Goal: Develop a baseline Salmon run data set for Kings and Reds for every major tributary on the Copper River Watershed over a complete five year run cycle and index it to existing data systems.

a:	October 1 - October 31	Hold organizational meeting to get direction from elders on fisheries management plan.
b:	October 1 - October 31	Develop list of important issues on data project at elders meeting.
c:	October 1 - October 31	Designate Tribal Fisheries Management Plan/Data work team.
d:	October 1 - October 31	Hire fisheries biologist.
e:	October 1 - December 31	Develop a Tribal fisheries management data plan that addresses the list of important issues addressed by the Tribal Elders.
f:	November 1 - December 31	Meet with Alaska Department of Fish and Game Fisheries Management Personnel, the Alaska Board of Fisheries, US Fish and Wildlife Personnel, and National Marine Fisheries Personnel and get input from scientific experts in these departments regarding the design of the data system to meet scientific standards and the needs of these departments.
g:	November 1 –December 31	Define maximum benefit/minimum cost data gathering locations and data needs for the fishery.
h:	November 1-December 31	Establish cooperative agreement to coordinate research so efforts of ADF&G and Eyak will compliment each other and fill in needed data gaps.
g.	November 1 - January 31	Design data gathering sonar system and data system that will capture sonar data for Kings and Reds.
h.	November 1 - January 31	Design data storage, transmission system and central data base using store and forward technology, radio/cell phone and other technology that is developed during the project period.

i.	May 1 - September 30	Install test system at one tributary and monitor results.
j.	August 1 - September 30	Design and plan system installation for FY 01 for full implementation on all major tributaries of the Copper River.
k.	September 1 - September 30	Report results to Tribal members, the Native American Fish and Wildlife Society, Trustees Council and cooperating agencies.

B. Project Milestones and Endpoints:

Goal :		Develop a baseline Salmon run data set for Kings and Reds for every major tributary on the Copper River Watershed over a complete five year run cycle and index it to existing data systems.
	Milestone:	Test data for one tributary completed September 30, 2000.
	Milestone:	Full Data for all Tributaries Completed each year September 30, 2001, 2002, 2003, 2004 and 2005.
	Milestone:	Annual Data Report published by April 15, following each year end. Final project report and full data analysis for the test year and 5 full years published by April 15, 2006.

C. Completion Date:

The project work will be completed by September 30, 2006. Final project report and data analysis for the full project period will be published by April 15, 2006.

Publications and Reports:

A manuscript will be submitted at the end of field work for FY 01 on the results of the test sonar counts on the tributary selected in the Copper Basin by April 15, 2002. An annual project report with annual data analysis will be published by April 15, following each year end. A final project report and full data analysis for the test year and 5 full years will be published by April 15, 2007.

Professional Conferences:

The results of the FY 01 field work and project design will be shared at the Native American Fish and Wildlife Society. The society will be updated annually.

Normal Agency Management:

The Trustee Council should fund this project because the Copper River is one of the last sources of subsistence resources for the Native Village of Eyak and protecting this resource for use in the absence of lost resources as a result of the oil spill is paramount.

Coordination and Integration of Restoration Effort:

The project will be coordinated with other restoration projects through the Community Facilitator at the Chugach Regional Resources Commission. We will participate with other projects when

possible to share equipment, materials and transportation. We will work with the Alaska Department of Fish and Game to target the most critical data need areas and to focus our efforts to complement the research and management efforts of this agency on the Copper River.

Explanation of Changes in Continuing Projects:

Not applicable (New Project).

Proposed Principal Investigator:

Robert Henrichs, President
Native Village of Eyak
P.O. Box 1388
Cordova, AK 99574
Phone: 907-424-7738
Fax: 907-424-7739
email: rhenrichs@tribalnet.org

Robert Henrichs is a strong leader in his community and understands the need to maintain solid fishery management of the Copper River and the need for better data. He has the ability to insure that qualified personnel will be staffed for the project and will insure that the work of specialists and scientists is closely monitored and reported on.

Other Key Personnel:

There will be a highly qualified lead fisheries biologist who will design the sonar data gathering system and recruit the assistance of qualified fisheries technicians to assist with the design and implementation of the system in a professional manner.

Literature Cited:

Morstad, Szarzi, Hoffmann, "Management of Salmon Stocks in the Copper River; A Report to the Alaska Board of Fisheries"; December 8-14, 1996; Cordova, Alaska.

Following the budget are graphs that were published in the above cited report. These graphs demonstrate the large increase in the fishing pressure placed on the Copper River System in recent years.

Native Village of Eyak

P.O. Box 1388
Cordova, AK 99574
907-424-7738 Fax 907-424-7739

April 15, 1999

Molly McCammon, Executive Director
Exxon Valdez Oil Spill Trustee Council
645 G Street, Suite 401
Anchorage, AK 99501-3451

Dear Molly:

Enclosed is a restoration proposal for The Copper River Data Infrastructure Project. This project will provide a data collection system for the Copper River that will protect and allow better management of subsistence resources for many years in the future.

With the State of Alaska Board of Fish designating Customary and Traditional Use for dipnetting at Chitina for all Alaskans, at their December 1999 meeting, it has put even more pressure on the Copper River.

As a Tribal Council, we are requesting technical assistance from EVOS on this proposal.

If you have any questions, please give me a call.

