Approved TC 8-13-98

Habitat Protection and Acquisition Support

Project Number:	99126
Restoration Category:	Habitat Protection
Proposer:	Alaska Dept. Of Natural Resources
Lead Trustee Agency:	ADNR, USFS
Cooperating Agencies:	ADFG, DOI
Duration:	To be determined
Cost FY 99:	$ 770.4
Cost FY 00:	$ To be determined
Cost FY 01:	$ To be determined
Geographic Area:	Prince William Sound, Kenai Peninsula, Alaska Peninsula Kodiak Archipelago
Injured Resource/Service:	Multiple Resources

ABSTRACT

Project 99126 provides negotiation support to the Trustee Council in order to reach closure on habitat protection priorities. This support includes those services such as title reports, appraisals, on-site inspections, hazardous materials surveys, surveys, timber cruises and reviews, and other services necessary for the successful completion of habitat protection negotiations. The Trustee Council has completed acquisition packages with 8 large parcel landowners resulting in the protection of 507,712 acres of land. Agreements with three additional landowners would result in protection of an additional 117,175 acres of land. In addition, the Trustee Council has reached closure on the acquisition of nearly 35 small parcels encompassing more than three thousand seven hundred acres. Negotiations and closing activities continue with additional large parcel and small parcel landowners.

INTRODUCTION

This project is designed to support habitat protection activities of the Trustee Council and is a continuation of the Comprehensive Habitat Protection Process. These activities include resource evaluations, appraisals, title searches, hazardous materials surveys and other efforts necessary for the Trustee Council to achieve habitat protection objectives. In 1993, the Restoration Team, Habitat Protection Work Group, conducted a survey and assessment of selected large parcels of private land (>1000 acres) within the oil spill zone. The lands were mapped, scored and ranked to determine the restoration value of these areas to injured resources and services and the benefits that could be achieved through habitat protection.

Successful acquisitions have been completed with owners of lands within Kachemak Bay State Park and on northern Afognak Island resulting in the purchase of the park inholdings and in the establishment of the Afognak Island State Park; with Akhiok-Kaguyak and Old Harbor Native Corporation for the purchase of habitat protection rights on lands located within the Kodiak National Wildlife Refuge; with Eyak Corporation for timber rights in the Orca Narrows viewshed; with the Kodiak Island Borough for lands on Shuyak Island that have been included in Shuyak Island State Park; and with Chenega Corporation for habitat protections rights in western Prince William Sound. The English Bay Corporation has agreed to sell 32,537 acres of land within the Kenai Fjords National Park and the Alaska Maritime National Wildlife Refuge. The first closing occurred in November 1997 and resulted in the purchase of 29,636 acres. A second closing for the remaining acreage will complete this acquisition. Tatitlek Corporation has agreed to sell interests in 69, 814 acres of land in Eastern Prince William Sound. The first closing occurred in June 1998 and resulted in the purchase of 57, 436 acres. A second closing scheduled for October 1999 will complete this acquisition. The Council made an offer that was accepted by the Eyak Corporation Board of Directors for protection of 75,000 acres of land in eastern Prince William Sound. Negotiations are continuing with Afognak Joint Venture and Koniag for fee title lands.

COMPLETED LARGE PARCEL ACQUISITIONS

Acquisition	Acreage	Total Price	EVOS Trust Fund
Kachemak Bay State Park Inholdings	23,800	$22,000,000	$7,500,000
Seal Bay/Tonki Cape	41,549	$39,549,333	$39,549,333
Orca Narrows (timber rights)	2,052	$3,650,000	$3,650,000
Akhiok-Kaguyak Inc.	118,674	$46,000,000	$36,000,000
Old Harbor	31,609	$14,500,000	$11,250,000
Koniag (fee)	59,689	$26,500,000	$19,500,000
Koniag (limited term easement)	57,082	$2,000,000	$2,000,000
Shuyak Island-Kodiak Borough	26,665	$42,000,000	$42,000,000
Chenega	59,520	$34,000,000	$24,000,000
English Bay Corp.	29,636	$14,107,390	$12,913,644
Tatitlek Corp.	57,436	$24,150,000	$14,150,000

In 1995, Volume III of the Comprehensive Habitat Protection Process, *Small Parcel Process, Evaluation and Ranking* was completed. Responses to the solicitation for nominations of small parcels were processed and evaluated. The Trustee Council is currently moving forward with acquisition of a suite of small parcels that best meet the restoration goals and objectives identified by the Trustee Council. A current status report of these activities can be found in the Restoration Office's "Habitat Protection Program: Small Parcel Status Report."

Negotiations continue with several large parcel landowners as well as with numerous small parcel landowners. Reaching closure on these agreements requires substantial technical support. It is expected that Trustee Council efforts in this area will continue in the near term.

NEED FOR THE PROJECT

The objective of habitat protection is to identify and protect essential wildlife and fisheries habitats and associated services and to prevent further environmental damage to resources injured by the *Exxon Valdez* oil spill. Nineteen resources and services injured by the spill are linked to protection of upland and nearshore habitats. Protection of lands containing these habitats prevents additional injury to resources and services and natural support systems while recovery is taking place. Active negotiations and closing activities with landowners are currently taking place and anticipated to continue for at least one more year.

COMMUNITY INVOLVEMENT

The public has reviewed and commented favorably on all habitat protection efforts and has been highly supportive of habitat protection as a major restoration strategy into the future. All reports published as part of the Comprehensive Habitat Protection Process have been reviewed by the public. Input from natural resource and services specialists in the public sector was collected in a workshop conducted by The Nature Conservancy.

Members of local communities have previously had the opportunity to review habitat protection evaluation and ranking results and Trustee Council priorities. The Trustee Council continues to be receptive and responsive to pubic comment pertinent to habitat protection priorities and acquisitions. The Council's Public Advisory Group is briefed and the public is given the opportunity to comment prior to any Council action.

PROJECT DESIGN

A. Objectives

Habitat protection and acquisition is designed to protect lands linked to resources and services that were injured by the *Exxon Valdez* oil spill. Protection of these lands prevents additional injury to living resources and habitats, services and natural support systems while recovery is taking place. Habitat protection addresses cases where existing regulations affecting private land use may be inadequate to protect essential habitats of recovering resources and services. In

situations where natural recovery is slow to occur or where direct restoration is neither technically feasible or cost effective, other measures need to be considered to mitigate injury. These may include replacement of injured resources and services with those that are equivalent. Replacement or acquisition of the equivalent means compensation for an injured, lost or destroyed resource by substituting another resource that provides the same or substantially similar services as the injured resource (56 Federal Register 8899 [March 1, 1991]).

The affected injured resources and associated services are listed below. Although habitat protection objectives and benefits for each of these resources and services differ depending on the particular parcel and the options acquired, general objectives and benefits are outlined below.

Pink salmon, sockeye salmon, cutthroat trout, Dolly varden, herring: ensure maintenance of adequate water quality, riparian habitat and intertidal habitat for spawning and rearing.

Bald eagle: ensure maintenance of adequate nesting habitat and reduce disturbance in feeding and roosting areas.

Black Oystercatcher: reduce disturbance to feeding and nesting sites.

Common murre: reduce disturbance in nearshore feeding areas and near nesting colonies.

Harbor seal and sea otters: reduce disturbance at haul-out sites, pupping sites, and in nearshore feeding areas.

Harlequin duck: ensure maintenance of adequate riparian habitat for nesting and brood rearing, and reduce disturbance to nearshore feeding, molting, and broodrearing habitats.

Intertidal/subtidal biota: maintain water quality along shoreline and reduce disturbance in nearshore areas.

Marbled murrelet: ensure maintenance of adequate nesting habitat and reduce disturbance to nearshore feeding and broodrearing habitats.

River otter: ensure maintenance of adequate riparian and shoreline habitats for feeding and denning.

Recreation: Maintain or enhance public access for recreational opportunities, reduce disturbances that would create visual impacts.

Wilderness: Maintain wilderness qualities, reduce impacts to wilderness qualities.

Cultural resources: Maintain or reduce disturbance to cultural resource sites.

Subsistence: Ensure subsistence opportunities in known harvest areas.

In FY 99, it is expected that negotiations and closing activities will continue with Afognak Joint Venture, Eyak Corporation, Tatitlek Corporation and Koniag as well as with several small parcel landowners.

Completing the Eyak agreement will involve extensive title research and review, hazardous materials assessments, mapping modifications, and services of outside consultants. Negotiations with Afognak Joint Venture may require modifications and adjustments to appraisals and parcel evaluations as necessary to reflect changes in parcel boundaries and modifications to property rights being conveyed or discussed. If an agreement is reached, extensive title research will need to be completed and results reviewed, as well as a hazardous materials survey with follow-up site visits prior to closure. While the first closing has occurred with the English Bay and Tatitlek acquisitions, work remains to bring the second phase of these transactions to closure. The Akhiok-Kaguyak and Old Harbor exchanges will continue to be active. The Old Harbor/Sitkalidak land exchange is contingent on completion of a conservation easement by Old Harbor on Sitkalidak Sound. As Koniag Phase II negotiations continue, mapping, appraisals and other tasks may be necessary.

Additional work on small parcels will focus primarily on those parcels currently identified as actively under consideration. Those requiring the most extensive work are likely to be Termination Pt., the Kenai Natives Association package, Tatitlek homesite lots, and the Kodiak Island Borough tax parcels as well as 42 additional 10 acre parcels along Uyak Bay. Appraisals, appraisal reviews, title research and review, hazardous materials surveys and closing costs are all anticipated. Habitat biologists with the Alaska Department of Fish and Game continue to provide resource information. In addition, the U.S. National Park Service will explore other habitat protection options for park lands impacted by the oil spill.

B. Methods:

The Habitat Protection and Acquisition Process is the method for acquiring lands or partial interests in lands that contain habitats linked to resources and/or services injured by the oil spill. Protection tools that will be considered for use by the Trustee Council include: fee acquisition, conservation easements, acquisition of partial interests, cooperative management agreements, and others. Following purchase, acquired parcels will be managed by the appropriate resource agency in a manner that is consistent with the restoration of the affected resources and/or services. The Trustee Council will decide which agency will manage the land or may create a new management authority.

Funds from this project will be used to acquire full title or partial interests in lands, subject to approval by the Trustee Council, that contain habitats/sites linked to resources and services that were injured by the *Exxon Valdez* oil spill. Acquisition of lands or interest in lands will be accomplished according to accepted realty principles and practices. All acquisitions will require title evidence, appraisals of fair market value, litigation reports, hazardous substances surveys, legal review of title, and negotiations.

Some acquisitions may require land surveys and additional ecological surveys.

C. Contracts and Other Agency Assistance

Various components of this project will be contracted out to the private sector. Contracting is managed by the agency responsible for acquisition of habitat protection rights and future management. Various agencies handle various realty requirements differently depending upon agency requirements and in house expertise.

SCHEDULE

This project is a continuation of 93064, 94126, 95126, 96126, 97126, and 98126, and does not lend itself to a specific timetable. Activities associated with this project are subject to influence from landowners, negotiators and various contractors.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

All habitat protection efforts including this project are dependent upon the results of on-going research and monitoring projects. For example, the Large Parcel Element used information from the anadromous fish stream catalog, colonial seabird catalog, bald eagle nesting maps, and data from Trustee Council funded studies on black oystercatchers, marbled murrelets and pigeon guillemots.

EXPLANATION OF CHANGES IN CONTINUING PROJECTS

There is no substantive change anticipated for FY 99. It is anticipated that the approach to habitat protection acquisitions pursued by the Trustee Council will remain essentially the same. However, it is expected that the bulk of the work associated with the Habitat Protection Program will be completed by the end of this fiscal year.

ENVIRONMENTAL COMPLIANCE

Previous acquisitions have received a categorical exclusions. The appropriate federal agencies, U.S. Department of the Interior or U.S. Forest Service will comply with NEPA where appropriate.

PERSONNEL

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Revision 7 10/98
Approved TC 8-13-98

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

Budget Category:	Authorized FY 1998	Proposed FY 1999	PROPOSED FY 1999 TRUSTEE AGENCIES TOTALS					
			ADEC	ADF&G	ADNR	USFS	DOI/USFWS	DOI/NPS
				$22.4	$316.5	$248.6	$172.6	$10.3
Personnel	$352.8	$261.7						
Travel	$56.0	$39.3						
Contractual	$294.3	$395.5						
Commodities	$4.7	$7.2						
Equipment	$0.0	$0.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	$707.8	$703.7		Estimated FY 2000	Estimated FY 2001	Estimated FY 2002		
General Administration	$73.6	$66.7						
Project Total	$781.4	$770.4		$480.0	$0.0	$0.0		
Full-time Equivalents (FTE)	4.8	3.9						
	Dollar amounts are shown in thousands of dollars.							
Other Resources	$0.0	$0.0		$0.0	$0.0	$0.0		

Comments: This project is a continuation of Project 98126. Budget estimates are based upon the current status of negotiations as of April 15, 1998.

1999

Prepared: 1 of 21

Project Number: 99126
Project Title: Habitat Protection & Acquisition Support
Lead Agency: AK Dept. of Natural Resources, US Forest Service

FORM 2A
MULTI-TRUSTEE
AGENCY
SUMMARY

8/5/98

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

Budget Category:	Authorized FY 1998	Proposed FY 1999
Personnel	$43.2	$35.6
Travel	$3.7	$2.8
Contractual	$218.6	$254.7
Commodities	$0.5	$0.5
Equipment	$0.0	$0.0
Subtotal	$266.0	$293.6
General Administration	$21.8	$22.9
Project Total	$287.8	$316.5
Full-time Equivalents (FTE)		0.4
Other Resources		

LONG RANGE FUNDING REQUIREMENTS					
	Estimated FY 2000	Estimated FY 2001	Estimated FY 2002		
	$150.0				

Dollar amounts are shown in thousands of dollars.

Comments:

Budget reflects continuation of AJV and Eyak large parcel transactions, Tatitlek second closing, Old Harbor Exchange, AKI Exchange, Lesnoi, Blondeau, and several other small parcels.

1999

Prepared: 2 of 21

Project Number: 99126
Project Title: Habitat Protection & Acquisition Support
Agency: AK Dept. of Natural Resources

FORM 3A
TRUSTEE
AGENCY
SUMMARY

8/5/98

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

Personnel Costs:		GS/Range/ Step	Months Budgeted	Monthly Costs	Overtime	Proposed FY 1999
	Position Description					
TBD	Natural Resource Manager II	20	3.0	7.2		21.6
TBD	Natural Resource Manager II	20	2.0	7.0		14.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		5.0	14.2	0.0	
					Personnel Total	$35.6

Travel Costs:	Ticket Price	Round Trips	Total Days	Daily Per Diem	Proposed FY 1999
					0.0
Travel to Prince William Sound and Gulf of Alaska for purposes of survey, title verification, and recordation, appraisal review and site inspections.	0.30	3	7	0.15	2.0
					0.0
					0.0
					0.0
Travel to Juneau for Trustee Council briefings, presentations.	0.50	1	2	0.15	0.8
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$2.8

1999

Prepared: 3 of 21

Project Number: 99126
Project Title: Habitat Protection & Acquisition Support
Agency: AK Dept. of Natural Resources

FORM 3B
Personnel
& Travel
DETAIL

8/5/98

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

Contractual Costs:	Proposed
Description	FY 1999
Map productions, maps and data analysis for negotiators, appraisers, land status verification, data management support.	28.0
Charters to uplands to further refine parcel boundaries (8 hours @ $400/hour)	3.2
Services necessary for the Trustee Council to reach closure on purchase agreements for parcels under negotiation. This may i	95.0
title reports, litigation reports, appraisal reviews, timber reviews, survey review.	
Travel and negotiation support expenses for Dept. of Law	5.0
Document production and printing costs	2.0
Small Parcel Title Insurance	10.0
Small Parcel Appraisals	10.0
Closing and recordation of final title documents, surveys, easements.	15.0
Hazardous Materials Review, AJV, Lesnoi, Small parcels.	13.0
Old Harbor Exchange (previously outlined in 98126 supplemental)	40.0
1998 Funding for Old Harbor Exchange Title work and Appraisal not utilized in 1998.	33.5
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$254.7

Commodities Costs:	Proposed
Description	FY 1999
Office and field supplies (toner cartridges, data cassettes, etc.)	0.5
Commodities Total	$0.5

1999

Project Number: 99126
Project Title: Habitat Protection & Acquisition Support
Agency: AK Dept. of Natural Resources

FORM 3B
Contractual & Commodities DETAIL

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

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

Existing Equipment Usage:	Number of Units	Inventory Agency
Description		

1999

Project Number: 99126
Project Title: Habitat Protection & Acquisition Support
Agency: AK Dept. of Natural Resources

FORM 3B
Equipment
DETAIL

	Authorized	Proposed

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

Budget Category:	Authorized FY 1998	Proposed FY 1999
Personnel	$129.0	$132.0
Travel	$16.7	$19.0
Contractual	$35.5	$68.0
Commodities	$2.5	$5.0
Equipment	$0.0	$0.0
Subtotal	$183.7	$224.0
General Administration	$21.8	$24.6
Project Total	$205.5	$248.6
Full-time Equivalents (FTE)	1.7	1.9

LONG RANGE FUNDING REQUIREMENTS

	Estimated FY 2000	Estimated FY 2001	Estimated FY 2002		
	$150.0				

Dollar amounts are shown in thousands of dollars.