Sincerely:

NATIVE VILLAGE OF EYAK TRADITIONAL COUNCIL

Robert Henrichs, President

Monitoring Harbor Seal Population Condition to Assess Changes in Carrying Capacity in Prince William Sound

Project Number:	01509
Restoration Category:	Monitoring
Proposer:	Robert J. Small, ADF&G
Lead Trustee Agency:	ADF&G
Cooperating Agencies:	none
Alaska Sea Life Center:	no
Duration:	1st year, 3-year project
Cost FY 01:	$92,400
Cost FY 02:	$95,000
Cost FY 03:	$65,000
Geographic Area:	Prince William Sound
Injured Resource:	Harbor Seals

ABSTRACT

The production and survival of young harbor seals is critical to reversal of the long-term decline of seals in Prince William Sound, and to ultimate recovery of the population from damage due to the *Exxon Valdez* oil spill (EVOS). Significant inter-annual differences in diet and body condition of young seals that may impact long-term survival were documented in 1997-1999. We propose to obtain additional information on the population condition (e.g., diet and % body fat) of pup, yearling, and sub-adult harbor seals, the age classes most likely to be limited by food availability. Data obtained on harbor seal population condition from this proposed study and from 1997-1999 will be compared with concurrent population abundance data to assess the status of PWS harbor seals relative to carrying capacity, and subsequently derive more comprehensive and realistic expectations for population recovery.

INTRODUCTION

Harbor seals (*Phoca vitulina richardsi*) were one of the wildlife resources damaged by the March 1989 Exxon Valdez oil spill (EVOS) (Frost et al. 1994, Lowry et al. 1994, Spraker et al. 1994). The number of harbor seals in central and eastern Prince William Sound (PWS) had been declining before the spill (Frost et al. 1994) and has continued to decline ever since, with an overall reduction in population size of 57% during 1984-1998 (Frost et al. 1999a). As of 1999, harbor seals had not yet met the recovery objectives specified by the EVOS Trustee Council.

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

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

The decline in abundance of harbor seals has not been limited to PWS, but has also occurred in adjacent parts of the Gulf of Alaska (GOA) (Pitcher 1990). Over the same period of time, populations of other pinniped species, including Steller sea lions (*Eumetopias jubatus*) and northern fur seals (*Callorhinus ursinus*), have also declined in the GOA and the Bering Sea (Loughlin, et al. 1992, NMFS 1993). Seabird numbers at several colonies in these areas have also declined (Byrd and Dragoo 1997).

Marine mammals and seabirds are apex predators in ecosystems in which fishes and cephalopods are important prey. As such, a strong relationship is expected between predator populations and the abundance of fish stocks. This relationship is likely to be influenced by factors such as commercial fisheries and ecosystem changes (e.g., Beddington et al. 1985, Springer 1993). Currently, an atmospheric "regime shift" causing changes in the availability of prey is considered a likely cause for the observed decline in harbor seals, as well as that of other apex predators (Springer, in press).

Shifts in prey availability are likely to have the greatest impact on the health, condition, and survivorship of juvenile pinnipeds because of their smaller size, immature physiological status, and lower foraging efficiencies (e.g., Merrick and Loughlin 1997). Harbor seals are one of the most precocial of phocid seals, with special adaptations that allow them to enter the water immediately after birth (Bowen et al. 1992). However, this ability carries with it both advantages and disadvantages. While swimming is an effective defense against terrestrial predators, it is more energetically expensive than resting on shore. In order for young harbor seals to thrive while spending time in the water, they must quickly gain the ability to regulate metabolic rates and physiological mechanisms associated with diving. The dependence of young pups on their perinatal fat reserves for thermoregulation puts them at increased risk of starvation, should prey availability decline. If provisioning rates decline (either during the nursing period or once weaned) and fat reserves become compromised, then seals will lose more heat to the water and may need to expend greater amounts of energy to maintain body temperature. At the same time mass-specific metabolic rate will increase, which, in turn, will require more fat reserves to be utilized. Thus, pups that are initially slightly compromised in condition may rapidly lose mass through increased heat loss and energetic expenditure, at the exact time when they need to spend more time in the water foraging to recoup lost energy reserves.

During 1997-1999 the harbor seal restoration study included satellite tagging of pups, measuring body composition of pups and yearlings, and estimating the diet composition all age classes using fatty acids. Preliminary analysis of data from 1997-1999 showed some important differences and correlations (Iverson et al. 1999). Pups in 1997 averaged 43% body fat, and the diets of older seals in the same year were high in eulachon (*Thaleichthys pacificus*) and rainbow smelt (*Osmerus mordax*). In 1998, pups were leaner (average of 39% body fat) and older seals had eaten less eulachon and smelt. The 1997 year-class that was fat as pups was also fat as yearlings in 1998. These data begin to provide information about the possible influence of prey types on body condition, the long-term effects of condition at weaning on growth and survival, and the interaction of post-weaning condition and food availability during the first winter.

As the recovery objective for harbor seals in PWS is a stable or increasing population, a component of the previous harbor seal restoration study has been to conduct aerial surveys to monitor population trend (Frost et al. 1999a,b, Ver Hoef and Frost 1999). While it is relatively simple to measure the trend in the number of seals, determining the status of the seal population relative to what the PWS environment can support (i.e., carrying capacity) is more complicated. Current thinking about environmental regime shifts (e.g., Springer in press), as well as population modeling conducted by Restoration Project 064 (Frost et al. 1996), suggest that the carrying capacity of PWS may have declined in the late 1970s and 1980s.

A more direct approach exists to determine changes in carrying capacity of marine mammals: concurrent time-series of both population condition and population abundance (Gerrodette and DeMaster 1990). For example, the number of northern fur seal (*Callorhinus ursinus*) pups born (population abundance index) and the pup mortality rate (population condition index) on rookeries in the Pribilof Islands both declined during 1972-1987 (Lander 1980, York 1985, NMML/NMFS unpublished data). Although the decline in the number of pups born (abundance index) could be interpreted as a result of a reduced carrying capacity, the concomitant decrease in pup mortality (condition index) indicates the carrying capacity remained relatively constant (Gerrodette and DeMaster 1990).

Concurrent time-series of PWS harbor seal population condition and population abundance indices are needed to determine seal population status relative to carrying capacity. Recent counts indicate that the population of seals may be stabilizing in PWS, and thus could potentially soon be considered recovered from the effects of the oil spill. However, the carrying capacity for seals in PWS could be declining or increasing with a stable population trend estimate, emphasizing the need for population condition indices to determine the dynamics of harbor seal carrying capacity in PWS.

NEED FOR THE PROJECT

A. Statement of Problem

From 1984-1988, harbor seal counts at 25 trend sites in PWS declined by 43% due to unknown causes. The decline continued in 1989, aggravated in oiled areas by the EVOS. Counts of seals at oiled trend count sites declined by 45%, compared to 11% at unoiled sites. More than 300 harbor seals (36% of the estimated total population in oiled areas) were estimated to have died in PWS due to the spill (Frost et al 1994).

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

The reasons why harbor seal abundance in PWS declined before and after the EVOS remain unknown, but may relate to food limitation. Although aerial surveys of seals on haulouts provide a reliable means of assessing population trend, they do not provide any information about why a particular trend is occurring. Furthermore, in the case of PWS where the population has been declining, the surveys provide no information about whether or not it is realistic to expect a change in trend. If environmental conditions are limiting carrying capacity in some way (e.g., though food limitation), then it is unlikely that harbor seal abundance will return to early-1980s levels until carrying capacity has increased. Harbor seal restoration should include an understanding of population status relative to carrying capacity. Therefore, in addition to continued aerial surveys to monitor population trend, indices of population condition (e.g., diet, % body fat) are required to assess the status of PWS harbor seals relative to carrying capacity, and subsequently derive more comprehensive and realistic expectations for population recovery.

B. Rationale

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

Like all marine mammals, harbor seals have special federal protection under the Marine Mammal Protection Act. Because of the ongoing decline, it is essential that current population

data be available so that inappropriate restrictions on human activities are not implemented. The National Marine Fisheries Service is currently conducting a Population Viability Analysis for harbor seals in Alaska. This analysis will be used to determine whether harbor seals have declined to such a degree that they should be listed as depleted under the MMPA, or threatened/endangered under the Endangered Species Act.

Aerial surveys have documented the downward trend in PWS harbor seal abundance and have provided the information needed to determine whether the recovery objective of "stable or increasing population trend" has been met in the spill area. However, they are not adequate for determining what is causing the seal population to decline, or whether it is realistic to expect the population to increase given existing carrying capacity in PWS. Population condition indices (e.g., diet, % body fat) must be monitored simultaneously with population abundance indices (e.g., population trend) to determine the status of PWS harbor seals relative to the current carrying capacity of their environment.

The Restoration Program has funded a strong field research program to test hypotheses about the health, condition, and foraging behavior of harbor seal adults and sub-adults within PWS. In recent years, attention has been focused more on the youngest age classes within the population: pups and yearlings. This attention is warranted because survival rates of juveniles are significantly lower than for older animals, and recruitment of juveniles is critical for population recovery. Because they are small and physiologically immature, juvenile marine mammals have relatively high metabolic rates, smaller oxygen stores, and lower energy reserves, which in turn work to severely limit the diving capacity and foraging efficiency of these young animals. Compared with adult animals, juveniles must either select prey that are easier to capture, or forage on similar prey by 'pushing' their physiological limits (Hindell et al. 1992, Stewart and DeLong 1995, LeBoeuf et al. 1996, Burns 1997, Frost et al. 1997). Most often they do this by spending more time in the water, expending more effort foraging, and diving closer to their anaerobic threshold, all at considerable metabolic cost. As a result, juvenile pinnipeds are more vulnerable to changes in food availability than adults, and thus are the most appropriate cohort to monitor population condition.

With the current harbor seal population trend in PWS possibly stabilizing, monitoring of both population abundance and condition indices are needed now to gain a more comprehensive understanding of a stable trend in relation to carrying capacity. A stable population trend could occur while carrying capacity is declining, remaining the same, or increasing (Gerrodette and DeMaster 1990). Therefore, additional population condition indices are needed in 2001 and 2002, to be combined with indices obtained during 1997-1999, to more adequately address the recovery objective for PWS harbor seals.

C. Location

This project will be conducted in southcentral PWS, at study sites where pup, yearling, and subadult seals were sampled in 1997-1999. Harbor seals will be captured near haulouts at Seal Island and Applegate Rocks in central PWS, and at Channel Island, Little Green Island, and Port Chalmers in southern PWS.

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

COMMUNITY INVOLVEMENT

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

When invited, investigators will continue to attend meetings of the Alaska Native Harbor Seal Commission (ANHSC) to discuss study results and proposed research. Investigators will assist as requested in developing community-based sampling programs. Biosampling is a cooperative effort of the ANHSC, NMFS, the University of Alaska Sea Grant program, and the ADF&G. Personnel from this harbor seal project will facilitate sample analysis and communication of results to community residents.

PROJECT DESIGN

A. Objectives

1. Monitor the condition (D_2O equilibrations) of pups and yearlings in southcentral PWS to provide a basis for understanding population trend in relation to changing environmental conditions (i.e., carrying capacity).

2. Monitor annual changes in diet of seals in southcentral PWS by using fatty acid signature analysis.

3. Monitor and compare morphological data for pup, yearling and subadult seals across years.

4. Evaluate differences in the diets of lactating females (using fatty acid analysis of blubber from their pups) relative to size and body condition of pups.

5. Examine time series (1997-1999, 2001-2002) of population abundance and condition indices to determine more comprehensive expectations for the recovery of harbor seals in PWS.

B. Methods

The following hypotheses, and the means to address them, were developed to meet the above objectives during FY 01 – FY 03:

Hypothesis 1: Interannual and regional differences in the diets of female harbor seals affect the size and condition of their pups.

1. Analyze fatty acid signatures in blubber of newly weaned pups.
2. Quantify regional (central vs southern) and interannual differences in maternal diet, as indicated by fatty acid signatures of blubber from newly weaned pups.

3. Correlate size and body condition (using D_2O equilibration) of newly weaned pups with maternal diet.

Hypothesis 2: Body size and condition of pups at weaning, and two months post-weaning, affect size and condition as yearlings.