Other Resources								

Comments:

1999

Prepared:

Project Number: 99126
Project Title: Habitat Protection & Acquisition Support
Agency: US Forest Service

FORM 3A
TRUSTEE
AGENCY
SUMMARY

4/9/98

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 1999
R. Goosens	Appraiser	13	1.0	6.5		6.5
L. Keeler	Lands Specialist	12	5.0	6.0		30.0
K. Holbrook	Realty/Land Parcel Specialist	13	7.0	6.5		45.5
J. Swanson	Lands Examiner	9	3.0	4.7		14.1
D. Kennedy	Lands Specialist	13	3.0	6.5		19.5
R. Schrank	Cadastral Engineer	12	1.5	6.0		9.0
C. Woods	Lands Recorder	6	2.0	3.7		7.4
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		22.5	39.9	0.0	
					Personnel Total	$132.0

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 1999
					0.0
RT Anchorage to Cordova	0.24	6	30	0.2	7.4
RT Anchorage to Juneau	0.45	4	16	0.2	5.0
RT Anchorage to Washington DC	2.50	2	8	0.2	6.6
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$19.0

1999

Project Number: 99126
Project Title: Habitat Protection & Acquisition Support
Agency: US Forest Service

FORM 3B
Personnel
& Travel
DETAIL

Prepared:

4/9/98

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

Contractual Costs:	Proposed
Description	FY 1999
Title documents, title reports, purchase agreements	10.0
Air Charter, 20 hours @ $400/hr.	8.0
Appraisals (small parcels)	50.0
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$68.0

Commodities Costs:	Proposed
Description	FY 1999
supplies	2.0
Maps	2.0
Film and development	1.0
Commodities Total	$5.0

1999

Project Number: 99126
Project Title: Habitat Protection & Acquisition Support
Agency: US Forest Service

FORM 3B
Contractual & Commodities DETAIL

Prepared:

4/9/98

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

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

Existing Equipment Usage: Description	Number of Units	Inventory Agency

1999

Project Number: 99126
Project Title: Habitat Protection & Acquisition Support
Agency: US Forest Service

FORM 3B
Equipment
DETAIL

Prepared: 4/9/98

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

Budget Category:	Authorized FY 1998	Proposed FY 1999
Personnel	$155.8	$69.9
Travel	$34.4	$16.3
Contractual	$39.9	$69.5
Commodities	$1.5	$1.5
Equipment	$0.0	$0.0
Subtotal	$231.6	$157.2
General Administration	$26.2	$15.4
Project Total	$257.8	$172.6
Full-time Equivalents (FTE)	3.1	1.2

LONG RANGE FUNDING REQUIREMENTS

Estimated FY 2000	Estimated FY 2001	Estimated FY 2002
$150.0		

Dollar amounts are shown in thousands of dollars.

Other Resources

Comments:

Budget represents closing costs associated with Koniag, Phase I Final Closing, Koniag Phase II, negotiations, AKI final closing remnants, AKI exchange closing and AJV purchase agreement and closing. Addition small parcel work focuses on KNA closing, 10-acre parcel closings and KIB foreclosed lands.

1999

Project Number: 99126
Project Title: Habitat Protection & Acquisition Support
Agency: US Fish & Wildlife Service

FORM 3A
TRUSTEE
AGENCY
SUMMARY

Prepared: 4/9/98

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 1999
						0.0
C Rasmussen	Review Appraiser	13	1.0	5.6	0.0	5.6
S. Shuck	Realty Specialist	13	4.0	6.6	0.0	26.4
N. Parker	Realty Specialist	9	4.0	3.9	0.0	15.6
S. Alexander	Realty Assistant	6	2.0	3.2	0.0	6.4
K. Milton	Cartographic Technician	7	2.0	3.6	0.0	7.2
G. Muehlenhardt	Biologist	12	1.5	5.8	0.0	8.7
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		14.5	28.7	0.0	
					Personnel Total	$69.9

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 1999
					0.0
Travel to Kodiak	0.4	8	16	0.15	5.6
Travel to Kenai Salamatof and KNA		2	4	0.15	0.6
Travel for Washington, D.C. and Colorado Staff	1.5	5	17	0.15	10.1
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$16.3

1999

Project Number: 99126
Project Title: Habitat Protection & Acquisition Support
Agency: US Fish & Wildlife Service

FORM 3B
Personnel
& Travel
DETAIL

Prepared: 4/9/98

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

Contractual Costs:	Proposed
Description	FY 1999
Air Charter, Kodiak Charter Air Service	6.0
Title Insurance and Related Fees	46.0
Survey of 10-acre parcels	7.5
Appraisal - 10-acre parcels	10.0
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$69.5

Commodities Costs:	Proposed
Description	FY 1999
Office Supplies	1.5
Commodities Total	$1.5

1999

Project Number: 99126
Project Title: Habitat Protection & Acquisition Support
Agency: US Fish & Wildlife Service

FORM 3B
Contractual & Commodities DETAIL

Prepared: 4/9/98

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

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

Existing Equipment Usage: Description	Number of Units	Inventory Agency

1999

Project Number: 99126
Project Title: Habitat Protection & Acquisition Support
Agency: US Fish & Wildlife Service

FORM 3B
Equipment
DETAIL

Prepared: 4/9/98

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

Budget Category:	Authorized FY 1998	Proposed FY 1999
Personnel	$13.0	$18.0
Travel	$1.2	$1.2
Contractual	$0.3	$0.3
Commodities	$0.2	$0.2
Equipment	$0.0	$0.0
Subtotal	$14.7	$19.7
General Administration	$2.0	$2.7
Project Total	$16.7	$22.4
Full-time Equivalents (FTE)		0.3
Other Resources		

LONG RANGE FUNDING REQUIREMENTS

Estimated FY 2000	Estimated FY 2001	Estimated FY 2002		
$20.0				

Dollar amounts are shown in thousands of dollars.

Comments:

1999

Project Number: 99126
Project Title: Habitat Protection & Acquisition Support
Agency: AK Dept. of Fish & Game

FORM 3A
TRUSTEE
AGENCY
SUMMARY

Prepared: 4/9/98

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 1999
	Habitat Biologist III	18	2.0	6.5		13.0
	Cartographic Support	16	1.0	5.0		5.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		3.0	11.5	0.0	
					Personnel Total	$18.0

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 1999
					0.0
Travel to Spill Area Communities	0.1	4	4	0.2	1.2
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$1.2

1999

Project Number: 99126
Project Title: Habitat Protection & Acquisition Support
Agency: AK Dept. of Fish & Game

FORM 3B
Personnel
& Travel
DETAIL

Prepared:

4/9/98

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

Contractual Costs:	Proposed
Description	FY 1999
Document reproduction	0.3
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$0.3

Commodities Costs:	Proposed
Description	FY 1999
Office Supplies	0.2
Commodities Total	$0.2

1999

Project Number: 99126
Project Title: Habitat Protection & Acquisition Support
Agency: AK Dept. of Fish & Game

FORM 3B
Contractual & Commodities DETAIL

Prepared: 4/9/98

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

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

Existing Equipment Usage: Description	Number of Units	Inventory Agency

1999

Project Number: 99126
Project Title: Habitat Protection & Acquisition Support
Agency: AK Dept. of Fish & Game

FORM 3B
Equipment
DETAIL

Prepared:

4/9/98

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

Budget Category:	Authorized FY 1998	Proposed FY 1999
Personnel	$11.8	$6.2
Travel	$0.0	$0.0
Contractual	$0.0	$3.0
Commodities	$0.0	$0.0
Equipment	$0.0	$0.0
Subtotal	$11.8	$9.2
General Administration	$1.8	$1.1
Project Total	$13.6	$10.3
Full-time Equivalents (FTE)		0.1
Other Resources		

LONG RANGE FUNDING REQUIREMENTS					
	Estimated FY 2000	Estimated FY 2001	Estimated FY 2002		
	$10.0				

Dollar amounts are shown in thousands of dollars.

Comments:

1999

Prepared:

Project Number: 99126
Project Title: Habitat Protection & Acquisition Support
Agency: National Park Service

FORM 3A
TRUSTEE
AGENCY
SUMMARY

4/9/98

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 1999
TBD	Lands Specialist	13	1.0	6.2		6.2
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		1.0	6.2	0.0	
					Personnel Total	$6.2

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 1999
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$0.0

1999

Project Number: 99126
Project Title: Habitat Protection & Acquisition Support
Agency: National Park Service

FORM 3B
Personnel
& Travel
DETAIL

Prepared:

4/9/98

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

Contractual Costs:	Proposed FY 1999
Description	
Closing costs, including title evidence and escrow fees for English Bay	3.0
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$3.0

Commodities Costs:	Proposed FY 1999
Description	
Commodities Total	$0.0

1999

Project Number: 99126
Project Title: Habitat Protection & Acquisition Support
Agency: National Park Service

FORM 3B
Contractual & Commodities DETAIL

Prepared: 4/9/98

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FY 1999
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			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

1999

Project Number: 99126
Project Title: Habitat Protection & Acquisition Support
Agency: National Park Service

FORM 3B
Equipment
DETAIL

Prepared:

4/9/98

Approved TC 8-13-98

Tatitlek Coho Salmon Release

Project Number:	99127
Restoration Category:	General Restoration
Proposer:	G. Kompkoff/Tatitlek IRA Council
Lead Trustee Agency:	ADFG
Cooperating Agencies:	None
Alaska SeaLife Center:	No
New or Continued:	Cont'd
Duration:	5th yr. 5 yr. project
Cost FY 99:	$10.7
Cost FY 2000:	$0.0
Cost FY 01:	$0.0
Cost FY 02:	$0.0
Geographic Area:	Prince William Sound
Injured Resource/Service:	Salmon, subsistence

ABSTRACT

This project will create a coho salmon return to Boulder Bay near the village of Tatitlek. Enough coho eggs to produce 20,000 smolt will be collected from an Alaska Department of Fish and Game approved stream, incubated and reared to smolt at the Solomon Gulch Hatchery, transported, and held for two weeks in net pens in Boulder Bay before release. Release will produce a 2,000 to 3,000 adult return to Boulder Bay for harvest in a subsistence fishery.

INTRODUCTION

Subsistence fisheries available to residents of Tatitlek village were severely disrupted by the *Exxon Valdez* oil spill. This project is intended to enhance subsistence resources near Tatitlek by creating a 2,000 to 3,000 coho salmon return to Boulder Bay immediately adjacent to Tatitlek village. This resource is intended to partially replace for the near term other subsistence resources, such as harbor seal, that were injured by the spill

This coho salmon return will be created through an annual release of 50,000 coho salmon smolt in Boulder Bay. The smolt are produced at the Solomon Gulch Salmon Hatchery under an agreement between its operator, the Valdez Fisheries Development Corporation and the Tatitlek IRA Council. The coho salmon eggs needed to produce the smolt come from a wild coho run that has been approved by ADF&G for the egg take. The eggs are taken to the Solomon Gulch hatchery for incubation and rearing to the smolt stage. The sea ready smolt are then transported by boat to Boulder Bay and are imprinted to the bay by placing them in net pens for about a two week period before being released into the wild.

The EVOS Trustee Council approved this project in FY 95. Funds were appropriated to underwrite the environmental assessment, a draft of which has been produced. Funds received in FY 96 and beyond will be used to produce the coho salmon returns to Boulder Bay.

NEED FOR THE PROJECT

A. Statement of Problem

Subsistence harvests by Tatitlek village residents have declined considerably since the oil spill. Most marine resources that were utilized for subsistence by Tatitlek villagers have not substantially improved since the spill. Subsistence harvests are still lots less then they were prior to the spill.

B. Rationale/Link to Restoration

This project would enhance the recovery of the local salmon resource that is utilized for subsistence and provides a means for lessening the impacts of continued harvests on other subsistence harvests injured by the spill such as harbor seals.

C. Location

This project will be undertakes at the Solomon Gulch Hatchery and in Boulder Bay near Tatitlek. Those participating in the subsistence fishery created by this project will realize the benefits. These will mainly be residents from Tatitlek.

COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE

This project was initiated at the request of the Tatitlek Bay IRA Council. The council negotiated

the agreement with the Valdez Fisheries Development Corporation to produce the smolt for the project. Members of the village set up the net pen site each year in Boulder Bay and hold and feed the smolt each year prior to release. The villagers participate in the subsistence fishery on the returning adults.

PROJECT DESIGN

A. Objectives

1. Continue agreement with the Valdez Fisheries Development Corporation to produce 50,000 coho salmon smolt for release in Boulder Bay.

2. Imprint smolt to Boulder Bay by holding and feeding them in net pens in the bay for two weeks prior to release into the wild.

3. Harvest for subsistence 2,000 to 3,000 coho salmon annually upon their return to the imprint site.

B. Methods

The purpose of this project is to create a run of coho salmon in Boulder Bay near Tatitlek for subsistence use. The project would be undertaken annually and could be classified as "put and take" since it is unlikely that the coho returns produced by this project would establish a wild run. There are four basic steps to the project; egg take, incubation and rearing to the smolt stage, imprinting and release of smolt and the subsistence harvest.

The Solomon Gulch hatchery is responsible for the egg take and smolt production, Tatitlek village is responsible for imprinting and releasing the smolt into the wild. The subsistence fishery is open to all, but mostly consists of Tatitlek village residents.

The eggs are taken from a coho run approved by ADF&G for use in this project. Enough eggs are taken to produce 50,000 smolt. They are taken to the Solomon Gulch hatchery where standard fish culture practices are utilized to incubate the eggs and rear the resultant fry to the smolt stage. The smolt are then transported by boat to Boulder Bay where they are placed in net pens and held (and fed) for a two week period during which time they imprint to Boulder Bay. The smolt are then released into the wild and proceed to their ocean rearing grounds returning back to Boulder Bay approximately 12 months later as adults. Around 2,000 to 3,000 adult coho salmon return to Boulder Bay from the smolt release. As many of these fish as possible (usually 75% to 85%) are harvested in a subsistence fishery that has been set up specifically for this purpose. The unharvested fish die without spawning.

C. Cooperating Agencies, Contracts and Other Agency Assistance

The Tatitlek IRA Council is contracted by ADF&G to oversee this project. The council in turn contracts with the Valdez Fisheries Development Corporation to take the eggs and produce the smolt.

SCHEDULE

A. Measurable Project Tasks for FY 99

August, 1998:	Egg take
May 20 to 25, 1999:	Smolt transported to Boulder Bay and placed in net pens.
June 3 to 8, 1999:	Smolt released into Boulder Bay

B. Project Milestones and Endpoints

Objective 1.	Initial agreement in place. Will be reviewed and renewed by April 15 each year.
Objective 2.	Completed by June 15 each year.
Objective 3.	Completed by July 15 annually.

C. Completion Date

This project will continue until the subsistence resources injured by the spill have fully recovered.

PUBLICATIONS AND REPORTS

Annual reports	Describe project activities for each fiscal year. Due April 15 following the fiscal year being reported on.
Final report	Synopsis of each year's activities and analysis of project as a whole. Due April 1 following the year in which the final adult return occurs.

PROFESSIONAL CONFERENCES

No travel to professional conferences is planned under this project.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

There appear to be no opportunities to coordinate or integrate this project with other restoration efforts.

EXPLANATION OF CHANGES IN CONTINUING PROJECTS

There are no project design or schedule changes in this proposal from the DPD approved by the Trustee Council for FY 98.

PROPOSED PRINCIPAL INVESTIGATOR

Gary Kompkoff, President
Tatitlek IRA Council
Box 171
Tatitlek, AK 99677
Phone (907) 325-2311
Fax (907) 325-2298

Revis 5-8-98
Approved TC 8-13-98

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

Budget Category:	Authorized FY 1998	Proposed FY 1999
Personnel		$0.0
Travel		$0.0
Contractual		$10.0
Commodities		$0.0
Equipment		$0.0
Subtotal	$0.0	$10.0
General Administration		$0.7
Project Total	$0.0	$10.7
Full-time Equivalents (FTE)		0.1
Other Resources		

LONG RANGE FUNDING REQUIREMENTS

	Estimated FY 2000	Estimated FY 2001	Estimated FY 2002		
	$0.0	$0.0	$0.0		

Dollar amounts are shown in thousands of dollars.

Comments:

FY 99

Prepared: 4/14/98

Project Number: 99127
Project Title: Tatitlek Coho Salmon Release
Agency: ADFG

FORM 3A
TRUSTEE
AGENCY
SUMMARY

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

Budget Category:	Authorized FY 1998	Proposed FY 1999
Personnel		$2.8
Travel		$0.0
Contractual		$2.6
Commodities		$1.6
Equipment		$0.0
Subtotal	$0.0	$7.0
Indirect		$3.0
Project Total	$0.0	$10.0
Full-time Equivalents (FTE)		0.1
	Dollar amounts are shown in thousands of dollars.	
Other Resources		

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

Comments:

FY 99

Prepared: 4/14/98

Project Number: 99127
Project Title: Tatitlek Coho Salmon Release
Name: Tatitlek IRA Council
Agency: ADFG

FORM 4A
Non-Trustee
SUMMARY

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

Personnel Costs:			Months	Monthly		Proposed
	Name	Position Description	Budgeted	Costs	Overtime	FY 1999
		Net Pen Worker	0.5	2.8		1.4
		Net Pen Worker	0.5	2.8		1.4
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
		Subtotal	1.0	5.6	0.0	
					Personnel Total	$2.8

Travel Costs:		Ticket	Round	Total	Daily	Proposed
	Description	Price	Trips	Days	Per Diem	FY 1999
						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

FY 99

Prepared: 4/14/98

Project Number: 99127
Project Title: Tatitlek Coho Salmon Release
Name: Tatitlek IRA Council
Agency: ADFG

FORM 4B
Personnel
& Travel
DETAIL

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1998 - September 30, 1999

Contractual Costs:	Proposed FY 1999
Description	
Transport 20,000 coho smolt to Boulder Bay, provide fish food & supplies	2.0
Village skiff rental	0.6
Contractual Total	$2.6

Commodities Costs:	Proposed FY 1999
Description	
Fish Food	1.2
Skiff fuel/oil	0.2
Misc. Supplies	0.2
Commodities Total	$1.6

FY 99

Prepared: 4/14/98

Project Number: 99127
Project Title: Tatitlek Coho Salmon Release
Name: Tatitlek IRA Council
Agency: ADFG

FORM 4B
Contractual & Commodities DETAIL

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

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

Existing Equipment Usage:	Number	
Description	of Units	

FY 99

Prepared: 4/14/98

Project Number: 99127
Project Title: Tatitlek Coho Salmon Release
Name: Tatitlek IRA Council
Agency: ADFG

FORM 4B
Equipment
DETAIL

99131

99515

Revision 11-12-98
Approved TC 12-15-98

Chugach Native Region Clam Restoration

Project Number:	99131
Restoration Category:	General Restoration
Proposer:	P. Brown- Schwalenberg/ CRRC
Lead Trustee Agency:	ADFG
Cooperating Agencies:	None
Alaska SeaLife Center:	No
New or Continued:	Cont'd
Duration:	5th yr. 5 yr. project
Cost FY 99:	$306.2
Cost FY 2000:	$0.0
Cost FY 01:	$0.0
Cost FY 02:	$0.0
Geographic Area:	Prince William Sound, Lower Cook Inlet
Injured Resource/Service:	Clams, subsistence

ABSTRACT

Cost effective procedures for establishing easily accessible subsistence clam populations near Alaska Native villages in the oil spill region will be established. In FY 99 the scope of work will be confined to developing effective, standardized techniques for producing littleneck clam seed at the Qutekcak Hatchery and analyzing growth and mortality of this seed placed on the beaches in FY 96, FY 97 and FY 98. Total seeded area during the project will not exceed five hectares. Follow-up research on success of seeding will be conducted. Growout development work will be confined to areas near the Native villages of Tatitlek, Nanwalek and Port Graham. Nursery and growout work will be emphasized in FY 99.

INTRODUCTION

A. General

The purpose of this project is to develop cost effective procedures for establishing managed populations of clams in areas that are readily accessible from Native villages in the oil spill region. These clams will be used as a source for subsistence food to replace the natural clam resource that has been lost, damaged or depleted. The villages of Port Graham, Nanwalek, Tatitlek and Eyak will take part in the development process.

Clams were once an important subsistence food in the Native villages. Clam populations in areas that are reasonably accessible to the villages have decreased to very low levels in recent years. Consequently, the role of clams in the subsistence diet in these villages has been greatly reduced. And, with a few exceptions, the role of clams in the subsistence diet of most Native villages in the oil spill area is a lot less than it was historically.

There are probably a number of reasons why local clam populations are currently at low levels. Since clams are basically an unmanaged resource in the oil spill area, there are no quantifiable data available that could point to the actual circumstances that lead to the sharp reduction in these clam populations. However, there are events that likely played a major role. These include changes in beach configurations resulting from the 1964 earthquake, increasingly heavy sea otter predation, human over-harvest, and the *Exxon Valdez* oil spill.

The oil spill impacted the wild clam populations and their importance as a subsistence food in two ways. First, many clam beds suffered from direct oiling. The impact of the oil on the clam beds in Windy Bay, for instance, destroyed one of the more important clam beds in the lower Kenai Peninsula. With the current timber harvesting operations soon to provide road access from Port Graham and Nanwalek to the Windy Bay area, the loss of the clam resource there had a major impact on these villages. Second, even though many clams weren't killed from the oil, they have a tendency to accumulate and concentrate the toxic contaminants from non-lethal amounts of oil. This has badly eroded the confidence of the villagers in the healthfulness of the remaining wild clam populations as a subsistence food.

In order to re-establish local clam populations as a subsistence resource for the Native villages a program needs to be developed to enhance the depleted stocks and the replace damaged ones. Over the past ten years the nursery systems and field growout technologies have sufficiently evolved to make clam enhancement and reseeding efforts feasible. This technology can be readily applied to increasing the clam resource near the villages to determine which applications would be best suited for the task at hand.

This program was initiated in FY 95 as a demonstration project. The first year objectives were to decide what species of clams will be used for the project, determine the potential of the Qutekcak Shellfish Hatchery to produce seed for the project and develop the system for identifying the growout areas near the villages of Port Graham/Nanwalek and Tatitlek.

After consultation with the Native villagers, experts in clam production techniques and a

literature search, iittleneck clams (*Protothaca staminea*) and cockles (*Clinocardium nuttalli*) were selected as the species that will be used in the restoration effort. The butter clam (*Saxidomus giganteus*), a popular species with the Native villagers, was rejected because of its slow growth characteristics and propensity to retain the Paralytic Shellfish Poison toxin for extended periods.

Work will be restricted to Littleneck clams in FY 99. Littleneck clam broodsource for both Port Graham/Nanwalek and Tatitlek have been cleared for use in the Qutekcak Shellfish Hatchery in Seward.

As part of the study to identify growout areas near the villages a literature search was conducted through the University of Alaska to identify all previous research on littleneck clam life histories and population surveys. Time was spent with Alaska Department of Fish & Game (ADF&G) shellfish biologists from lower Cook Inlet and Prince William Sound to review and discuss clam surveys and management plans. Residents of the villages of Port Graham, Nanwalek and Tatitlek were interviewed to identify nearby areas that either now or once had significant populations of littleneck clams. Beach surveys were then conducted near Port Graham, Nanwalek and Tatitlek. Several sites were identified as suitable for use in this project.

The hatchery produced several small batches of littleneck clam seed. However, survival through metamorphosis was poor. An experienced shellfish hatchery manager was brought into the hatchery to ensure that the proper culture procedures were in place and to improve larval health and survival. He will remain on staff for at least the duration of the project.

A tidally driven fluidized upwelling nursery system (tidal FLUPSY) was set up near Tatitlek to test its potential for nursery production. Test plots on beaches near Tatitlek, Nanwalek and Port Graham have been seeded with littleneck clams for growth, mortality and predator control studies.

In FY 99 hatchery work will be done in the new shellfish hatchery in Seward that was built by the State. The hatchery is being leased and operated by the Qutekcak Native Tribe who will contract with the project to conduct the hatchery and nursery work. This new facility will greatly enhance operations and allow the project to increase production as well as expand into cockles. The increased algae production capabilities in the new facility will, in addition to permitting increased seed production, allow the project to expand investigations on pre- nursery production at the hatchery.

In FY 99 hatchery work will focus on continuing to development broodstock holding and maturation techniques and continuing to improve survival rates through settling. Nursery work at the hatchery will concentrate on increasing and sustaining algae production in the pond and adding more up-wellers.

Hatchery seed produced in FY 98 and FY 99 will be used to continue work on determining the potential of remote tidal FLUPSYs. Nursery seed produced by both the hatchery and the tidal FLUPSY will be planted on project beaches to continue and enhance growout studies. The large numbers of hatchery seed available in FY 99 will allow the project to expand growout studies

beyond what was originally planned. A new set of protocols for planting seed in the growout study areas will be presented for review no later than March 12, 1999. Other work on the growout phase in FY 99 will concentrate on collecting and analyzing data to determine growth and mortality of littleneck clams planted in FY 96, FY 97 and FY 98.

Because very little culture or enhancement work has been done previously with littleneck clams this project is breaking a lot of new ground. This is perhaps good news from the standpoint of contributing to the knowledge pool, but it is slowing the project down. The hatchery, nursery and growout procedures that are being developed for this project must be adapted from previous work on other species. The growout work will first require the development of a database on growth and mortality to help determine the best enhancement approach.

The progress that the project has experienced so far gives the investigators great confidence that successful hatchery, nursery and growout procedures will be developed. This knowledge can then be put to work in providing safe, reliable subsistence clam resources for the villages in the oil spill region.

B. Funding

In addition to funds requested from the EVOS Trustee Council there are several other bivalve shellfish projects ongoing in the Chugach Native region that will contribute to this project in FY 99. Although only one of these projects is directly involved in subsistence clam development, some of the objectives in all of them are similar. Shared objectives translate into shared funding, which reduces the overall cost of the subsistence clam project. The table below describes the projects that will contribute to the EVOS TC clam project in FY 99 with a brief description of how these projects will contribute and estimated amount.

Funding Source	Recipient/Purpose	Shared Objectives	Est. Amount
Administration for Native Americans	CRRC/subsistence razor clam, cockle and littleneck clam development in 10 Native villages	Littleneck clam hatchery, nursery and growout	$40.0
Administration for Native Americans	Qutekcak Native Tribe/ hatchery development	Shellfish hatchery operations	$130.0
Dept. of Community & Regional Affairs (AK)	Village of Chenega Bay/ oyster farm development	Nursery production with powered FLUPSY	$35.0
Dept. of Community & Regional Affairs (AK)	Village of Tatitlek/ shellfish mariculture	Operation of tidal powered FLUPSY	$25.0
Bureau of Indian Affairs	CRRC/mariculture development	Shellfish hatchery operations	$25.0
		Total	**$ 255.0**

Once the objectives of this project have been met, and the hatchery is in commercial production,

funding for the continued maintenance of the subsistence clam beds will come from the shellfish hatchery and the participating Native villages. Seed for the subsistence clam beds would be produced by the Qutekcak hatchery. Hatchery seed production for subsistence use would be a small piece of the anticipated commercial hatchery production and would not require additional funding.

Maintenance of the subsistence beaches, once they are set up, would be the responsibility of the respective villages. Maintenance costs would be small except for labor. All the participating villages also have commercial fisheries development projects. The labor costs for subsistence clam beach maintenance could easily be covered under these projects.

NEED FOR THE PROJECT

A. Statement of Problem

Local shellfish populations, especially clams have been severely reduced as a subsistence food source for Native villages. Part of the reduced use is a loss of confidence in the safety of consuming shellfish as a result of the Exxon Valdez Oil Spill. In addition, local shellfish populations have been greatly reduced as result of hydrocarbon toxicity, sea otter predation, human overharvest and beach changes from the 1964 earthquake.

B. Rationale

This project will accomplish two things. One, it will help restore the clam resource base in the oil spill area, and two, it will enhance subsistence gathering by providing an easily accessible source of clams for subsistence use.

C. Location

The hatchery and pre-nursery work will be carried out at the Qutekcak Shellfish Hatchery in Seward. Growout operations and sampling will occur in the area around the villages of Tatitlek in Prince William Sound and in the Port Graham/Nanwalek area in Lower Cook Inlet. Pathology work will be conducted in Anchorage and Juneau. PSP sampling will occur at the DEC lab in Palmer. Data Analysis and project oversight will be conducted from CRRC offices in Anchorage and Moose Pass.

COMMUNITY INVOLVEMENT

The communities named in this project will be directly involved in it. Each community decided whether or not it wanted to be involved in the project initially. Local residents will be heavily relied upon to help locate existing clam populations and the areas for reseeding. Project work involving the villages will be done with local labor. Community leaders will be kept appraised of how the project is progressing.

PROJECT DESIGN

A. Objectives

1. Hatchery Processes- Continue to develop reliable hatchery techniques for the littleneck clam (*Protothaca staminea*). Produce a 5mm seed in the hatchery within 19 weeks after spawning.

2. Nursery- Develop cost effective, reliable techniques to grow 5mm hatchery seed to an out-planting size of 10+ mm within 12 weeks in the hatchery nursery system and in remote nursery systems.

3. Growout - Describe current local clam populations through interviews and resource assessments. Locate sites, develop reliable, cost effective growout techniques, and evaluate the efficacy of proposed methods.

B. Methods

The following is an outline of the methods that will be applied to accomplish each objective. In the pursuit of all the objectives the principal investigators will rely heavily on the advice and assistance of experts in the field. The technology for hard clam aquaculture on both the east and west coasts of the U. S. and Canada has been advancing rapidly in recent years. In order to keep abreast of the developments, determine which ones would be best suited for adapting to Alaska and avoid repeating mistakes that others have made, it will be necessary to keep in contact with the leaders of this technological advance.

For the hatchery, nursery and growout objectives, experts will be brought in to set up production or testing programs and train hatchery staff or Native villagers in clam production and/or enhancement techniques. In all cases project investigators will keep abreast of the literature and in contact with experts in the various disciplines that make up this project.

OBJECTIVE 1. HATCHERY

The Qutekcak Shellfish Hatchery located on the Institute of Marine Science grounds in Seward has been in operation since October 1993. During this time the hatchery was designed and assembled and has evolved into a small pilot-scale operation. The staff has successfully set larvae of the pacific oyster (*Crossastrea gigas*) and raised them to 15 mm for the aquatic farm industry. In addition, the hatchery has successfully conditioned, spawned, set and raised the native littleneck (*Protothaca staminea*) to 10mm.

Although a great deal had been accomplished at the hatchery, operations and procedures needed to become more reliable and efficient for the hatchery program to succeed over the long term. Total survival and production were low. To address this problem an experienced shellfish culturist with twelve years of practical hatchery experience was brought on as hatchery manager.

He will remain on staff for the duration of this project at least and will be responsible for developing operational procedures and policies, finishing and equipping the new hatchery, training staff and making hatchery operations more successful and efficient.

Process water analyses along with broodstock and larval histology work was initiated and a comprehensive health management program for the hatchery was established. This effort will be used to identify and resolve any toxins and other potential problems with the process water and to improve broodstock development and clam seed and alga culture production.

The small pilot facility that had been used for the hatchery/nursery portion of this project is being closed down. Hatchery operations were moved to the new shellfish hatchery facility that was completed by the state in the fall of 1977. With the new facility online littleneck seed production will be increased. In FY 99 the hatchery will work with only littleneck clams under this project. The littleneck clam seed production goal for FY 99 is a minimum of 600,000. A set of standard procedures will be adopted for the production of hatchery seed.

Hatchery rearing of bivalves follows three or four principal stages common to most species. Specific variations in the procedures apply to each species and strains adapted to Alaska's cold water. Some variations in procedures and practices also arise due to specific differences in the local environment of a hatchery and to the technology available to a hatchery. The following descriptions are a synopsis of the successful procedures for the production of Littleneck clam spat (juveniles) developed at the Qutekcak shellfish hatchery during the last several years. It includes how these procedures will be applied on a larger scale (150 fold) in the new hatchery, and what areas may need further investigation when applied to the new facility. Different facilities have almost always performed somewhat uniquely in the experience of most hatchery operators.

1. Broodstock Conditioning and Development

   Beginning in January six hundred brood clams will start an eight to twelve week period of conditioning (ripening) at 9-10 C. Four successive groups of three hundred additional brood clams will begin conditioning every three weeks. Spawning can then commence in April and continue through July, as needed, which also takes advantage of their natural spawning cycle to maximize fecundity and gamete quality. Broodstock are maintained in 1000 or 3000 liter indoor conditioning tanks receiving a slow continuous ambient seawater flow for dilution and temperature control, and are drained and cleaned every other day. During this period the brood clams will be fed a diet of six species of microalgae rich in essential lipids and sterols such as eicosopentanoic, docosohexanoic, and arachidonic acids to impart maximum reserves to the eggs. The six species are *Pavlova (ccmp459)*, *Tetraselmis striata*, Tahitian *Isochrysis sp.(tIso)*, *Thalassiosira pseudonana (3H)*, and *Chaetoceros calcitrans (Ccal)*, and a cold water diatom *Thalassiosira gravida*, isolated from our seawater pond. Phytoflagellates are fed at a 2:1 ratio to diatoms to the conditioning tanks at a continuous cell density of about 100,000 cells per ml.

   This protocol has repeatedly yielded well-ripened adults that mass spawn three to five million eggs per female. Lowering the conditioning temperatures to below 10 C rapidly solved our prior problem where half of the brood clams failed to undergo gametogenesis

(females) or spawn (males). These same brood clams began spontaneous spawning at 10.5 C within one month after lowering the conditioning temperature to 10 C. We spawned them twice more in mid-winter (normally an inactive period) and during these controlled spawns the embryos developed normally to D-veliger larvae unlike the previous summer. Additional clam brood from Port Graham placed in conditioning in mid-March 1997 underwent rapid, normal gametogenesis as well. Starting from a completely spent gonadal state we have been able to spawn sub-groups these additional clams as necessary after only eight weeks. The embryos from these controlled spawns have developed to normal D-veligers as well and have not subsequently grown deformed.

Any F1 generation clam families exhibiting unusually rapid growth in the spill area beaches such as those planted in June 1996 will be used as a broodstock source for future strain propagation and development. These adult clams will also often produce larvae that perform better under hatchery rearing conditions.

2. Spawning and Larval Rearing

Two spawning methods will be tested in the new hatchery to determine the most successful. One will be uncontrolled mass spawning of 100 brood clams in a 30,000 liter rearing tank (as commonly practiced in Pacific Northwest hatcheries). The other will be an induced, controlled spawn of 100 to 200 clams using a 600 liter spawning tank, individual containers, and carefully controlled fertilization. The former method is simple and very labor saving when successful while the latter method requires more time and labor but has worked well in our pilot hatchery. The latter method may also avoid stimulating initially high levels of pathogens during the first 48 hours development to D-veliger by eliminating the build-up and decomposition of excess sperm. Early development can also be reliably observed with this method to gauge overall health and viability by observing and measuring the condition of gametes and by monitoring the percent normal development rate during the first few cell divisions.

After fertilization the clam embryos are transferred to the 30,000 liter larval rearing tanks filled with 1μ filtered, UV-irradiated seawater at 16 C for the next 48 hours. One-micron filtration has proven necessary to remove the fine glacial flour seasonally present in our waters. Initial densities will not exceed ten embryos per milliliter (ml). During the 48 hour period of development from egg to D veliger larva is where we have experienced persistent high rates of abnormal development for multiple species during some periods of the year. If extensive abnormal development recurs an additional seawater treatment step consisting of at least 45 minutes of percolation through a bed of granular activated carbon (GAC) will be incorporated. This treatment has improved seawater quality sufficiently enough to reduce the rate of abnormality. Lowering the broodstock conditioning temperature has substantially reduced the problem of abnormal development. Supplementation of essential metals such as strontium, magnesium, and calcium may also be used during periods of surface water downwelling (induced by sustained, strong southerly winds) combined with high flow rates from a nearby stream. Prior IMS research revealed nutrient depletion down to their 70 m intake depth during periods of downwelling and our own water analysis found a depleted selenium concentration. Sustained downwelling weather conditions occur very infrequently based on our present experience

with the IMS seawater system whose intake now sits on the sea floor after many years of sedimentation.