1. Measure body fat (using D_2O equilibration) and size of newly weaned pups and yearlings for five years (1997-1999 done under project 064 and 2001-2002 through this project).
2. Measure body fat of independently feeding pups 1-2 months after weaning (2001-2002 this project).
3. Correlate yearling size and condition to pup size (at weaning and two months later) in the previous year (1997-1999 done under project 064 and 2001-2002 through this project).

Hypothesis 3: The diet of pups in the first two months after weaning is different from the diet of older seals.

1. Analyze fatty acid signatures in blubber of pups caught in August.
2. Compare fatty acid signatures from pups caught in August to fatty acid signatures of newly weaned pups and older seals.

Hypothesis 4: The carrying capacity for harbor seals in PWS declined concurrently with the population trend.

1. Analyze blubber samples for fatty acid signatures of individuals and age groups as a measure of diet.
2. Identify and quantify annual differences in diets of young harbor seals.
3. Measure total body composition (fat, protein, and lean body mass) of pups and juveniles using D_20 equilibration as an indicator of individual nutritional status.
4. Continue to conduct aerial trend count surveys during 2001 and 2002.
5. Compare trends in population abundance and condition indices.

The final year of field study with take place in 2002 with final data analysis and reporting to take place in 2003. We expect to prepare reports and manuscripts on the following subjects: 1) interannual differences in diets and body condition of harbor seal pups and yearlings; 2) effects of maternal diet, as measured by fatty acids in blubber of their pups, on size and condition of weaned pups; and 3) comparisons of body condition in pups and yearlings with the overall population trend to determine changes in carrying capacity.

Catching and Sampling Seals (2001-2002)

Seals will be caught by entanglement in nets placed near the haulouts. Nets will be ~100 m long and either 3.7 or 7.4 m deep with standard floats or float line and light lead lines. Mesh openings will be about 30 cm stretched measure. Nets will be deployed from a 6 m boat assisted by one or two other small boats to assist in maneuvering the net and tending it to ensure that all captured seals are quickly detected and removed (see Frost et al. 1995). Some seal pups may be caught using long-handled dipnets. Seals will be caught in two regions of southcentral PWS: 1) central PWS, including Seal Island and Applegate Rocks; and 2) southern PWS, including Channel and Little Green Islands and Port Chalmers to coincide with sampling areas used is previous years. We will try to catch and sample approximately 50-60 seals during the post-weaning sampling period, and 20-40 during August.

When seals become entangled, they will be brought into the boats, disentangled from the net, and placed into hoop nets (large stockings made of 1 cm mesh soft nylon webbing). As necessary, seals will be sedated with diazepam (5mg/mL) administered intravenously. Each seal will be weighed, measured, and tagged in both hindflippers with individually numbered plastic tags. Field personnel will collect approximately 50 cc of blood from the extradural intervertebral vein. Standard virology screens (phocine distemper virus, herpes, and others as indicated) will be run on these samples. A 0.5 cm x 2.5 cm blubber biopsy for fatty acid analysis and a small piece of skin for genetics studies will be taken from each seal. Virology screens will be coordinated and paid for by the ADF&G's NOAA-funded harbor seal study, as will all genetics analyses.

Total body composition (fat content, protein content, and lean body mass) will be measured on a subset of the pups and juveniles that we sample using isotope dilution with deuterium oxide (D_20). D_20 is a stable isotope of water, which is widely used as a non-invasive method to measure body water pool size and the rate of water turnover in mammals and other vertebrates (Nagy and Costa 1980, Oftedal and Iverson 1987, Oftedal et al. 1987, Iverson et al. 1993). After administration of a known amount of D_2O, the isotope completely equilibrates with all body water of the animal. Measurement of the final dilution of D_2O in the body water (dilution space) can then be used to accurately measure total body water content (Oftedal et al. 1993). Body water content is then used to calculate total body fat, protein, and energy stores of the seal, based on the fact that the water and protein contents of lean body mass (fat-free mass) are approximately constant among mammals, particularly among individuals of a given species and age (Pace and Rathbun 1945, Reilly and Fedak 1991, Iverson et al. 1993).

Prior to the onset of the D_20 procedure, seals will be weighed to the nearest 0.5 kg, and a blood sample taken. Pups will be checked for the presence of milk in their stomachs by gastric intubation, and milk will be removed if present to avoid delay in equilibration of isotope. Stomach contents of older animals will not be checked. An exact pre-weighed amount (1g/kg body mass) of deuterium oxide (99.8% purity, Sigma), contained in a syringe with a three-way stopcock, will be delivered by gastric intubation using a small 12-French stomach tube (to reduce total surface area during delivery). The syringe and stomach tube will then be rinsed with two 5-cc quantities of fresh water, and air blown through the tube as it is withdrawn to ensure complete delivery. The animal will then be held for approximately 2-4 hours to permit isotope equilibration. Two sequential blood samples, separated by about 30 minutes, will be taken to ensure that equilibration has occurred. Bloods will be centrifuged and sera collected and frozen in airtight cryovials until the time of analysis. Laboratory analyses will be done at Dalhousie University. Total free water will be collected from blood sera by heat distillation, and D_2O concentration will be determined by quantitative infrared spectrophotometry according to Oftedal and Iverson (1987) and Oftedal et al. (1987) on a Perkin Elmer Fourier Transfor Infrared Spectrophotometer with integrated data station (Paragon 1000).

Fatty Acids Analysis (analysis 2001-2002)

Recently, fatty acid signature analysis (Iverson 1993) has been used to study marine food webs and pinniped diets (Iverson 1995). In pinnipeds, ingested fatty acids can be deposited directly into adipose tissue, such that blubber may be a mirror of current diet when a seal is rapidly fattening on a high fat diet (Iverson et al. 1995). Alternately, blubber may reflect a longer-term integration of dietary fatty acids and possibly biosynthesized fatty acids at times of reduced intake (Kirsch et al. 1995). Although methods of fatty acid signature analysis are still being refined, the technique has been used both to identify general trophic level of diets and to detect

major and minor shifts in diet within populations (Iverson et al. 1997; Smith et al. 1997). More recently, fatty acid signatures have been used to statistically model the actual diet of pinnipeds (species composition, proportion of diet) (Frost et al. 1999a).