On day two the larvae tanks are gently drained onto an immersed 38 micron screen and the new D-veligers are washed repeatedly, measured and counted, and returned to another filled larval rearing tank at a density of one per ml. Littleneck clam larvae have proven sensitive to usual rearing densities and handling. Because of this on each successive water change, which will be every three days rather than two, the density will be gradually lowered until about 0.25 larva per ml is reached on day eleven or fourteen. On day eight the larvae tanks are drained on a 54 micron screen. A 68 micron screen is used on day 14, and a 75 micron screen on day 20. Pediveligers are removed with a 120 micron screen. The littleneck clam larval cycle has consistently required around 30 days at 16 C at which point 200 μ pediveligers are screened off and placed in a setting system.

Each day the following data are collected for each larvae tank: temperatures, observations of larval health, activity, and feeding, alga cell density and specific ratios (measurements are taken several times to monitor clearance and maintain food cell density), and total *Vibrio* bacterial levels by TCBS plating. Initially the clam larvae are fed a 3:1 phytoflagellate to diatom ration of 50,000 cells/ml of *Pavlova, tIso, Ccal,* and *3H.* Each of these species is small enough to be ingested by the D veliger. The ration is maintained at 80,000 cells/ml after day 14 by which time the phytoflagellate to diatom ratio has gradually dropped to 1:1. *Tetraselmis striata,* another particularly nutritious but larger species, is also incorporated into the diet at that time.

Since March 1997 this larval rearing protocol has twice yielded modest but increasing numbers of healthy clam pediveligers that were placed into a setting system. The first larval group produced 50,000 pediveligers from an initial 1.2 million D-veligers (4.2 %) and the second group produced 105,000 pediveligers from an initial 1.4 million D veligers (7.5 %). To put this in perspective typical hatchery yields from D veliger to pediveliger is highly variable with a median of about 40 % depending on how intensively a hatchery tries to rear the larvae and how aggressively they cull out the slow growing proportion.

We know that a certain proportion of our lowered yields was due to pathogenically-bacterized algae cultures and higher than optimum larval densities. To determine the cause of larval mortalities experienced in the hatchery, we have and will continue to collect samples during periods of mortality of both live and freshly dead larvae for histopathological examination by Dr. Ralph Elston of AquaTechnics, Inc. Dr. Elston, a certified shellfish pathologist, has extensive experience serving the Pacific Northwest shellfish industry. Some results to date of his examination of Washington state oyster larvae soon dying after being transferred to our hatchery revealed infections with mantle invasive bacteria. He also found "advancing fronts of necrotic host cells suggesting the presence of a bacterial exotoxin." He recommends that bacterial management of the systems be addressed by investigating the usual sources of bacterial contamination and amplification, including stock and expanded algal cultures. We will implement his recommended bacterial management using testing media described in his book on shellfish diseases and his specific advice during an upcoming trip to our hatchery. Additional steps

being taken to avoid growing or feeding pathogenically contaminated microalgae are described below under microalgae production. If after effective bacterial management within the new facility substantial larval mortality persists we will conduct an EPA-developed Toxicity Identification Evaluation (TIE). We are still investigating this procedure and seeking someone familiar with its use.

We are presently rearing a third clam larvae group with three more former alga tanks converted to larvae culture for rearing an initial 3.1 million D veliger larvae. We expect at least ten percent of these to reach the pediveliger stage barring any sudden water quality change. At our present rates of larval rearing success the 150 fold increase in larval rearing volume in the new hatchery will permit an initial 120 million D veligers to be reared per spawn group for a yield of 9 million pediveligers into setting. As described in the following section on setting and spat rearing this should yield at least 4 to 5 million clam spat; five times as many as required for planting on the three village beaches (800,000 spat).

3. Larval Metamorphosis (Setting) and Spat Rearing

Clam pediveligers are placed into gentle downwelling setting systems at one million pediveligers per 4 cu. ft., screened tray and three trays per 600 liter partially recirculating tank. The same airlift-driven setting systems have proven themselves versatile and efficient at a number of other hatcheries. Temperatures, diet and ration remain the same as during larval rearing. Systems are drained and cleaned every other day. Temperature, larval health and feeding, and percent metamorphosed are monitored daily. The larvae complete the complicated metamorphic process on the surface of the tray screen and retain their larval foot and their ability to secrete byssal threads. Our first group of clam pediveligers required over a month to fully complete metamorphosis suggesting the probable role of a natural compound inducing metamorphosis. Various catechol compounds serving as neurotransmitters have been successfully used to induce metamorphosis in other bivalve species and are being tested on the Littleneck clam larvae to rapidly induce and synchronize metamorphosis. The induction compound and method must not, however, increase the low setting mortality presently experienced in our hatchery. About 80 % of the clam pediveligers in our first group have survived metamorphosis without any induction and now measure between 0.5 to 2 mm in length. Twenty five to fifty percent survivals through metamorphosis are more common for the Manila clam at other hatcheries.

Our second group of clam pediveligers is still undergoing metamorphosis and preliminary observations suggest that most of these have now metamorphosed with at least 50 % survival. The spat (as they are now called after metamorphosis) are not counted by volumetric and gravimetric methods until they have reached 3 mm in length to avoid crushing thin shells and triggering ongoing mortality.

Once clam spat have grown to1mm and are firmly byssing themselves to the screen surface, the water flow is reversed to an upwelling flow through the trays to better monitor flow rate and to better assure even feeding and oxygenation of the mat of spat on the screen surface. Later the upweller water temperature is dropped in steps to 12 C to prepare the expanding volumes of spat for transfer to outdoor upwelling systems plumbed to the one million liter

seawater pond. The spat are transferred in the spring to this outdoor pre-nursery at 2mm in size where much greater quantities of natural food can be grown to support their exponentially increasing appetites and to acclimate them to more natural conditions. Pond seawater will be pumped through the trays of 2 mm spat at about 10 to 15 gpm and at higher flow rates as the spat grow to 3 to 5 mm in size. At this point they are ready for transfer to either the hatchery pre-nursery or a field nursery for the next stage of growth.

4. Microalgae Culture

Both batch and semi-continuous culture methods of microalgae culture will be used in the new hatchery. All microalgae cultures originate from axenic flask cultures of the seven species we use: *Pavlova sp.(ccmp459), Tetraselmis striata,* Tahitian *Isochrysis sp.(tIso), Thalassiosira pseudonana (3H),* and *Chaetoceros calcitrans(Ccal),* and two cold water strains of the diatoms *Thalassiosira gravida* and *Skeletonema costatum* isolated from our seawater pond. Stock cultures are regularly restarted using sterile technique in a transfer cabinet. Sterility for every transfer is verified by testing for bacterial growth in tubes of Guillard's sterility test medium. A number of other quality control steps were outlined in the 1996 EVOS report. Four day old flasks are used to inoculate larger batch cultures such as carboys or 200 liter tubes which in turn are used to inoculate the much larger tank batch cultures. The seawater for flask and carboy scale culture is one micron filtered, UV irradiated, and percolated through activated carbon for 40 minutes. Flasks are autoclaved and carboys are chlorinated overnight at 8 ppm then de-chlorinated prior to use. In the new hatchery microalgae will also be cultured in more efficient semi-continuous, 600 liter, bag cultures. Seawater will be pasteurized and fertilized before flowing into the bag cultures. All aeration of the above-mentioned cultures is sterile filtered at 0.2 microns. Guillard's L1 nutrient medium (an enhanced F/2) is used to fertilize all cultures. The solutions are prepared from dry compounds in distilled freshwater and kept refrigerated.

Seawater for large tank batch cultures receives the same treatment described above for hatchery microalgae culture. The only differences are that the activated carbon treatment is omitted and the air is not sterile filtered. These larger open cultures are fed only to larger spat and brood clams. They are plated on TCBS medium for pathogen levels at less regular intervals than the carboys and bags.

Great care is now taken in choosing which cultures to feed to larvae. The additional precautions are necessary to avoid as much as possible the feeding of a pathogenically bacterized alga culture to larvae. Our routine procedure requires that the culture had been TCBS plated one or two days earlier with no colonies present, that the alga cultures not exhibit any clumping, degradation, or contamination with other organisms when examined under the microscope, and that it smells "good". Odor can regularly reveal a pathogenically bacterized culture that TCBS medium and visual examination miss. These three steps have helped improve the health and survival of the larval to the modest levels we now achieve, however, more has to be done to virtually eliminate bacterial contamination as a source of larval mortality. In pursuit of that goal, a procedure has been established to take samples along the entire hatchery process. Dr. Don Button at UAF will analyze these samples in order to gain an understanding of the various microbial dynamics of the hatchery operations. Dr. Button has researched microbial ecology for years and has developed

sophisticated instrumentation for DNA, biomass, and size structure analysis of small samples. This sampling will serve as a preliminary investigation for more extensive research into the microbial dynamics of the hatchery and local seawater as influenced by the nearby seafood processing plant among other factors. Efforts by Dr. Button and our hatchery to secure grant funding is under way. The hatchery's health management funds will help match grant money.

OBJECTIVE 2. NURSERY SYSTEM

A. Seawater Pond Pre-Nursery

The QSH utilizes a 1 million liter pond to culture algae for its pre-nursery. The 30m by 37m pond is 5 meters at its deepest point. Natural cell densities of Resurrection Bay are 5,000 cells/ml while the pond can be manipulated to produce a dense 250,000 cells/ml or more for feeding the shellfish. Raw seawater from a 70 meter deep intake is pumped into the pond to bring in nutrient rich water. The flow can be controlled to allow for adequate flushing yet maintain the ambient air temperature. An air compressor is used to aerate and circulate water in the pond to eliminate stratification and increase phytoplankton production. Fertilizer solutions are added daily to increase the intensity and duration of phytoplankton blooms. Physical parameters of the seawater including temperature, salinity, pH, and redox potential are monitored and water samples are collected at various intervals for nutrient level analysis. Identification of the most abundant phytoplankters as well as secchi disk readings is also made. The food laden pond water is pumped through dense trays of small (1.5-2 mm) bivalve spat.

The pond could support good growth for one million 3 - 5 mm clam spat. The full production potential of the pond as a pre-nursery has yet to be tapped, however, due to the limitations of the natural ecosystem that develops in it. It is very difficult to drain and clean regularly so phytoplankton grazers, undesirable species of competitive microalgae, heavy particulate formation, and unlit depths tend to control and reduce the quantity and quality of microalgae that could otherwise grow.

This system can be greatly improved by installing four 40 meter diameter open top tanks individually plumbed and equipped with drains. This would allow the production of up to four different mono- or bi-specific alga cultures at a time. They could be grown much more intensively (up to 400,000 cells/ml) than possible in the pond because they can be easily and regularly drained and thoroughly cleaned. Improved passive solar gain may also accelerate the algae and spat grown with these partially recirculated cultures.

Until the pond can be converted to the tank system a program of keeping the pond as clean as possible and inoculated with 10,000 liter batch cultures of *Thalassiosira gravida* and *Skeletonema costatum* isolated from natural blooms here. These inoculate batches are produced in tanks placed by the pond. The tanks are filled with the same unfiltered, 70 m seawater as flows into the pond, fertilized with Guillard's L1 medium, provided with aeration, and then inoculated with a carboy culture of the above species. During the summer passive solar gain quickly raises the tank temperature to between 13 C and 18 C which is 3 C to 4 C warmer than

the pond. Plastic sheeting over the top of the tank helps retain more heat during cooler periods. Growth is from ambient daylight only. A tank is harvested in 5 to 8 days at about 400,000 cells/ml.

Additional shellfish rearing tanks will be placed around the pond in FY 99 to better accommodate the increased seed production coming from the hatchery.

B. Remote Nursery Systems

Remote nursery systems offer several advantages over nursery culture at the hatchery. One is that it frees up hatchery space and personnel that can be better used in hatchery production. Another is that several remote nursery systems offer a redundancy of supply in case one of the systems fails. A third is that remote nursery systems can be located near the growout areas thus reducing transport costs. The big disadvantage to remote nursery systems is that the cost of pumping water at a remote location in Alaska can be difficult.

Recently, work initiated in Maine and expanded under the South Carolina Sea Grant program lead to the development of a tidally driven remote nursery system. This system, called a Tidally Driven Floating Upwelling System (tidal FLUPSY), uses the strength of tidal currents to force seawater, with its accompanying load of phytoplankton, through cages containing small clams. The system appears to work quite well and is easy to maintain. Because the system is driven by a natural energy source readily available in Alaska, it appears to have great promise here.

A prototype tidal FLUPSY was built toward the end of FY 96. Because of production problems in the hatchery there was no clam seed available to test in the FLUPSY. A modest amount of oyster seed was placed in the FLUPSY in lieu of clams and they did quite well for the time they were in it. The FLUPSY broke its moorings during a mid-winter storm and most of the seed was lost. The moorings have been strengthened and the FLUPSY is back in place. Procedures have been changed so that the FLUPSY now operates only from April 15 to October 15.

The increased availability of hatchery seed in FY 99 will allow a more complete analysis of tidal FLUPSYs as a nursery system. The production objective for a tidal FLUPSY will be to produce 10+mm littleneck clam seed in a 12 week period between April 15 and October 15. Work in FY 99 will test the validity of this objective and attempt to determine optimum loading densities. This research will be continued in the future under follow-on grants currently being applied for.

OBJECTIVE 3. GROWOUT

A. Growout Techniques

The enhancement procedures that will ultimately be used under this project must be cost effective and efficient in producing harvestable clams in a reasonable time frame, and be compatible with the subsistence concept. For instance, it may be cost effective and efficient to grow cockles to harvestable size in a tidal FLUPSY, however managing a subsistence harvest from the FLUPSY could prove difficult.

At this point it appears that the most reasonable approach to providing clams for subsistence harvest is from beach growout systems. It is likely that predator control covering will be a necessary component of an enhanced beach area, however, setting up a system of uncovering an area for harvest and then recovering it would seem a relatively easy task. Because enhanced beaches seem to offer the best chance for meeting the project goal, much of the work under this project will be aimed at producing cost effective and efficient beach growout systems.

1. Seeding Intertidal Areas

In 1995 a series of baseline surveys were conducted in the vicinity of Tatitlek, Port Graham and Nanwalek to select a cross-section of beaches that might be suitable for growout. One beach per village was selected. The Nanwalek beach is representative of moderate energy beaches, the Tatitlek beach is representative of open gravel beaches with good tidal exchange and the Port Graham beach is representative of protected areas. The Port Graham and Nanwalek beaches are located within two miles of one another and can be tended by the same crew.

The intent of the beach growout work is to establish similar growth and mortality, and predator control studies on each of the three beaches and compare the results. This information will be used to determine the kind of clam production, for each of the two species, that can be expected from each beach type, and what predator control measures seem to work best on each beach.

Clams were first seeded onto the project beaches in FY 96. Additional seeding will be done in FY 97. Preliminary results from the FY 96 seeding look very promising. Examination of caged clams from the three project beaches showed an average 30% increase in valve length from the time they were seeded in late June/early July to the end of the growing season (mid October). Overwinter survival averaged 82%. At this point there was very little difference in growth or mortality among the three project beaches.

The littleneck clam study involves the placement of seed clams (5 mm to 15 mm valve length) in a replicate, blocked design to examine growth and mortality as a function of several parameters including tidal height, rearing density and in the presence or absence of protective predator exclusion devices.

For the first time during the course of this project seed availability in FY 99 will not be the restricting factor in how the growout study areas are seeded. Follow-on grants for this project will provide for the analysis of clam seed planted in FY 99. Given this situation, it is well worth the effort to review the current clam seeding protocol for this project and expand it if warranted to enable it to address other questions that were previously put aside for lack of sufficient seed. This review will be conducted this winter and a new seeding protocol established for the FY 99 season. This protocol will also cover the data collection and analysis that will need to be conducted under the follow-on grants. The FY 99 seeding and analysis protocol will be submitted for peer review no later than March 12, 1999.

C. Cooperating Agencies, Contracts and Other Agency Assistance

This project will be conducted by the Chugach Regional Resources Commission (CRRC), a consortium of Native villages and associations in the Chugach Native Region that deals with natural resource issues and development, under a contract with the Alaska Department of Fish & Game. CRRC will be contracting with the Qutekcak Shellfish Hatchery in Seward to develop spawning and culturing techniques for clams and the 10 mm to 15 mm seed for growout. CRRC may also be contracting with various mariculture experts for technical advise and assistance.

SCHEDULE

A. Measurable Project Tasks for FY 98

10/98 - ongoing	continue to collect broodstock, and transport to hatchery
10/98 - 9/99	continue to develop techniques to mature and spawn broodstock
10/98 - 9/99	continue to develop techniques for producing 5 mm seed in hatchery
3/99 - 7/99	transfer 5 mm seed to hatchery pre-nursery and FLUPSY
4/10/99	submit annual project report for FY 98
4/99 - ongoing	continue develop techniques for producing 10 mm to 15 mm seed for growout
10/98 - ongoing	continue work on nursery production in tidal FLUPSY at Tatitlek
10/98 - ongoing	continue predator control studies on razor clam beaches near Eyak.
10/98 - ongoing	continue growth/mortality and predator control studies for littleneck clams – develop new seeding and analysis protocol and submit for peer review no later than March 12, 1999.
4/10/00	submit annual project report for FY 99.