We have applied this concept of fatty acids as trophodynamic indicators to harbor seals in PWS. The previous harbor seal restoration study (Project 064) conducted in PWS during 1994-1999 has been one of the two most comprehensive ecosystem studies ever conducted using fatty acids signature analysis (Iverson et al. 1997, Iverson, Bowen and Ackman, unpublished data), and has come the farthest in advancing the development of this method. To date, fatty acid signature analysis has discerned fine-scale structure in harbor seal foraging due to localized feeding patterns, and also to specific differences in prey species with size and location or habitat within PWS (Iverson et al. 1997). In addition, we used this technique to demonstrate major differences in harbor seal diets between the 1970s and 1990s, and to infer predominant prey species in the diet of individual seals. Harbor seal foraging patterns are likely to reflect changes in abundance of local prey (Olesiuk 1993, Tollit and Thompson 1996). Consequently, it is likely that information about changes in diets will also provide clues to differences in local prey availability, predominant species size classes, and species abundance at the spatial and temporal scales that are essential to the nutrition of individual animals.

Unlike some phocid seals, harbor seal females are unable to support all of lactation with stored energy and therefore must feed during lactation (Bowen et al. 1992). Thus, milk produced by females at the end of lactation reflects foraging during lactation (Smith et al. 1997). The fatty acid composition of pup blubber near and shortly after weaning mirrors the fatty acids that have been transferred during lactation (Iverson 1993). This makes it possible to estimate regional and annual differences in diets of lactating females, which are difficult to catch in large numbers in PWS, by conducting fatty acid signature analysis on blubber from pups, which are much easier to catch and handle.

In the proposed study, blubber samples will be taken from all seals that we catch using routine biopsies (sterile 6 mm biopsy punches). Samples will be collected in late June-early July as pups are being weaned and again in August after pups have been independent for several months. For yearlings and other age classes, these sample periods will provide information on late spring and summer diets. Samples will be placed in chloroform and methanol with BHT as an antioxidant, and kept frozen until analyzed.

Through project 064, harbor seal prey in PWS was extensively sampled. The existing "prey library" includes more than 22 taxa and 1,000 individual prey. Few additional prey items will be collected as part of this study.

Dr. Sara Iverson will conduct laboratory analysis and evaluation of data at Dalhousie University, Nova Scotia. Fatty acids will be extracted from seal blubber and prey according to methods described in Iverson (1988). Fatty acid methyl esters will be prepared directly from aliquots of the chloroform extract, then extracted and purified in hexane. Analysis of fatty acid methyl esters will be performed according to Iverson et al. (1992) using temperature programmed capillary gas liquid chromatography and linked to a computerized integration system (Turbochrom, PE Nelson). Identifications of rare isomers will be performed using techniques described in Iverson et al. (1997). Approximately 70 fatty acids and isomers can be separated and quantified in most marine lipids. The proper isolation of all components in any sample is critical in assessing diets

and prey items; these methods are currently set up and routinely used in the Dalhousie University laboratory of Dr. Iverson.

Data will be analyzed using a multivariate model called classification and regression tree (CART) analysis (Clark and Pregibon 1992). This model has recently been applied and modified for fatty acid signature analysis (Iverson et al. 1997, Smith et al. 1997). CART will allow us to differentiate individual seals and groups of seals by such factors as age, year, or haulout location. These differences are a function of differing fatty acid signatures originating from different diets. For analysis and interpretation of data, fatty acids will be grouped as follows: 1) components which could readily be biosynthesized by a seal; 2) components that could be biosynthesized but at the measured levels are likely mostly of dietary origin; and 3) components that could only come from the diet. Categories 2 and 3 represent the important "indicator" fatty acids (Iverson 1993). The latter two categories will be most heavily relied upon in interpreting CART results.

Carrying Capacity Assessment (2003)

The influence of natural perturbations in the environment (e.g., a 'regime shift' causes reduced prey availability) can cause changes in the carrying capacity of a natural ecosystem. Thus, the status of a population relative to what an ecosystem can sustain is difficult to interpret with only abundance indices (e.g., population trend, number of pups born). With knowledge of trends in both abundance and condition indices (see Eberhardt and Siniff 1977), changes in carrying capacity can be deduced (Gerrodette and DeMaster 1990). We will determine the trend in the following condition indices: body size, diet, and % body fat, protein, and lean body mass (through D_20 equilibration), and possibly dive behavior and movement patterns (dependent on financial support from ADF&G). Aerial trend count surveys will be conducted following Frost et al. (1999) in 2000-2002 (ADF&G will conduct the survey in 2001 & 2002; see *Coordination and Integration of Restoration Effort*), providing consecutive annual trend counts for population trend estimation, which represents the primary abundance index. A comparison of the condition and abundance indices will then deduce changes in carrying capacity following Gerrodette and DeMaster (1990):

Decision matrix for determining changes in carrying capacity (K) indicated by changes in an abundance index and a condition index.

Condition Index	**Abundance Index**		
	Decrease	No Change	Increase
Worse	K much lower	K lower	No Change in K
No Change	K lower	No Change in K	K higher
Better	No Change in K	K higher	K much higher

C. Contracts and Other Agency Assistance

Research vessels used in seal sampling will be chartered from the private sector. Small vessel contracts will be completed by the Principal Investigator according to the state SOP manual.

Fatty acids and D_2O analyses and interpretation will be done by Dr. Sara Iverson at Dalhousie University through a Cooperative Agreement between ADF&G and Dalhousie. Dr. Iverson is the only person in North America with specific experience in analysis of fatty acids in seal

blubber, and particularly with the sophisticated statistical analyses necessary to infer diet from the relative abundance of these fatty acids. Dr. Iverson has conducted all previous fatty acid signature analyses and body composition work for PWS harbor seal studies.

Lloyd Lowry and/or Kathy Frost at the University of Alaska Fairbanks will coordinate field sampling and assist with data analysis through a Reimbursable Services Agreement with UAF. Lowry and Frost have been conducting similar work in PWS for more than 10 years. Dr. Jennifer Burns at the University of Alaska Anchorage will coordinate blood sampling and D_2O studies in the field and assist with data analysis through a Reimbursable Services Agreement with UAA. Dr. Burns has participated in all three pup/yearling sampling trips since 1997 and is an expert in conducting such work.

SCHEDULE

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

FY 01 October 1, 2000- September 30, 2001

January (3-4 days)	Attend Annual Restoration Workshop
January-March:	Arrange logistics (vessel, contracts, order supplies)
February (2-3 days)	Coordination meeting for ADF&G and NOAA harbor seal studies
April 15:	Annual progress report – not applicable in April 2002 since no field work accomplished by then
April 15:	Submit renewal proposal
June 20-July 7 (~8 days):	Sample seals in southcentral PWS - fatty acids and body condition
August 15-30(~8 days):	Sample seals in southcentral PWS - fatty acids and body condition

FY 02: October 1, 2001- September 30, 2002

October – March:	Analysis of fatty acid and D_2O data
November:	Attend Biennial Marine Mammal Conference in Vancouver, B.C.
January (3-4 days)	Attend Annual Restoration Workshop
January-March:	Arrange logistics (vessel, contracts, order supplies)
February (2-3 days)	Coordination meeting for ADF&G and NOAA harbor seal studies
April 15:	Annual progress report
April 15:	Submit renewal proposal
June 20-July 7 (~8 days):	Sample seals in southcentral PWS - fatty acids and body condition
August 15-30(~8 days):	Sample seals in southcentral PWS - fatty acids and body condition

FY 03: October 1, 2002- September 30, 2003

October – March:	Analysis of fatty acid and D_2O data
January (3-4 days)	Attend Annual Restoration Workshop
September 30:	Submit final report and draft manuscripts

B. Project Milestones and Endpoints

Objective 1: (Monitor condition of pups and yearlings)

June- July, 2001-2002:	Sample 30-40 seal pups and juveniles/yr using D_20 equilibration
August, 2001-2002:	Sample 20-30 seal pups and juveniles/yr using D_20 equilibration
October-March, 2001-2003:	Analyze blood for D_20

November 2001: Papers on condition and diet at Biennial Marine Mammal Conference

Objective 2: (Monitor changes in diet)

June-July, 2001-2002:	Sample 40-50 seals/yr in southcentral PWS for blubber fatty acids
August, 2001-2002:	Sample 30-40 seals/yr in southcentral PWS for blubber fatty acids
October-March, 2001-2003:	Analyze blubber samples for fatty acids and compare across age classes and years

Objective 3: (Monitor morphological data)

June-July, 2001-2002:	Collect morphometric data from 40-50 seals/yr
August, 2001-2002:	Collect morphometric data from 30-40 seals/yr
October-March, 2001-2003:	Analyze morphometric data and make inter-annual comparisons of pup size

Objective 4: (Body condition of pups relative to female diet)

June-July, 2001-2002:	Collect blubber samples, morphometric data and do body composition on 15-20 seal pups/yr
October-March, 2001-2003:	Analyze and interpret data
November 2002	Paper on annual variability in pup condition, Vancouver
September 2003:	Report/manuscript on pup condition, female diet and annual variability

Objective 5: (Harbor seal trend relative to carrying capacity as indicated by juvenile condition)

September 2003:	Submit report/manuscript describing status of carrying capacity based on comparisons of trends in population condition and abundance indices

C. Completion Date

This project will include 3 fiscal years, FY 01 – FY 03. Field work and laboratory analyses will be conducted during FY 01 – FY 02. Final data analyses will be conducted and a final report prepared in FY 03.

PUBLICATIONS AND REPORTS

1. Oral/poster presentations at 14th Biennial Conference on the Biology of Marine Mammals; papers to include annual variations in condition of pups and yearlings, pup size and condition relative to female diet, and trend relative to condition of juveniles (November 2001, Vancouver B.C.)
2. Oral/poster presentations at EVOS Restoration Annual Workshop (January 2002-2003)
3. Submit manuscript(s) on same topics identified under item 1 (September 2003)
4. Annual report for each FY studies; will include status reports and/or draft manuscripts for fatty acid and D_2Oanalyses (April 2002 - 2003)
5. Report of field activities for June/July and August field work (September 2001-2002)
6. Final report for project (September 2003)

Manuscript titles and journals to which they will be submitted have not been determined. Topics include: 1) annual changes in condition and diet of pups and yearlings: does one predict the other; 2) effects of female diet during lactation on size and condition of pups; and 3) population trend in PWS relative to carrying capacity as indicated by condition of juvenile seals.

PROFESSIONAL CONFERENCES

Project investigators plan to attend the 14th Biennial Conference on the Biology of Marine Mammals in November 2001 in Vancouver, B. C. This biennial conference is sponsored by the Society for Marine Mammalogy and is the largest marine mammals conference in the world. Abstracts will be submitted and it is anticipated that oral or poster presentations will describe the results of fatty acids (Iverson and Frost), body condition (Iverson, Burns and Frost), and trend in abundance in relation to carrying capacity (Small, Frost and Lowry). Results of other studies using samples from PWS provided by this restoration study are also likely to be reported but travel will not be funded by this grant.