B. Project Milestones and Endpoints

Objective 1.	
June, 1995	initial procedure developed for Littleneck clam
June, 1997	completed for littleneck clam
Objective 2.	
September, 1998	Littleneck clam in hatchery
October, 1999	Complete tests on tidal FLUPSY.
Objective 3.	
August, 1995	Describe current local clam populations for Tatitlek and Port Graham/ Nanwalek areas.
September, 1995	Locate sites in Tatitlek and Port Graham/Nanwalek areas for developing beach growout methods.
March, 1996	Obtain permits and begin fieldwork at growout sites at Tatitlek and Port Graham/Nanwalek.
June, 1996	Initiate predator control studies on razor clam beaches near Eyak.
June/July, 1996	Conduct baseline beach survey at Chenega Bay and Ouzinkie.
June/July, 1997	Initiate process for establishing permanent subsistence beaches at Tatitlek

	and Port Graham/Nanwalek.
March 12, 1999	Submit new seeding and analysis protocol for peer review.
April 20, 1999	Initiate seeding study plots under new protocol.

C. Completion Date

The objectives of this project will be met in FY 2000.

PUBLICATIONS AND REPORTS

April 15, 1996	FY 95 annual report due. Report will discuss progress to date, compare accomplishments against stated objectives and make recommendations regarding future work.
April 15, 1997	FY 96 annual report due. Report will discuss progress to date, compare accomplishments against stated objectives and make recommendations regarding future work.
April 15, 1998	FY 97 annual report due. Report will discuss progress to date, compare accomplishments against stated objectives and make recommendations regarding future work.
April 15, 1999	FY 98 annual report due. Report will discuss progress to date, compare accomplishments against stated objectives and make recommendations regarding future work.
April 15, 2000	Final report due

PROFESSIONAL CONFERENCES

Staff from the Qutekcak Shellfish Hatchery will attend the Pacific Northwest Shellfish Conference, which will likely be held in Seattle or Portland, to present papers on hatchery and nursery culture techniques for littleneck clams and cockles. The Pacific Coast Shellfish Growers Association and the Sea Grant Program from the University of Washington and/or Oregon State University sponsor this conference. A paper on the project will be presented at the symposium marking the 10th anniversary of the *Exxon Valdez* oil spill.

COORDINATION AND INTERGRATION OF RESTORATION EFFORT

The project (96131) will complement Fish/Shellfish Study 13 Effects of Hydrocarbons on Bivalves conducted under State/Federal Natural Resource Damage Assessment. That project studied shellfish populations throughout the oil-impacted area. Growth and mortality studies were conducted, age and size information was collected and reciprocal transplants from oiled and control beaches were examined. It was determined that littleneck clam populations were adversely affected through increased mortality and reduced growth rates.

The Clam Restoration Project (96131) will provide future resources for subsistence harvest and will be valuable for Projects 95279(Subsistence Restoration Projects Food Safety) and 95052 (Community Interaction/ Traditional Knowledge) to develop harvest plans. Information from 95052 was used in the community survey, population assessment described in Objective 3.

EXPLANATION OF CHANGES IN CONTINUING PROJECTS

The objective to develop a subsistence management plan for the villages has been eliminated. As this project became more focused, working with only littleneck clams and restricting all growout and predator control investigation to three villages, pursuing a subsistence management plan became less important. The core of this project is developing hatchery, nursery and growout techniques. Broadening it out to include subsistence management planning has no purpose. Instead a grant from the Administration for Native Americans is being sought to extend clam enhancement to more villages and to develop the subsistence management plan.

PROPOSED PRINCIPAL INVESTIGATOR(S)

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Revision 11-10-98
ADDS TO INTERIM
approved TC 12-15-98

Exxon Valdez Oil Spill Trustee Council Project Budget
January 1, 1999 to September 30, 1999

Budget Category:	Authorized FFY 1998	Proposed FFY 1999						
Personnel	$0.0	$0.0						
Travel	$0.0	$0.0						
Contractual	$284.5	$210.0						
Commodities	$0.0	$0.0						
Equipment	$0.0	$0.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	$284.5	$210.0	Estimated FFY 2000	Estimated FFY 2001	Estimated FFY 2002	Estimated FFY 2003		
General Administration	$18.4	$12.8						
Project Total	$302.9	$222.8	$0.0	$0.0	$0.0	$0.0		
Full-time Equivalents (FTE)		0.0						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments:

FY 98

Project Number: 99131
Project Title: Chugach Native Region Clam Restoration
Agency: AK Dept. of Fish & Game

FORM 3A
AGENCY
PROJECT
DETAIL

Prepared: 11/18/98

Exxon Valdez Oil Spill Trustee Council Project Budget
January 1, 1999 to September 30, 1999

Personnel Costs:			GS/Range/	Months	Monthly		Proposed
PM	Name	Position Description	Step	Budgeted	Costs	Overtime	FFY 1998
*							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
		Subtotal		0.0	0	0	
Those costs associated with program management should be indicated by placement of an *.						**Personnel Total**	$0.0

Travel Costs:		Ticket	Round	Total	Daily	Proposed
PM	Description	Price	Trips	Days	Per Diem	FFY 1996
						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 costs associated with program management should be indicated by placement of an *.					**Travel Total**	$0.0

FY 98

Project Number: 99131
Project Title: Chugach Native Region Clam Restoration
Agency: AK Dept. of Fish & Game

FORM 3B
Personnel
& Travel
DETAIL

Prepared: 11/18/98

Exxon Valdez Oil Spill Trustee Council Project Budget
January 1, 1999 to September 30, 1999

Contractual Costs:	Proposed
Description	FFY 1998
Contract with non-trustee agency	210.0
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$210.0
Commodities Costs:	Proposed
Description	FFY 1996
Commodities Total	$0.0

FY 98

Project Number: 99131
Project Title: Chugach Native Region Clam Restoration
Agency: AK Dept. of Fish & Game

FORM 3B
Contractual & Commodities DETAIL

Prepared: 11/18/98

Exxon Valdez Oil Spill Trustee Council Project Budget
January 1, 1999 to September 30, 1999

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

Existing Equipment Usage: Description	Number of Units	Inventory Agency

FY 98

Project Number: 99131
Project Title: Chugach Native Region Clam Restoration
Agency: AK Dept. of Fish & Game

FORM 3B
Equipment
DETAIL

Prepared: 11/18/98

Exxon Valdez Oil Spill Trustee Council Project Budget
January 1, 1999 to September 30, 1999

Budget Category:	Authorized FY 1998	Proposed FY 1999
Personnel	$53.8	$43.1
Travel	$2.4	$0.0
Contractual	$201.2	$145.1
Commodities	$0.0	$0.7
Equipment	$0.0	$0.0
Subtotal	$257.4	$188.9
Indirect	$27.1	$21.1
Project Total	$284.5	$210.0
Full-time Equivalents (FTE)		0.9
Other Resources		

LONG RANGE FUNDING REQUIREMENTS

Estimated FY 2000	Estimated FY 2001	Estimated FY 2002	Estimated FY 2003		
$0.0	$0.0	$0.0	$0.0		

Dollar amounts are shown in thousands of dollars.

Comments: The Shellfish Culture and Hatchery Operations Specialist will be employed by CRRC and not by the Qutekcak Shellfish Hatchery. The hatchery budget below is basically 75% of the full FY99 hatchery budget.

Hatchery Budget Breakdown			
Personnel		Contractual	
1/2 Hatchery Specialist (full time)	$13.2	Shellfish Health Mngt	$15.0
1/2 Technician II (half time)	$9.7	Maintenance	4.5
1/2 Maintenance/Tech II (full time)	$10.0	Supplies	
Fringe @ 21%	$6.9	Maintenance supplies	$5.0
Utilities		Hatchery chemicals	$3.0
Boiler Fuel	$16.9	Plumbing & Electrical	$4.5
Electricity	$8.0	Equipment	
Sewer & Water	$1.3	(5) up/down-weller tanks	$10.0
		Tribal Administration	$12.1
		Total	$120.1

1998

Project Number: 99131
Project Title: Chugach Native Region Clam Restoration
Name: Chugach Regional Resources Commission

FORM 4A
Non-Trustee
SUMMARY

Prepared: 11/18/98

Exxon Valdez Oil Spill Trustee Council Project Budget
January 1, 1999 to September 30, 1999

Personnel Costs:			Months	Monthly		Proposed
	Name	Position Description	Budgeted	Costs	Overtime	FY 1998
						0.0
	4 positions	village project worker	1.5	2412.0		3.6
	1 position	shellfish culture & hatchery operations specialist.	9.0	4389.0		39.5
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
		Subtotal	10.5	6801.0	0.0	
					Personnel Total	$43.1

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

1998

Project Number: 99131
Project Title: Chugach Native Region Clam Restoration
Name: Chugach Regional Resources Commission

FORM 4B
Personnel & Travel
DETAIL

Prepared: 11/18/98

Exxon Valdez Oil Spill Trustee Council Project Budget
January 1, 1999 to September 30, 1999

Contractual Costs:	Proposed
Description	FY 1998
Broodstock development and seed production at Qutekcak Shellfish Hatchery	120.1
Contracts for technical assistance in hatchery, nursery and growout operations	25.0
Contractual Total	$145.1

Commodities Costs:	Proposed
Description	FY 1998
Final report materials	0.7
Commodities Total	$0.7

1998

Project Number: 99131
Project Title: Chugach Native Region Clam Restoration
Name: Chugach Regional Resources Commission

FORM 4B
Contractual & Commodities DETAIL

Prepared: 11/18/98

Exxon Valdez Oil Spill Trustee Council Project Budget
January 1, 1999 to September 30, 1999

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

Existing Equipment Usage:	Number of Units	
Description		

1998

8 of 8

Project Number: 99131
Project Title: Chugach Native Region Clam Restoration
Name: Chugach Regional Resources Commission

FORM 4B
Equipment
DETAIL

Prepared: 11/18/98

Approved TC 10-13-98
(Interim Only)

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

Budget Category:	Authorized FY 1998	Proposed FY 1999
Personnel		$0.0
Travel		~~$1.0~~
Contractual		$77.9
Commodities		$0.0
Equipment		$0.0
Subtotal		$77.9
General Administration		$5.5
Project Total		$83.4
Full-time Equivalents (FTE)		0.0
Other Resources		

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

Dollar amounts are shown in thousands of dollars.

FY 99

Project Number: 99131 (Interim Budget)
Project Title: Chugach Native Region Clam Restoration
Agency: ADFG

FORM 3A
TRUSTEE
AGENCY
SUMMARY

Interim C y
7-13-98
Approved TC 8-13-98

Exxon Valdez Oil Spill Trustee Council Project Budget
October 1, 1998 to December 31, 1998

Budget Category:	Authorized FY 1998	Proposed FY 1999
Personnel	$53.8	$13.3
Travel	$2.4	$2.4
Contractual	$201.2	$57.1
Commodities	$0.0	$0.0
Equipment	$0.0	$0.0
Subtotal	$257.4	$72.8
Indirect	$13.8	$5.1
Project Total	$271.2	$77.9
Full-time Equivalents (FTE)		0.3
Other Resources		

LONG RANGE FUNDING REQUIREMENTS

Estimated FY 2000	Estimated FY 2001	Estimated FY 2002	Estimated FY 2003		
$0.0	$0.0	$0.0	$0.0		

Dollar amounts are shown in thousands of dollars.

Comments: The Shellfish Culture and Hatchery Operations Specialist will be employed by CRRC and not by the Qutekcak Shellfish Hatchery. The hatchery budget below is basically 25% of the full FY99 hatchery budget except that fuel and electricity is higher in the winter and the insurance must be paid in full by 12/31/98.

Hatchery Budget Breakdown			
Personnel		Contractual	
1/2 Hatchery Specialist (full time)	$4.5	Shellfish Health Mngt	$5.0
1/2 Technician II (half time)	$3.3	Maintenance	$1.5
1/2 Maintenance/Tech II (full time)	$3.5	Supplies	
Fringe @ 21%	$2.4	Maintenance supplies	$1.8
Utilities		Hatchery chemicals	$1.0
Boiler Fuel	$8.0	Plumbing & electrical	$1.5
Electricity	$4.0	Insurance	$10.0
Sewer & Water	$0.5	Tribal Administration	$4.1
		Total	$51.1

1999

Project Number: 99131
Project Title: Chugach Native Region Clam Restoration
Name: Chugach Regional Resources Commission

FORM 4A
Non-Trustee
SUMMARY

Prepared: 7/13/98

Exxon Valdez Oil Spill Trustee Council Project Budget
October 1, 1998 to December 31, 1998

Personnel Costs:			Months Budgeted	Monthly Costs	Overtime	Proposed FY 1999
Name	Position Description					
1 position	shellfish culture & hatchery operations specialist.		3.0	4430.0		13.3
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
		Subtotal	3.0	4430.0	0.0	[illegible]
					Personnel Total	$13.3

Travel Costs:		Ticket Price	Round Trips	Total Days	Daily Per Diem	Proposed FY 1999
Description						
						0.0
Hatchery staff to present papers at Pacific Northwest Shellfish Conference in November 1998						2.4
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
					Travel Total	$2.4

1999

Prepared:

Project Number: 99131
Project Title: Chugach Native Region Clam Restoration
Name: Chugach Regional Resources Commission

FORM 4B
Personnel & Travel DETAIL

Exxon Valdez Oil Spill Trustee Council Project Budget
October 1, 1998 to December 31, 1998

Contractual Costs:	Proposed FY 1999
Description	
Broodstock development and seed production at Qutekcak Shellfish Hatchery 10/1/98 to 12/31/98	51.1
Contracts for technical assistance in hatchery, nursery and growout operations and final report	6.0
Contractual Total	$57.1

Commodities Costs:	Proposed FY 1999
Description	
Commodities Total	$0.0

1999

Prepared:

Project Number: 99131
Project Title: Chugach Native Region Clam Restoration
Name: Chugach Regional Resources Commission

FORM 4B
Contractual & Commodities DETAIL

Exxon Valdez Oil Spill Trustee Council Project Budget
October 1, 1998 to December 31, 1998

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

Existing Equipment Usage:	Number of Units
Description	

1999

Project Number: 99131
Project Title: Chugach Native Region Clam Restoration
Name: Chugach Regional Resources Commission

FORM 4B
Equipment
DETAIL

Prepared:

Approved 8-13-98

Project Title: Port Dick Creek Tributary Restoration and Development Project.

Project Number: 99139-A2.

Restoration Category: General Restoration.

Proposer: Alaska Department of Fish and Game.

Lead Trustee Agency: Alaska Department of Fish and Game

Cooperating Agency:

Alaska Sea Life Center:

RECEIVED
APR 14 1998
EXXON VALDEZ OIL SPILL
TRUSTEE COUNCIL

Duration: 4th year, 5 year project

Cost FY 99: $85.800 (includes general administration).

Cost FY 00: $47,000

Cost FY 01: $10,000

Cost FY 02: $5,000

Geographic Area: West Arm Port Dick Bay, Outer Gulf Coast of Southern Kenai Peninsula.

Injured Resource/Service: Pink and Chum Salmon. Lost or reduced commercial fishing services.

ABSTRACT

The major project goal involves the restoration of the native Port Dick Creek salmon stocks which had been exposed to moderate to heavy oiling during the 1989 *Exxon Valdez* Oil Spill. Actual restoration of the spawning habitat took place in June, 1996. Natural colonization rates were adequate to fully seed the newly restored spawning habitat. Water temperature, water level, salinity and stream velocity will be monitored as these parameters are well correlated in the literature with spawning success and egg to fry survival. Additional sedimentologic parameters (bedload transport, accumulated sediments and gravel/cobble transport rates) will also be analyzed. These evaluation studies will be conducted annually from 1996 to 2000, with possible extension of minor monitoring through 2002 for streambed stability research.

INTRODUCTION

The Port Dick Creek Tributary Restoration Project located on the outer gulf coast of the Kenai Peninsula, (Figure 1) was initiated under the restoration surveys (R105) in FY/91 and FY/92 which resulted in the selection of Port Dick Creek for further instream restoration work. A potential tributary restoration feasibility analysis was initiated at this site in 1992 and was continued through the spring of 1993.

The feasibility studies warranted excavation of 3,000 m^3 of materials in June 1996 to create an additional 2,500 m^2 of stable spawning habitat in two tributaries to Port Dick Creek. In July and August of 1996, approximately 572 pink and 300 chum salmon colonized the tributaries and spawned (Dudiak et. al. 1996). Field staff have reported juvenile and adult Dolly Varden trout and juvenile coho salmon also using the new habitat. The following spring, ADF&G field staff enumerated a combined total of 324,889 pink and chum fry from both tributaries which resulted in an estimated egg to fry survival rate of 42.0% or 346 fry produced/m^2. For comparison, (Lister et. al. 1980) found an egg to fry survival rate of 16.3% for chum salmon on seven groundwater-fed spawning channels in British Columbia.

The restored tributaries were designed to withstand two extremes; very low and very high water discharge events. Continuation of post construction project evaluation in FY99 will continue to determine the capability of the tributaries to withstand the two extremes through monitoring and analyses of hydrologic events such as sedimentation and bedload transport.

A general trend of downstream fining can be observed from the detected tracer gravel movement. The significant gravel transport has probably been caused by the peak of short (recorded) flood events amounting to a surprisingly short period of time, but which results in the majority of streambed morphologic change. The addition of a third water level monitoring station in April 1998 will enable surface water energy slope to be monitored in support of numerical modeling of the stream channel sediment transport. This modeling will be used to solve stream channel optimization problems for restoration projects of this kind that include factors such as meanders, stream channel widening and groundwater-surface water interaction.

The monitoring and analyses project work is being used for three main purposes. The first purpose has been to monitor and compare various hydrologic parameters to data collected by fisheries biologists to support the survivability of salmon to the habitat restoration project. The second purpose is to monitor and analyze sediment transport parameters to resolve problems that stem from surface water dynamics and sediment transport to support the salmon spawning channel project. The third purpose is to disseminate this information and research to the public, Trustees and the peer-reviewed scientific community.