NORMAL AGENCY MANAGEMENT

NMFS/NOAA has the management responsibility for harbor seals, and conducts range-wide aerial surveys to determine population abundance as required by the Marine Mammal Protection Act. The ADF&G NOAA-funded harbor seal project is a range-wide research program with two primary objectives: 1) monitor the trend in harbor seal numbers in selected areas, and 2) obtain information on the general biology of harbor seals that can be used for designing a conservation and management program for Alaskan harbor seals. The focus of the proposed study is to assess the status of the PWS harbor seal population relative to carrying capacity, and subsequently derive more comprehensive and realistic expectations for population recovery; i.e., meet the EVOS recovery objective for harbor seals in PWS. Neither NMFS/NOAA nor ADF&G are required to do the proposed study by statute or regulation, regardless of whether the oil spill had occurred.

ADF&G has not conducted any study of harbor seals in PWS that was not a part of the restoration program. ADF&G has conducted studies of harbor seals in Southeast Alaska and near Kodiak with similar components to previous EVOS supported harbor seal studies; e.g., SDR studies to examine foraging ecology and movement patterns. These studies have been closely coordinated to ensure that data are collected and analyzed in a similar manner, thus facilitating comparisons of data. Some equipment is shared by the two projects. Consequently, it has not been necessary for the EVOS supported PWS project to purchase many equipment items and supplies solely for the use of this study. The proposed study is new, in that ADF&G will provide substantial support for those objectives that are within their overall research program.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

This newly proposed project is a follow-up to project 00064 and will be a multidisciplinary, inter-agency undertaking. Lipid analyses and interpretation will be conducted by Dalhousie University; body composition analysis and interpretation by Dalhousie, ADF&G, UAF and UAA; blood chemistry analyses at UAA and UAF; and population trend analyses relative to

body condition by ADF&G and UAF. Statistical modeling to assign quantitative values to seal diets based on fatty acids signatures will be done as a cooperative effort between this restoration study and Scotian Shelf research project, with partial support from NSERC. Inclusion of interdisciplinary components within the same project will ensure that data are shared and interpreted in an interdisciplinary manner.

This project will provide logistics, the MMPA permit to conduct sampling, and access to seals and samples for this study. Harbor seal investigators at ADF&G and other universities have been working successfully together for the last eight years on harbor seals in PWS and elsewhere, and future collaborations should be equally productive.

The ADF&G NOAA-funded harbor seal program will provide substantial assistance to the proposed study. Starting in 2001, the ADF&G program will fund and conduct the aerial trend count survey in PWS; this aspect of the monitoring program has previously been funded through EVOS harbor seal projects. The ADF&G program will also provide the necessary funding for virology screening, genetic analyses, and approximately 50% of the cost for fatty acid analyses. Additional financial support from the ADF&G program will fund the following personnel costs: 2 months of a Wildlife Biologist II (to be named) for data analysis and interpretation, 1 month for a Wildlife Biologist 1 (Gay Sheffield) for field work and database management, and 1 month for a Wildlife Technician IV (Chris Curgus) for field work and logistics. Depending on the NOAA grant award amount for the ADF&G harbor seal project for the 1 April 2001 to 31 March 2002 period, the ADF&G project may also be able to purchase satellite-linked time-depth recorders (SDRs) such that the foraging ecology and movement patterns (additional population condition indices) of seals during their first year of life can be determined. Such assistance would enable such data to be collected for the 2001-2002 period as it was during the 1997-1999 period supported by project 00064. The overall cost of the SDR component, including SDR costs, ARGOS data acquisitions costs, and additional personnel costs for data analyses, is ~$70,000. As the ADF&G program cooperates with the National Marine Mammal Laboratory (NMML/NMFS) on harbor seal research efforts, NMML personnel will be available for capture trips.

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

PROPOSED PRINCIPAL INVESTIGATOR

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PERSONNEL QUALIFICATIONS

Dr. Robert Small (the principal investigator) has conducted research on harbor seals in Alaska since 1994. He has been the principal investigator for the ADF&G NOAA-funded harbor seal project, a large state-wide multidisciplinary research program, since 1997. He has published numerous articles on the population ecology of vertebrates, and authored the 1996 Alaska Marine Mammal Stock Assessments. He has conducted statistical analyses of harbor seal trend data, designed a population model for Alaskan harbor seals which was utilized in previous EVOS funded harbor seal studies, convened a workshop on the assessment of Alaskan harbor seals, and performed field work on harbor seals in Southeast Alaska, the Gulf of Alaska, PWS, and Bristol Bay. He has experience with administration of wildlife research and management programs, and supervision.

Rob DeLong is an Analyst Programmer for ADF&G. He has developed custom software for analysis of data from satellite-tagged seals. Mr. DeLong is also accomplished in seal catching and tagging techniques.

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

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

Lloyd Lowry was the Marine Mammals Coordinator for the State of Alaska from 1987-2000. He has conducted research on marine mammals in Alaska since 1975, including studies of the natural history, ecology, distribution, abundance, and food habits of seals. He has participated in all NRDA and Restoration studies on harbor seals, including the development of methodology to catch and attach satellite tags to harbor seals. He has been responsible for project coordination and management of state and federally funded research projects, and is familiar with the federal marine mammal permit system.

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

Dr. Jennifer Moss Burns is currently a professor at University of Alaska Anchorage. She specializes in understanding the development of young marine mammals, from both a behavioral and physiological perspective. Her research has focused on understanding how young seals are able to compete with older animals, given their smaller size and immature physiological status. Dr. Burns received her Ph.D. from the University of Alaska Fairbanks, while working under Dr. Mike Castellini. She has worked in Alaska with harbor seals for the past six years.