The Port Dick Creek tributary site is shown in Figure 1. The characteristics include a watershed that experienced several feet of uplift from the 1964 earthquake combined with a large change in streambed gradient and groundwater flow caused by the stream channel excavations. A model of surface water-groundwater interaction is important to understand the sediment transport dynamics

at a site affected by uplift, in this case causing subterranean tributaries. This interaction can be important in finding solutions to the problem of channel maintenance flows that would preserve the maximum amount of salmon spawning area (a primary project objective).

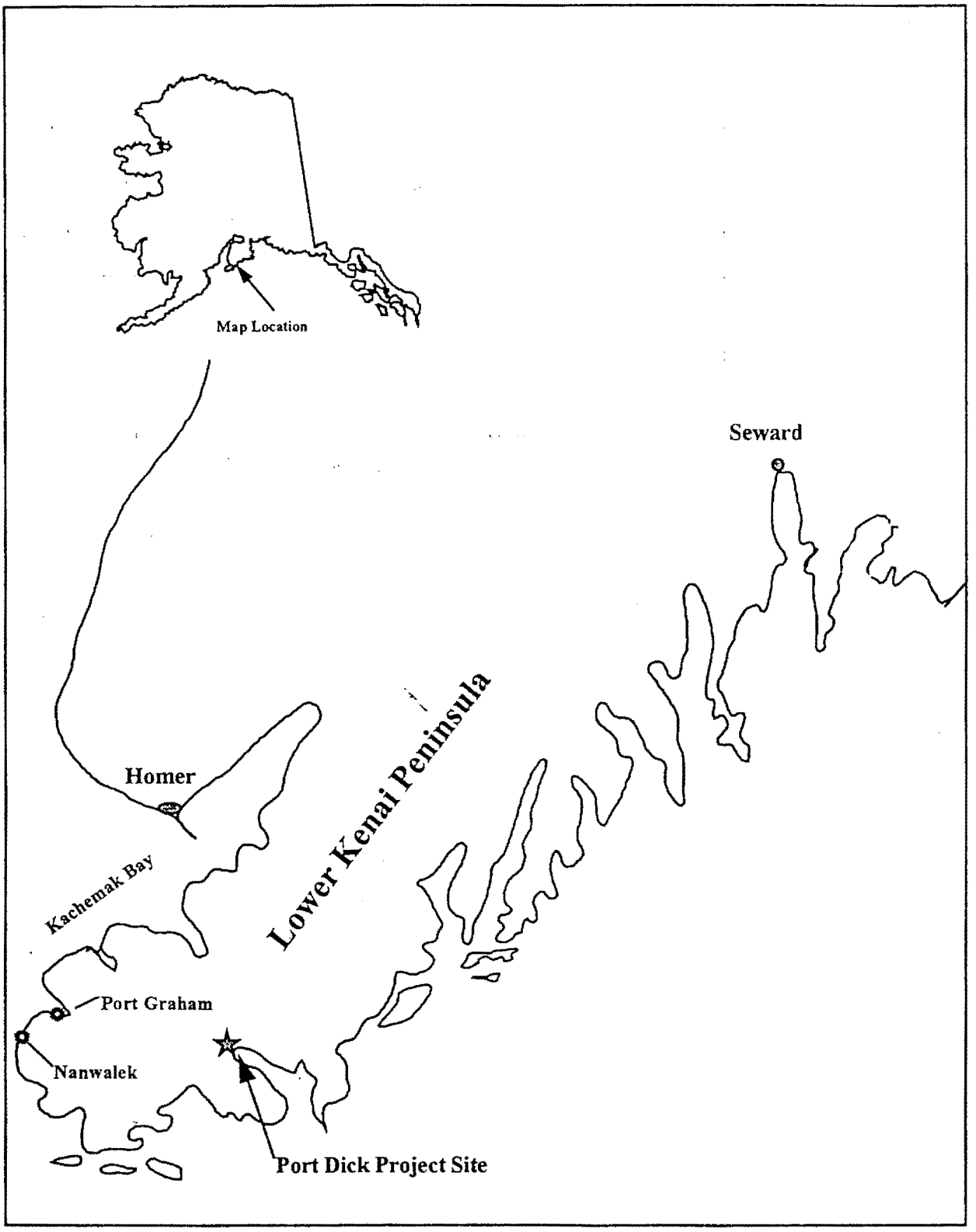

Figure 1. Map of the outer gulf coast of the Kenai Peniunsula showing the location Port Dick Project site.

There are many fundamental differences between this site and what is typically found in the literature. For example, the accuracy of estimates of a channel-maintenance discharge is already generally limited (Wilcock et al., 1996), especially for gravel-bedded channels. This is certainly a problem in the case of this project as the surface water will often visibly decline and wholly disappear upstream of the site. Similarly the surface water discharge onsite receives a significant contribution from groundwater. These facts prevent the routine application of channel geometry and sediment size to the problem of spawning channel design. The onsite monitoring and research are being applied to solutions of problems that will arise in restoration projects of this kind in the future.

Physical parameter monitoring and measurements such as water temperature, water level, salinity and stream velocity are well correlated in the literature with spawning success; egg fertilization and egg to fry survival. It is essential that this restoration project be thoroughly evaluated to adequately address the stability of the restored habitat and to learn from project performance.

Objectives for the FY99 Detailed Project Description will continue to evaluate project success through streambed stability and effectiveness of the restored tributaries as determined by spawning success. Monitoring and analyses of hydrologic data have been demonstrated to correlate to egg to fry survival rates in all salmon species. Similarly important in this instream habitat restoration project is the need to evaluate and adjust the spawning tributaries to optimize salmon spawning habitat. Bedload transport plays an important role in this evaluation. Monitoring bedload transport in an excavated channel includes accounting for sediment accumulation, quantifying the amount and depth of streambed flux and effects of channel discharge on gravel/cobble transport.

Egg to fry survival within the tributaries will be estimated by dividing the number of seaward bound fry trapped and enumerated from the tributaries by the potential fecundity. These instream survival rates along with tributary stability evaluation results will be used to evaluate project success. FY99 is tentatively the last year that spawning success and fry production will be estimated as they enter the marine life cycle. Given the age distribution at which chum salmon return to spawn at Port Dick Creek (approximately 58% aged 0.4 years and 38% aged 0.3 years, ADF&G 1993), these three years of emergent fry data, coupled with the physical stability elements of the restored habitat, will be important to evaluate project success. Additional adult salmon production resulting from the restoration efforts will be estimated from existing ADF&G ground (foot) surveys to estimate pink and chum spawning escapements.

Complete recovery from the EVOS may not occur for decades, and to fully determine the effect that instream habitat restoration has on the ecosystem, it is necessary to perform basic hydrologic measurements and analyses. The results of the 1997, 1998 and 1999 (calendar year) pink and chum emergent fry evaluation study when coupled with the concurrent sedimentologic study, will determine the overall survivability of the restored tributaries to salmon spawning and emergent fry survival.

This proposal reduces the cost of long term monitoring by use of high quality sensors and larger capacity datalogging equipment. The benefits of obtaining basic hydrologic and sedimentologic data has proved to be important for this project.

NEED FOR THE PROJECT

A. Statement of Problem

The targeted resource is the wild pink and chum salmon stocks of Port Dick Creek, in the West Arm of Port Dick Bay. Benefits realized from the restored spawning habitat will accelerate the recovery of the currently depressed wild pink and chum salmon stocks of Port Dick Creek. The total return of the Port Dick Bay chum salmon has averaged only 5,000 fish for the nine year period, 1988-1997, compared to the previous 15 year period (1974-1987) of 31,000 fish. The minimum spawning escapement goal at Port Dick Creek for chum salmon, has been met only twice since 1988 (ADF&G. 1996). Lost or reduced commercial fishing services would also be expected to benefit the LCI area from the increased salmon production at Port Dick Creek. The exvessel value of harvested pink and chum salmon would also serve as a base for the economic multiplier effect in nearby communities through processing and other fishery related services.

Success of the recently restored tributaries depends on a wide variety of physical parameters. Without adequate monitoring of temperature, water level and in some cases water velocity and salinity it would be difficult to compare fry survival rates to the expanded and restored and changed spawning habitat during the monitoring period, for example. During the design and construction planning stage of the tributary systems it became apparent that bedload transport was an additional important and compatible system that should be monitored. Long term shifting of the spawning channel gravel and sediment is expected and important to characterize for the future of such projects.

B. Rationale/Link to Restoration

The ultimate goal of this project is to restore the wild pink and chum salmon stocks of Port Dick Creek. The major hypothesis relates to the theory that the major survival problem occurs during the instream incubation and residence period for both chum and pink salmon. It is theorized that survival problems are caused by the unstable nature of the spawning habitat within the mainstream of Port Dick Creek. There has been a substantial investment, to date, by the EVOS Trustee Council and ADF&G to restore the spawning habitat at Port Dick Creek. This proposal will continue to thoroughly evaluate the effectiveness of this restoration project for publication, given the projected importance of stream restoration projects in the future.

In order to fully achieve the goal of restoration of the wild stocks, several parameters must be monitored to evaluate the success of the project. For example, the chum and pink salmon life history are similar, in that the females of each species migrate upstream to spawn in the summer and fall. They create a gravel cavity or redd and deposit their eggs. The eggs then reside in the

gravel substrate until fry emergence in the spring. Clearly the stability of the gravel substrate is an important habitat component that should be monitored in light of the changed post construction streambed hydraulic parameters (streambed slope, meander curvature, placement of riffles and point bars).

Due to the fact that salmon fry emergence occurs in the spring and a salmon run occurs in the summer, it is apparent that the salmon life cycle essentially requires year-round hydrologic monitoring to properly evaluate the spawning channel project. Long term data adjustments have been made, such as the addition of a third water level monitoring station and additional riffle and streambed elevation monitoring.

C. Location

Port Dick Creek is located on the Outer Gulf Coast of the Kenai Peninsula on the exposed coastline of the Gulf of Alaska. The area is characterized and influenced by the warming effect of the maritime currents of the North Gulf Coast, and annual rainfall can exceed 60 inches (ADNR 1994). The predominate vegetation type of the Port Dick Creek drainage is Sitka Spruce and Western Hemlock forest and is considered climax. Sitka Spruce in this area commonly reach a diameter of 24 inches. The creek corridor is narrow (less than 250m) with adjacent slopes in excess of 30% grade. Port Dick Creek is a fresh water creek with the headwaters originating 2 miles to the west of tide water. The soil at the project site is alluvial being poorly drained and low in organic matter.

COMMUNITY INVOLVEMENT

The Alaska Department of Fish and Game is the lead trustee agency for the Port Dick Creek project. A scoping meeting was held in Anchorage at the Alaska Department of Fish and Game Office, 333 Raspberry Road on June 19, 1995. ADF&G (Commercial Fisheries Management and Development Division) communicated with the U.S. Forest Service and ADF&G (Habitat and Restoration Division).

This project was reviewed by the *Exxon Valdez* Trustee Council (TC) in April 1995 and approved the project pending federal NEPA requirements be satisfied prior to further funding. State of Alaska members on the Trustee Council include the Attorney General, and the Commissioners of ADF&G and the Department of Environmental Conservation (DEC). Federal agency members include representatives of the U.S. Departments of the Interior and Agriculture and the National Oceanographic and Atmospheric Administration (NOAA). As part of the review process, the EVOS Trustee Council Public Advisory Group (PAG) reviewed this salmon instream habitat and stock restoration project in 1994 and 1995 prior to preparing recommendations to the Trustee Council. The PAG unanimously approved this type of project in 1994. In 1995, the PAG made no motion to approve or disapprove this project, however the project had received strong public support. In addition, conclusions from the Trustee Council Wild Stock Supplementation

Workshop in January 1995 also supported this project. Questions concerning goals, linkage to injury and benefit/cost were addressed and incorporated into the proposal.

A public hearing on the proposed Port Dick Restoration project was held in Homer in April, 1995, by the Oil Spill Restoration Office. There were no negative comments and most people voiced support for the project.

The proposed project has been listed in the Quarterly Chugach National Forest, schedule of proposed actions for environmental analysis since July 1995. This project, among others, is briefly described for interested parties at over 280 addresses. No comment has been received from this effort.

A letter summarizing the scoping meeting and listing the potential issues was drafted and sent to the U. S. Forest Service and other persons and elicited responses from the following: the Cook Inlet Regional Planning Team (CIRPT), Kenai Peninsula Borough Coastal Management Program and members of the Cook Inlet Seiners Association (CISA). All three organizations have endorsed the project.

Mr. Roger MacCampbell, District Ranger for the Kachemak Bay State Wilderness Park has received a draft copy of the Environmental Assessment written for the Port Dick Project. Mr. MacCampbell has responded with written comments and found no objections to the implementation of the proposed action.

In addition to the above community involvement, the marine biology class of the Homer High school in cooperation with ADF&G, entered into a program to test and evaluate instream salmon egg incubators. The incubators were to be used for supplemental colonization at Port Dick Creek should they be needed. The high school class secured a fish transport permit and actually incubated salmon eggs in the incubators in Fritz Creek near Homer.

In December 1996, a slide presentation of project accomplishments was presented at the annual Lower Cook Inlet Seiners Association Membership meeting. It was well received and won unanimous support.

PROJECT DESIGN

A. Objectives

(October 1, 1999 through September 31, 2000

The primary and secondary tributaries were excavated in June 1996. Objectives included in this proposal are designed to continue to evaluate project success through spawning success and long term sedimentologic stability as related to these tributaries.

1. Continue to estimate spawning success in the restored tributaries through egg to fry survival and fry production. Additonal adult production will be estimated through periodic ground (foot) surveys conducted by ADF&G to estimate the spawning escapement of pink and chum salmon.
2. Continue to evaluate the success of the restored tributaries through sediment transport parameters on a bi-monthly basis.
3. Prepare annual Port Dick Detailed Project Descriptions and annual reports. Prepare long term monitoring results for peer review and evaluation in preparation for publication.
4. Monitor and evaluate water/tributary parameters including proposed sediment transport parameters on a bi-monthly basis

B. Methods

Part A. Spawning success

Spawner abundance and density, number of females, potential egg deposition, egg to fry survival and fry production will be calculated. The spawning escapement for each tributary will be determined from periodic ground (foot) surveys by a 2-person CFM&D ground survey crew as part of the annual program to enumerate spawning escapements in Lower Cook Inlet streams. To standardize the escapement, ground survey data from both tributaries will be generated into daily escapement estimates using a FORTRAN program that takes into account stream life data (number of days) live and dead count, the number of surveys and the time between surveys (Yuen, 1993). Accumulated pink and chum salmon escapements are then estimated from:

$$\frac{\sum_{i=1}^{n} \frac{(x_i + x_{i-1})}{2} (d_i - d_{i-1})}{17.5}$$

where n = number of surveys, d_i = Julian calender date of survey i, and x_i = number of live pink or chum salmon observed in the study stream during the survey i. The total potential egg deposition for both tributaries will then be estimated as the number of fish spawned multiplied by the potential fecundity.

To enumerate seaward migrating fry intertidal fry traps will be installed at the down stream end of each tributary. The fry traps are modeled after intertidal fry trap systems developed by Dudiak and Quimby 1983. A two person crew will travel to Port Dick Creek in early April, 1999, to set up camp and the intertidal fry traps. The fry traps will effectively fish 100% of each tributary and all fry that enter the traps will be enumerated. When the numbers of fry are manageable (e.g. < 4,000), they will be identified to species, counted with hand held counters, and recorded in the fyke net log. When numbers of emigrating fry are too great to be counted by hand (e.g. > 4,000), a subsampling and bio massing procedure will be used. Then, all fry entering the trap will be weighed in a tarred container. Twenty fish per day will be subsampled to determine average weight,

length and species composition. To maintain accurate species composition during peak emigration, several hundred additional fish will be counted throughout the 24 hour period. To calculate the total number of fish for a given 24 hour period, the total weight of the catch will be proportioned by the ratio of pink to chum fry and divided by the average weight of each specie. The fry traps will remain in place until all fry have emerged. Egg to fry survival will then be calculated as the number of fry trapped divided by the potential fecundity.

Three variables are to be considered when estimating egg to fry survival. They are spawner abundance, fecundity and egg retention. To estimate spawner abundance, periodic ground (foot) survey data (fish counts) will be converted into spawner abundance estimates using a FORTRAN program that takes into account stream life (number of days), time between surveys, live and dead count and number of surveys (Yuen, 1993). Stream life is highly variable and determination of the stream life at Port Dick Creek is outside the scope of this project. Consequently, we chose a value (No. of days) based considerable work with pink and chum stocks in Prince William Sound by (Helle et al. 1961) and (McCurdy, 1984) of 17.5 that the Lower Cook Inlet CFMD staff uses to compute pink and chum spawner abundance.

Estimates of fecundity vary considerably between regions and systems and even size of fish. Groot and Margolis 1991, report fecundities for pink salmon ranging from 1,223 to 2,038 eggs per female. Fecundities for aged-0.3 chum (the dominate age class of Port Dick Chums) have been found to range from 2,200 to 3,450 eggs (Groot and Margolis 1991). Further work by (Lister et. al. 1980), supports a conservative fecundity of 2,295 eggs per female for chums of similar size to that of the Port Dick stock. Having no data for the actual Port Dick Creek Pink and Chum fecundities, we chose conservative fecundities of 1,600 for pink salmon (supported by fecundities found at the nearby pink salmon hatchery facility at Tutka Bay) and 2,295 eggs for chum salmon.

The third variable to estimate egg to fry survivals is the degree of egg retention. Actual egg retention will not be measured at Port Dick Creek. Therefore, we chose a conservative egg retention factor of 5.1%, to estimate survivals. Helle et al. 1964, found pink salmon egg retention rates of 2.7 - 5.1% on Olsen Creek in Prince William Sound. Higher retention rates of up to 41.5%, were found, however, they were associated with over crowding and competition for redd areas and were not considered for this evaluation.
Egg to fry survival success will be compared to survival rates found in natural streams and ground water fed spawning channels. For example, (Heard, 1978) found that survival rates for pink salmon in natural streams range from 0.2% to 22.8% and (Lister et. al. 1980) calculated survivals of 1.3% to 16.9% for chum salmon in ground water fed spawning channels in southern British Columbia.

Part B, *Physical Parameter Evaluation*

Following excavation of the tributaries in June, 1996, 4 types of sensors were installed: water temperature, level, velocity and conductivity. Figure 2 shows the general measurement locations and field arrangement of the equipment. Project methods for FY/98 will continue to measure spawning channel bed-load sediment transport that will address the stability of the spawning habitat created through the restoration project.

The changing channel geometry after construction and sensitivity of salmon eggs to water level necessitates monitoring of water levels after the spawning habitat was restored. The changing channel geometry after construction and sensitivity of salmon eggs to water level necessitated monitoring of water levels after the spawning channel was constructed. This data is collected using pressure transducers accurate to 0.01 ft of water within the pressure range expected at the site. The transducers measure pressure relative to atmospheric pressure so that atmospheric pressure effects need not be taken into account. The water level measurement scheme is shown in Figure 2, where the transducer strandpipes are situated in the stream bank.

Temperature is measured to an accuracy < 0.4 C at least every hour, in both surface water and in the spawning gravels of both tributaries. Temperature effects on salmon cited in the literature (e.g. Pauley, 1988; Wangaard, 1983) correlate fry survival rates to temperature using similar accuracy. When comparing results of the present study to previous studies it is useful to have similar accuracy.

Temperature monitoring locations are shown in Figure 2. There are expected to be some temperature differences between the lower reaches of the spawning channel and the upper reaches, particularly in summer and fall months. The variation of temperature with depth in the spawning channel is not thought to be significant due to the turbulence of the water. The temperature probes are secured within the top 10 cm of substrate to facilitate comparisons of temperature to egg-fry survival rates and to protect the sensors. An additional temperature monitoring point in Port Dick Creek is used to provide a comparison to the known chum and wild pink salmon runs in that reach as shown in Figure 2.

Water velocity measurements are needed because low and high stream velocities can both adversely affect chum salmon. Spawning adult chum salmon use water with velocities varying between 46 and 101 cm/sec (Pauley, 1988). Streamflow therefore regulates the amount of spawning area available: increased flow covers more gravel, thus making more suitable spawning substrate available. Higher stream velocities erode the substrate and suitable spawning is decreased. It is especially critical when constructing a spawning channel to monitor the stream velocities.

In addition, salmon eggs require sufficient water velocities to keep the stream well-oxygenated, protect the streambed from freezing temperatures, and to remove waste metabolites (CO_2).

Siltation is a major cause of egg and alevin mortality as mentioned previously, which is directly correlated to stream velocity. The current meter used is a non-mechanical flowmeter, which has an accurate window of measurement between 0.01 and 5.0 meters per second.

Salinity can interfere with fertilization of the eggs of chum salmon spawning in or near the intertidal zone. After absorption of the yolk sac, however, chum salmon can tolerate full-strength sea water. Salinity is correlated to conductivity which is the parameter proposed for measurement. Sea water has a conductivity of approximately 40 to 50 msiemens, which requires an electrode spacing much greater than conductivity sensors for fresh water. The conductivity meter used is calibrated from fresh water to full strength sea water, however the electrode spacing is designed for discerning salinity changes in the spawning channel. The conductivity sensors are attached to the temperature sensors in the substrate at approximate locations shown in Figure 2.

The datalogging equipment used by the sensors easily retains measurements every 30 minutes for 2 months, and a solar panel was added to increase the battery life. Several rapid sampling intervals will be monitored to obtain more information on tidal and flood events, which will help interpret both the biologic and sedimentologic events recorded already.

The datalogging equipment is rugged, and can operate under conditions ranging from -55 to +80 degrees centigrade. Dataloggers and power supplies are housed in fiberglass reinforced and humidity controlled field enclosures for long term monitoring. CGS provides a researcher in the field to provide for situations that have required a change in monitoring objectives, programming and repair of equipment in the field.

Part C, Sediment Transport and Spawning Channel Stability Evaluation:

The stability of stream channels and banks substantially affects the quality of riparian and aquatic habitats. Stream stability is affected by channel morphology and channel material (Myers et al., 1992), both factors of which were changed during spawning channel excavation. The benefits of characterization of sediment transport in the gravel-bedded channels can range from moderately helpful to extremely important.

Sediment and bedload transport in gravel-bedded rivers has received far less attention in the published literature compared to stream channels of finer grained sediments. There has even been controversy in the recent past about the effect of high discharge events on the sediment transport and bed armor of natural gravel-bedded streams and rivers (Ikeda et al., 1989). Discerning the effects of altering a gravel-bedded stream channel on sediment transport and deposition is a side benefit of this study useful for future spawning habitat rehabilitation projects.

As mentioned previously, this salmon spawning channel construction project has provided a unique opportunity to study these effects, in addition to providing needed information on channel stability. Four methods typically used in detailed sediment transport studies of gravel-bedded streams are being used for this project. The methods are designed for inexpensive long term

monitoring in conjunction with the hydrologic parameter monitoring. The four methods include measurement and comparison of changes in surveyed stream transects, use of tracer cobbles and gravel, measurement of changes in scour chain orientations and measurements of surface water energy slope. The implementation and justification of each technique is described below.

Stream Transects

Measuring the variation of parameters across a section of a stream channel as depicted in Figure 2 can be a very useful way to monitor streambed stability. Numerous studies have used this technique successfully, e.g. Jacobsen, 1995 in AGU Monograph 89. *Dietrich and Whiting 1989* concluded in their work with gravel-bedded rivers that monitored stream cross sections were very useful for the study of gravel transport. Transects are also useful in the hydrologic parameter objectives for this project for determining estimates of egg mortality due to erosion (McNeil, 1965), which is of particular interest in the few years following excavation of the spawning channel. Therefore monitoring stream transects is an important parameter to consider for all objectives of this project.

Streambed elevation along a transect has been useful for monitoring net erosion and sedimentation of the streambed. The elevation and position of each point along a cross section is obtained using a total station, and compared to previous cross sections to determine a sediment budget. It has also been useful to obtain streambed elevations between and upgradient of the cross sections as another way to determine the long term streambed changes and streambed gradients at the site.

Many studies find streambed elevation changes useful over the very long term by monitoring waves of sediment as they flow by a station (Jacobsen, 1995). In this case the study will be useful in determining relatively short-term changes (a few years) that may be reversed or enhanced by small alterations in the spawning channel geometry.

Certain upgradient cross sections may be affected by the drainage caused by moving the seepage face from the spawning channel sites to upgradient areas. This may mean a cross section will not receive flow at low to average discharge. It is recommended that some of the water velocity measurements used for obtaining the important discharge parameters be taken in the stream channel far upgradient from both channels. This value would be useful to compare to onsite discharge measurements, particularly for a dramatically 'losing' (recharging) stream. Depth-integrated water velocity measurements (using two measurements per station) are more accurate for discharge calculations, though frequently the water is too shallow to apply more than one value (CGS uses the 60% depth for single measurements).

Near-bed water velocity is a novel parameter that can be monitored using an on-line water velocity probe. The bed shear velocity, a parameter important in gravel-bedded stream sediment transport models, may be estimated using near bed velocity (Wilcock, 1996). This can also be done with the local shear stress parameter. These parameters are important in calculating scour or deposition rates and other channel changes. CGS maintains two Price-type meters, but does

not recommend using these mechanical gauges for online monitoring since they need frequent calibration and can easily get fouled (Pitlick, 1992). Other studies have found non-mechanical water velocity devices useful for gravel bedded river measurements (e.g. Dinehart, 1992).

Bedload sampling has the valuable advantage of directly sampling the rate of bedload transport along the streambed for a given measured discharge, however this method does not work well unless sufficient discharge is available for transport, particularly a problem for gravel transport which has longer residence times as mentioned previously. Since this type of sampling is only useful for monitoring the gravel component of bedload transport if significant flow events are occurring, a third water level monitoring station was added to help determine when gravel transport events would be occurring. This station will be online in April, 1998.

Surveyed markers and marked trees are used to locate stream transect sections. A surveyor tape is stretched between the markers for horizontal reference. Streambed elevations are then measured to ~0.01 ft with the total station at approximately 2 foot intervals across the transect. This is a standard method for monitoring changes in streambed morphology with time, compatible with other detailed studies of stream sediment transport in gravel-bedded streams (e.g. Jacobson, 1995). Eight such transects are currently being used, with approximate locations shown in Figure 2. Subsequent transects will show how much the stream channel adjusts to the designed spawning channel, particularly after high discharge events.

Tracer Gravel

Tracer gravel and cobbles are being used to determine rates of gravel transport, of particular concern for the post construction phase of the spawning channels. Port Dick Creek Tributary gravel and cobbles were constructed into tracer material. Some of the gravel used is in the range useful for salmon spawning grounds. The cobbles and gravel were marked using holes drilled in the material and filled with numbered copper discs and epoxy (the tracers must be unobtrusive, yet easy to find). The shape of the tracer material was as rounded as possible in order to reduce shape-induced uncertainties in the course of their movement (Cavazza, 1981).

Each tracer was weighed, and then carefully replaced with other gravel along the proposed marked stream source areas shown in Figure 2. The tracers are being relocated periodically with a metal detector to determine the amount of movement from the source area for the specific tracer material during periods of high discharge. Movement of the tracers seem to occur only during significant flood events. Each tracer will be re-weighed periodically throughout the long-term monitoring, and re-deployed to the source area if found near the mouth of either tributary.

Results from tracer tests are also of fundamental value in characterizing the size and rate of bedload transport averaged between monitored periods. The tracer data have determined accurate rates of bedload transport by comparison to the continuously monitored water level and stream velocity parameters. These direct measurements of gravel and cobble transport are useful in the discussion of construction techniques for future spawning channel projects in gravel-bedded streams.

The movement of bed load is complex, intermittent and yet very important to the understanding of problems this project poses. Gravel morphology and density play an important role in the entrainment of gravel, so use of onsite gravel is a good choice for tracer material, particularly since the data is to be published. Different sized gravel can be used for comparisons to a size-selective tracer study such as Ashworth et al. (1989). Bridge et al. (1992) show why tracer densities and tracer dimensions are important for studying the results of tracer transport, so the lengths of the orthogonal gravel axes were measured for completeness. Hassan et al. have also had success using tracer gravel in gravel-bedded streams to calculate gravel transport rates.

Scour Chains

Use of scour chains is the final method for addressing streambed stability. Scour chains are an inexpensive method for determining the thickness of bed mobility (depth of scour and depth of fill) following high discharge events. The scour chains consist of vertically oriented and weighted stainless steel link chain (1 inch links). The chains are periodically located and unburied; the length of horizontal chain and depth to the chain are recorded, and the chain reoriented vertically for the next high discharge event. This allows the evaluation of scour events such as the depth of bedload scour and subsequent sediment burial thickness. Such maximum-event data helps determine the mobility of sediment during high discharge (Gordon et al., 1992). The amount of bedload transport from a flood event can be estimated with scour chains in combination with stream elevation cross sections, tracer gravel and cobbles.

Scour chains are useful in estimating the amount of bed material eroded as a measure of salmon egg mortality. McNeil (1965) used ping pong balls buried vertically for this purpose, but had problems estimating scour depth when losing all of them in one location. The advantage of sour chains is they can be straightened and re-buried vertically quickly, and they can be relocated using a metal detector. Scour chains are useful in conjunction with stream elevation transects to understand the history of sediment transport between site visits.

Sediment Transport Analyses

There are many types of sediment transport analyses that benefit the spawning channel project both directly and indirectly.

One example of direct studies involving salmonids is to compare onsite gravel sizes to those preferred by salmonids or to recognize the influence salmonids have on fluvial gravel size (Kondolf, 1993). There have even been studies of gravel morphology on salmon egg mortality (Meehan, 1977).

Perhaps more importantly are concerns over the long term stability and viability of the spawning channels. The best way to approach this is to use onsite data from the sediment transport monitoring is to calculate basic sediment transport parameters via a variety of simple to complex techniques. These sediment transport parameters can then be used in surface water models to help answer questions concerning the long term streambed stability, the short term ability for the

channel to maintain its water depth and to determine what changes in the channel geometry could be made to improve the streambed stability. In addition comparison studies can be made with other gravel-bedded stream studies in the literature.

The 'flushing flow' discharge from hydroelectric projects is a current matter of intensive research. This 'flushing flow' is on a small scale directly related to the critical discharge necessary for bedload transport in gravel-bedded streams (e.g. Kondolf, 1990). Other basic parameters that must be derived from onsite data have been discussed previously (shear stress, sedimentologic characteristics, stream width, stream depth profile, variations in discharge etc.). Calculation of parameters as basic as discharge in gravel bedded streams are still a matter of current research (e.g. Bridge, 1992), particularly where there are many obstructions as is the case upgradient of the spawning channels.

Models that use the parameters for gravel-bedded streams are continually being refined, researched and published. For example, Bridge et al. recently published a basic sediment transport model for gravel-bedded streams that includes the critical discharge parameter, Hassan et al. proposed a model for gravel movement using tracer data (1991) and a model for the mixing of bedload downgradient from a source area (1994). Dietrich and Whiting (1993) have worked with models that include meanders in gravel bedded rivers, an important component at this site, and Pizzuto (1991) published an important model concerning gravel channel widening predictions. In addition there are valuable published data sets for comparison studies available for gravel bedded flow, for example from laboratory flume studies (e.g. Pizzuto, 1990).

A final subject that is of interest to the site is studying the influence of small and large drop structures and their effect on gravel sediment transport. These topics often appear in the context of bridge construction, since bridges frequently must be founded on erodible material. The scour of a gravel-bedded river is different at the location of a drop structure, so a variety of studies (e.g. Laursen et al., 1984) indicate the stable sediment size at sloping sills and erosion depth directly below drop structures.

Laursen et al. (1984) proposed a model for the size of riprap needed on the face of a sloping sill similar to the seepage face on the primary tributary. Elements of more specific papers on drop structures can also be useful in deriving models that describe sediment transport at drop structures (e.g. Humpherys, 1986; Fiuzat, 1987; Christodoulou, 1985). A related topic is streambank stability analyses (e.g. Chang, 1990). These topics are useful to keep in mind should future channel changes be deemed necessary.

Mr. Coble has spent his 12-year hydrologic career as a specialist in numerical modeling, and looks forward to applying his knowledge and experience to the interesting problems presented by the Port Dick Project, as might be expected. Monitored hydrologic and sedimentologic parameters as they relate to salmon spawning habitat and stream channel construction are planned for publication in peer-reviewed publications such as Water Resources Bulletin, Hydrologic Sciences Journal and/or the Journal of Hydrology.

C. Cooperating Agencies, Contracts, and Other Agency Assistance

The actual excavation/restoration of the tributaries was contracted out to the private sector in FY/96. The physical parameter monitoring and the studies to evaluate the stability of the excavated tributaries are contracted to Coble Geophysical Services of Homer.

SCHEDULE

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

Continuous through 2000:	Monitor environmental parameters within restored tributary e.g. water temperature, velocity, salinity and level. Monitor bedload transport, accumulated sediments and gravel/cobble transport rates. Certain bedload transport activities proposed continuous through 2002.
October 1, 97- Feb. 28, 98:	Prepare materials for possible participation in the annual restoration workshop in January. Prepare quarterly status reports as required.
March 1- April 15:	Prepare field equipment and arrange logistics for the pending field season. Complete annual report for the EVOS Trustee Council. Develop FY/99 Port Dick Detailed Project Description.
April 15 - June 15:	Estimate spawning success through estimation of egg to fry survival from the primary and secondary tributary. Perform stream stability and hydrologic field work.
June 16 - Sept. 30:	Conduct periodic ground surveys of the tributaries to estimate the spawning escapement. Evaluate pink and chum salmon fry survival data from springtime emigration. perform stream stability and hydrologic field work.

B. Project Milestones and Endpoints

June 1996	Excavate spawning tributaries at Port Dick Creek.

June 1996	Install water temperature, velocity, salinity and water level instruments. Install scour chains, install sediment transect markers and tracer gravel/cobbles.
July - August 96-1999	Monitor and enumerate adult escapement and colonization into restored habitat. Supplement colonization if needed. Label individual salmon redds for egg/fry survival estimates.
Continuous through 2000	Monitor environmental parameters within restored tributary e.g. water temperature, velocity, salinity and level. Monitor bed load sediment transport as affected by excavation, proposed through 2002.
May 1997 through 1999	Estimate subsequent egg-fry survival through on-site emergent fry studies. Correlate and analyze hydrologic, sedimentologic parameters with biologic parameters, publish results.
March 1997 - 1999	Prepare Port Dick Detailed Project Description. Attend symposium to present results of monitoring and analyses.
Sept. 2000	Complete final report. Continue monitoring sediment transport parameters on limited basis for publication/research.
Sept. 00 - 02	Continue monitoring sediment transport parameters and spawning channel success on reduced funding level.

C. Completion Date

Actual excavation of the tributaries occurred in June 1996, with post excavation evaluation and analysis to be completed in 2000. Limited additional monitoring of sediment transport parameters is proposed through 2002 on a limited basis for publication/research.

PUBLICATIONS AND REPORTS

For FY/98, and beyond we will have results of the newly restored spawning habitat available for possible report publication. Monitored hydrologic and sedimentologic parameters as they relate to salmon spawning habitat and stream channel construction are planned for publication for FY/98 and

beyond in peer-reviewed publications such as Water Resources Bulletin, Hydrologic Sciences Journal and/or the Journal of Hydrology. The annual reports will be completed and submitted on April 15th.