KEY PERSONNEL

Robert Small:	Principal investigator: project management and coordination, planning, sampling, data analysis, reporting
Lloyd Lowry:	Field logistics, sampling, data analysis
Kathryn Frost:	Sampling, data analysis
Robert DeLong:	Sampling, programming
Jay Ver Hoef:	Statistical analysis of data, sampling
Sara Iverson:	Fatty acid and body composition analysis and interpretation
Jennifer Burns:	Sampling, analysis of body composition data

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2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Budget Category:	Authorized FY2000	Proposed FY 2001
Personnel		$17.2
Travel		$4.0
Contractual		$57.3
Commodities		$7.3
Equipment		$0.0
Subtotal	$0.0	$85.8
General Administration		$6.6
Project Total	$0.0	$92.4
Full-time Equivalents (FTE)		0.3
Other Resources		

LONG RANGE FUNDING REQUIREMENTS					
		Estimated FY 2002	Estimated FY 2003	Estimated FY 2004	Estimated FY 2005
		$95.0	$65.0		

Dollar amounts are shown in thousands of dollars.

Comments:

This proposal is for year 1 of a 3-yr study designed to monitor population condition indices; i.e., the diet and body condition of pup, yearling, and sub-adult harbor seals. The study includes 2 field seasons and a year of data analysis/write-up. Seals will be captured in southcentral PWS in late June (weaning) and in late August or early September when pups have been foraging on their own for >2 months. Diet will be determined using fatty acids and body condition using dueterium oxide. We will evaluate annual changes in diet and body condition, and correlate them with population trends from aerial survey data to assess changes in the carrying capacity of harbor seals in PWS. This 2 yrs of data will augment 3 yrs of similar data obtained by project 064. The 5-year dataset should be adequate to distinguish annual variation from longer term trends and changes; the exisitng 3-year dataset is not.

None of the costs identified in this budget are for NEPA compliance. Marine mammals projects obtain permits required under the Marine Mammal Protection Act from NOAA as part of routine operations. Costs for meeting attendance are identified under travel . There is no cost for attendance at the 2001 annual EVOS workshop, since the PI lives in Anchorage.

This project achieves major cost savings by collaborating with other studies and agencies to conduct this work, and the ADF&G NOAA-funded harbor seal reserach program will provide substantial support. Specifically, ADF&G will fund the aerial trend survey, virology screening, genetic analysis, 50% of fatty acid analysis, 4 months FTE of Wildlife Biologists and Wildlife Technicians, and potentially all costs associated with a satellite tagging research component. Additionally, investigators will share costs for equipment, computers and software, as well as new methodologies and approaches to data analysis. Costs for fatty acid model development will be shared with Scotian Shelf research projects.

FY01

Prepared: 13 April 2000

Project Number: 01509
Project Title: Monitoring Harbor Seal Population Condition to Assess Changes in Carrying Capacity in Prince William Sound
Agency: ADF&G

FORM 3A
TRUSTEE
AGENCY
SUMMARY

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 2000
B. Small	WBIII - Program Coordinator and Mngt	18D	2.0	5.4		10.8
R. DeLong	Analyst Programmer III-GIS Programming	17F	0.5	6.2		3.1
J. Ver Hoef	Biometrician	19F	0.5	6.5		3.3
	Subtotal		3.0	18.1	0.0	
					Personnel Total	$17.2

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 2000
Fbks-Anchorage, tagging, 1 person per field trip	0.3	2	2	0.1	0.8
Portage-Whittier by train (2 vehicles per trip)	0.3	4	0	0.0	1.2
Fbks-Portage, vehicles	0.3	4	0	0.0	1.2
Juneau-Anchorage, field work, 1 person per field trip	0.3	2	2	0.1	0.8
				Travel Total	$4.0

FY01

Prepared: 13 April 2000

Project Number: 01509
Project Title: Monitoring Harbor Seal Population Condition to Assess Changes in Carrying Capacity in Prince William Sound
Agency: ADF&G

FORM 3B
Personnel
& Travel
DETAIL

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Contractual Costs:	Proposed
Description	FY 2000
RSA with UAA (Jennifer Burns)	7.0
Print/graphics (slides for workshops, report production)	0.3
Postage (DHL, courier, etc.)	0.3
Lipid analysis contract with Dalhousie University	5.0
Freight and shipping of samples	0.5
Trailer parking & launch fees, Whittier ($100/vehicle X 2 vehicles X 2 trips)	0.4
Vessel charter for sampling @ 1.8/day x 16 days (2 trips, June & August)	28.8
RSA with UAF (Lloyd Lowry/Kathy Frost)	15.0
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$57.3

Commodities Costs:	Proposed
Description	FY 2000
Misc. field and meeting supplies (notebooks, marine charts, film, etc.)	0.3
Fuel for boats and skiffs	0.5
Biopsy punches, flipper tags, hoop nets, etc.	1.5
Small boat supplies (propellers, oars, oil, etc.)	1.0
Laboratory supplies (D2O, cryovials, vacutainers, syringes, spinal needles, gel, etc.)	2.0
Repair supplies for skiffs, net, etc.	2.0
Commodities Total	$7.3

FY01

Prepared: 13 April 2000

Project Number: 01509
Project Title: Monitoring Harbor Seal Population Condition to Assess Changes in Carrying Capacity in Prince William Sound
Agency: ADF&G

FORM 3B
Contractual & Commodities DETAIL

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FY 2000
NONE			
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
Those purchases associated with replacement equipment should be indicated by placement of an R.		**New Equipment Total**	$0.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency
Equipment used by project, purchased with oil spill funds		
Leitz binoculars	1	ADF&G
HP LIID Printer	1	ADF&G
Compaq 286 Computer	1	ADF&G
Zodiac Raft	1	ADF&G
Equipment used by project, but purchased with non-oil spill funds		
20 ft Boston whaler	1	ADF&G
17 ft Boston whaler	1	ADF&G
Seal nets	1	ADF&G
2 486 computers + Plotter	1	ADF&G
Printer	2	ADF&G
Color printer	1	ADF&G

FY01

Prepared: 13 April 2000

Project Number: 01509
Project Title: Monitoring Harbor Seal Population Condition to Assess Changes in Carrying Capacity in Prince William Sound
Agency: ADF&G

FORM 3B
Equipment
DETAIL