PROFESSIONAL CONFERENCES

The conferences that we anticipate attending include the annual Exxon Valdez Oil Spill Trustee Council Restoration Workshop, the annual AWRA-Alaska meeting and either the Spring or Fall 1998 American Geophysical Union (AGU) meeting. Results are also planned for presentation for FY/98 and beyond at these meetings as well as possibly an appropriate International Association of Hydrological Sciences symposium. The project team includes members of these organizations and other professional organizations. Mr. Coble attended the 1996 AGU meeting in San Francisco on behalf of this project, for example.

NORMAL AGENCY MANAGEMENT

The Department of Fish and Game does not have the funding ability to respond to unforeseen crisis events such as the *Exxon Valdez* Oil Spill, which impacted the Port Dick area with moderate to heavy oiling. The Port Dick Creek restoration project was originally funded by the Trustee Council in 1991 and is currently funded in FY/97 to conduct project evaluation.

The project was originally proposed to facilitate restoration of the depressed Port Dick Creek pink and chum salmon stocks. This is the first spawning channel/spawning habitat restoration project conducted in the Lower Cook Inlet area.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

This instream habitat restoration project is the only commercial fisheries EVOS related project on the Outer Gulf Coast of the Kenai Peninsula currently being considered for further funding.

EXPLANATION OF CHANGES IN CONTINUING PROJECTS

PROJECT DESIGN Part B (Methods)

For the FY98 DPD, the methods stated that seaward bound fry will be enumerated (when numbers are to great to be counted by hand) through a sub-sampling method that includes a subsampling procedure that enumerates all fry passing through the fry trap during three 2-minute samples, and then multiplying by 10: (3) 2-minute samples x 10 = 60 minutes).

The methodology was changed for the 1997 field season (FY98) and will continue this year. This procedure will enumerate all seaward bound fry. When the numbers of fry are manageable (e.g. < 4,000), they are identified to species, counted with hand held tally counters, and recorded in the fyke net log. When numbers of emigrating fry are too great to be counted by hand (e.g. > 4,000), a subsampling and bio massing procedure will be used. Then, all fry entering the trap will be weighed in a tarred container. The sample will be weighed to the nearest 0.1 g using a Ohaus CT 600 portable electronic scale.

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

Approved 8-13-98

Budget Category:	Authorized FFY 1998	Proposed FFY 1999	LONG RANGE FUNDING REQUIREMENTS					
Personnel	$44.0	$44.0						
Travel	$0.6	$0.6						
Contractual	$31.0	$29.8						
Commodities	$1.4	$2.7						
Equipment	$0.0	$0.0						
Subtotal	$77.0	$77.1	Estimated FFY00	Estimated FFY01	Estimated FFY02	Estimated	Estimated	
General Administration	$8.8	$8.7						
Project Total	$85.8	$85.8	$47.0	$10.0	$5.0			
Full-time Equivalents (FTE)		0.9						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments:

1999

Prepared: 4/7/98 4/6/98

Project Number: 99139-A2
Project Title: Port Dick Creek Tributary Restoration Project
Agency: Alaska Dept. of Fish and Game

FORM 3A
TRUSTEE
AGENCY
SUMMARY

4/13/98

1999 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FFY 1997
Fry survival evaluation phase						
April 15-May 15 1997						
11-5362	Fish and Game Tech. III	11B	2.5	3644.0		9,110.0
11-5319	Fish and Game Tech.II	9A	2.5	3552.0		8,880.0
Project Admin: Fisheries data reduction & analysis. Annual report preparation & writing. Project management, DPD development						
	Fish and Game Tech IV	13J	5.0	4853.0		24,265.0
	Fish and Game Tech III	11A	0.5	3538.0		1,769.0
						0.0
	Subtotal		10.5	15587.0	0.0	
					Personnel Total	$44.0

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FFY 1997
Round trip, Anchorage for 3 days and return	180.0	1	3	150.0	630.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$0.6

1999

Project Number: 99139-A2
Project Title: Port Dick Creek Tributary Restoration Project
Agency: Alaska Dept. of Fish and Game

FORM 3B
Personnel
& Travel
DETAIL

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

Contractual Costs:	Proposed
Description	FFY 1997
4A Linkage	27,700.0
Fry survival evaluation phase:	
Air charter to transport 2 person crew in and out of project site @ 1 hr per trip at $580.00 per trip (D-H Otter)	1,160.0
Logistical support, 6 trips @ 1 hr. @ $160.00 per hr. (Cessna 305)	960.0
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$29.8

Commodities Costs:	Proposed
Description	FFY 1997
Food for 2 people for 75 days @ $15.00 per day per person while estimating fry survival.	2,250.0
Restoration workshop preparation, (film processing, poster board preparation)	400.0
Commodities Total	$2.7

1999

Project Number: 99139-A2
Project Title: Port Dick Creek Tributary Restoration Project.
Agency: Alaska Dept of Fish and Game

FORM 3B
Contractual & Commodities DETAIL

Prepared:

4/13/98

1999 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FFY 1997
No new equipment purchases are anticipated at this time.			0.0
Equipment purchased in FY/96 will be used throughout the remainder of the project			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
Full set camping and cooking set to accommodate 3 people	1	ADF&G
Fish cultural equipment such as spawning knives, buckets, nets, ice chests and holding nets	1	ADF&G
Full sets of rain gear and hip waders	4	ADF&G
Fyke net; to capture and enumerate emigrating salmon fry.	1	ADF&G
1750 generator	1	ADF&G
High frequency radio	2	ADF&G
Whetherport portable shelter for use while in the field	1	ADF&G

1999

Project Number: 99139-A2
Project Title: Port Dick Creek Tributary Restoration Project
Agency: Alaska Dept of Fish and Game

FORM 3B
Equipment
DETAIL

Prepared: 4/7/98

4/13/98

1999 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

Budget Category:	Authorized FFY 1998	Proposed FFY 1999						
Personnel	$21.3	$21.3						
Travel	$2.4	$2.4						
Contractual	$3.3	$3.3						
Commodities	$0.7	$0.7						
Equipment		$0.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	$27.7	$27.7	Estimated FFY 2000	Estimated FFY 2001	Estimated FFY 2002	Estimated	Estimated	
Indirect								
Project Total	$27.7	$27.7	$37.5	$5.0	$5.0			
Full-time Equivalents (FTE)		1.0						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments:

1999

Project Number: 99139-A2
Project Title: Port Dick Creek Tributary Restoration Project
Name: Coble Geophysical Services

FORM 4A
Non-Trustee
SUMMARY

Prepared: 4/7/98

4/13/98

1999 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

Personnel Costs: Name	Position Description	Months Budgeted	Monthly Costs	Overtime	Proposed FFY 1998
Original Proposal (Physical Parameter Monitoring)					0.0
-					0.0
G. Coble	Field Hydrologist/Technician	6.0	0,2		1.2
G. Coble	Field Hydrologic /Technician	2.0	4.4		8.8
					0.0
					0.0
Proposed Increment (Spawning Channel Stability Evaluation)					0.0
G. Coble	Field Hydrologist/Technician	1.5	5.0		7.5
G. Coble	Field Hydrologist/Technician	1.5	1.8		2.7
G. Coble	Project review, Conferences	0.5	2.1		1.1
					0.0
					0.0
	Subtotal	11.5	13.5	0.0	
				Personnel Total	$21.3

Travel Costs: Description	Ticket Price	Round Trips	Total Days	Daily Per Diem	Proposed FFY 1998
Helicopter for Instrument Inspection, download data	0.8	2	2	0.0	1.6
Plane trip for instrument inspection, download data (Super Cub)	0.2	4		0.0	0.8
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$2.4

1999

Prepared: 4/7/98

Project Number: 99139-A2
Project Title: Port Dick Creek Tributary Restoration Project
Name: Coble Geophysical Services

FORM 4B
Personnel
& Travel
DETAIL

4/13/98

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

Contractual Costs:	Proposed
Description	FFY 1997
Original Proposal (Physical Parameter Monitoring)	
1 USGS Type AA (Price-type) Current Meter, Digital, rental	0.4
2 Pressure Transducer, Hastelloy diaphragm-stainless casing, rental	0.3
3 Temperature Probe, rental	0.3
2 Conductivity probe, rental	0.3
2 Datalogger, rugged full bridge, half bridge and pulse measurements, rental	0.5
Proposed Increment(Spawning Channel Stability Evaluation)	
1 rotating laser level, stadia rod, detector and 300 ft surveyor tape, rental	0.5
1 metal detector for tracer gravel, 1 meter depth sensitivity, and tracer gravel expendables, rental	0.4
1 Helly-Smith bedload sampler, with bags and expendables, rental	0.6
Contractual Total	$3.3

Commodities Costs:	Proposed
Description	FFY 1997
1 project-specific insurance cost	0.7
Commodities Total	$0.7

1999

Project Number: 99139-A2
Project Title: Port Dick Creek Tributary Restoration Project
Name: Coble Geophysical Services

FORM 4B
Contractual & Commodities DETAIL

Prepared: 4/7/98

4/13/98

1999 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FFY 1997
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
Those purchases associated with replacement equipment should be indicated by placement of an R.		**New Equipment Total**	$0.0

Existing Equipment Usage: Description	Number of Units
Datalogger, rugged full bridge, half bridge and pulse measurements	3
Pressure transducer, Hastelloy diaphragm-stainless casing, 0,01 ft accuracy	3
thermistors, 0.4 degree C accuracy, soil and water measurement	4
data downloading equipment (laptop, optical interface, keypad etc.)	1
data field enclosures for datalogging equipment	4
temperature and conductivity instrument for field calibrations	1
conductivity sensors	2
Helly-Smith bedload sampler, with bags and expendables	1
rotating laser level, stadia rod, detector and 300 ft surveyors tape	1
scour chains, stainless, and installation equipment	1
metal detector for tracer gravel, 1 meter depth sensitivity	1
installation supplies (mounting brackets, conduit for exposed cable, expendables	1

1999

Project Number: 98139-A2
Project Title: Port Dick Creek Tributary Restoration Project
Name: Coble Geophysical Services

FORM 4B
Equipment
DETAIL

Prepared: 4/7/98

4/13/98

approved TC 8-13-98

Common Murre Population Monitoring

Project Number:	99144A
Restoration Category:	Monitoring
Proposer:	D. Roseneau/USFWS
Lead Trustee Agency:	DOI
Cooperating Agencies:	None
Alaska SeaLife Center:	No
New or Continued:	Cont'd
Duration:	4th yr. 5 yr. project
Cost FY 99:	$72.6
Cost FY 2000:	$23.0
Cost FY 01:	$0.0
Cost FY 02:	$0.0
Geographic Area:	Barren Islands, Lower Cook Inlet
Injured Resource/Service:	Common murres

ABSTRACT

This project will recensus the Barren Islands murre colonies in FY 99. The recensus had been scheduled for FY 00 or FY 01. However, returning 3-, 4-, 5-, and 6-year-old birds from the strong 1993-96 chick cohorts will provide an excellent opportunity to determine whether population increases documented in FY 97 are continuing, and if they are, to obtain the information needed to satisfy the remaining recovery goal for this injured species in the spill area (a potential finding appropriate for the 10th anniversary of the spill).

INTRODUCTION

The Barren Islands, in the northwestern Gulf of Alaska, supported one of the largest breeding concentrations of common murres *(Uria aalge)* in the path of the T/V *Exxon Valdez* oil spill (e.g., Sowls *et al.* 1978, Piatt *et al.* 1990, FWS 1994). When winds and currents swept oil through the region during April-May 1989, many of these seabirds were killed: they comprised 74% of 30,000 bird carcasses recovered by 1 August (see Piatt *et al.* 1990). Based on this information and a computer modeling study, estimates of total bird mortality suggested that 74,000-315,000 murres died after contacting floating oil (see Piatt *et al.* 1990, ECI 1991).

Because mortality of murres appeared to be high, the U.S. Fish and Wildlife Service (FWS) conducted *Exxon Valdez* Oil Spill Trustee Council-sponsored murre damage assessment and restoration studies at the Barren Islands during 1989-1991 and 1992-1996, respectively (see Nysewander and Dipple 1990, 1991; Dipple and Nysewander 1992; Nysewander *et al.* 1993; Dragoo *et al.* 1995; Roseneau *et al.* 1995, 1996a, 1997a).

In 1997, we recensused the Barren Islands murre colonies (Project 97144, see Roseneau *et al.* 1998a). Evidence indicated that murre populations were beginning to increase at these nesting complexes nine years after the spill. A positive trend, first noted on a small East Amatuli Island - Light Rock plot set in 1994 and still present in 1996, strengthened. A significant increase was also present on the much larger Light Rock section of the East Amatuli Island - Light Rock colony, and with only one exception, our counts at both colonies were significantly higher than the averages of all previous postspill estimates. The high counts on six of the seven monitoring plot sets were associated with the presence of large numbers of nonbreeding birds, probably 3- and 4-year-old subadults belonging to the strong 1993-1994 chick cohorts (productivity was about 0.50 and 0.70 fledglings per egg at East Amatuli Island - Light Rock and 0.70 fledglings per egg at Nord Island - Northwest Islet in 1993 and 1994, respectively; see Roseneau *et al.* 1995, 1996a).

We are proposing to recensus the Barren Islands murre colonies in FY 99 instead of deferring the work until FY 00 or FY 01 because returning 3-, 4-, 5-, and 6-year-old birds from the strong 1993-1996 chick cohorts will provide an excellent opportunity to determine whether population increases documented in FY 97 are continuing, and if they are, obtain the information needed to satisfy the remaining recovery goal for this injured species in the spill area (a potential finding appropriate for the 10th anniversary of the spill). We are also proposing to conduct this study because large-scale El Niño and La Niña events may strongly influence environmental conditions and seabird food webs in the northern Gulf of Alaska during 1998-1999. These events have potential to affect the recovery of murres in the spill area; any changes in population size that might result from them should be well documented, because undocumented changes may be difficult to interpret a few years later (e.g., in FY 00 or FY 01, if recensusing the colonies is deferred beyond FY 99).

NEED FOR THE PROJECT

A. Statement of Problem

Common murres are listed as still recovering in the spill area. Although FY 92 - FY 97 data clearly show that this injured species has met the productivity criteria for recovery (five consecutive years of productivity within normal bounds; see Roseneau *et al.* 1995, 1996a, 1996b, 1997b, 1998b), more information is needed to help confirm that populations are actually increasing in the spill zone (i.e., positive trends found at the Barren Islands in FY 97 were encouraging; however, these increases must continue for murres to meet the population recovery criteria and be declared fully recovered in the spill area).

Also, large-scale El Niño and La Niña events may strongly influence environmental conditions and seabird food webs in the northern Gulf of Alaska during 1998-1999. The proposed project is needed to help identify and document any changes in population size that might result from these events.

B. Rationale/Link to Restoration

There are two advantages to censusing the Barren Islands East Amatuli Island - Light Rock and Nord Island - Northwest Islet murre colonies in FY 99. In FY 97, we found evidence that murre populations were beginning to increase at these nesting complexes. Positive trends on two, and high counts on six of the seven monitoring plot sets were associated with the presence of large numbers of nonbreeding birds that were probably 3- and 4-year-old subadults belonging to the strong 1993-1994 chick cohorts. Given these results, we believe that by recounting the colonies in 1999, when 5- and 6-year-old individuals produced in 1993-1994 will be joined by 3- and 4-year-old birds from the strong 1995-1996 cohorts (productivity was about 0.70 fledglings per egg in both years; see Roseneau *et al.* 1997b, 1998b), we will be able to determine whether increases documented in FY 97 are continuing, and if they are, we may obtain the information needed to satisfy the remaining recovery goal for common murres in the spill area—a potential finding appropriate for the 10th anniversary of the spill.

Currently, the Gulf of Alaska is experiencing warmer than normal water temperatures, and sea temperatures may continue to increase for some time as pools of warm water from the largest El Niño event documented in the past 100 years drift northward to dissipate in the North Pacific Ocean and Gulf of Alaska. It is also possible that a similarly strong La Niña event, developing after El Niño conditions dissipate, may cause water temperatures to begin dropping sharply in the Gulf of Alaska sometime during 1999.

These events have potential to impact murres and other seabirds by affecting their food webs. Recensusing the Barren Islands murre colonies in FY 99 will ensure that any changes in population size that might occur because of the El Niño and La Niña events are identified and documented. If undocumented changes in population size occur as a result of these events, it may be difficult to correctly interpret census results obtained a few years later (i.e., if population counts are deferred until FY 00 or 01, any negative trends that might be detected in murre numbers may be difficult to explain because we will only be able to speculate on possible causes).

During March-April 1998, several hundred dead murres, including many individuals hatched in 1997, have been found in Cook Inlet, Kachemak and Resurrection bays, and Kodiak Island waters. These birds, and others found in the Unalaska vicinity earlier in the year, suggest that a relatively widespread, large-scale die-off is currently occurring in the northern Gulf of Alaska and southeastern Bering Sea. Although it is still uncertain whether these mortality events may be the result of El Nino conditions, they have potential to affect numbers of birds returning to the Barren Islands colonies during the next few years.

C. Location

The proposed FY 99 common murre population monitoring study will be conducted at the Barren Islands East Amatuli Island - Light Rock and Nord Island - Northwest Islet murre colonies about 100 km south of Homer in the northwestern Gulf of Alaska. No communities will be affected by the work.

COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE

Large format, computer-generated color posters summarizing annual results will be prepared and submitted to the Trustee Council for public display after data have been analyzed (as in past years). The posters are easily transported and can be used by Trustee Council staff for a variety of purposes, including public displays at oil spill community meetings and schools. Abstracts of annual findings and posters will also be available on-disk for inclusion in any on-line products that the Trustee Council may develop for public use. Field activities will be photographed and a file of 35 mm color slides will be compiled for Trustee Council use at community meetings and in public newsletters, displays, and on-line information services. Copies of annual and final reports will be available to the public in Homer and Anchorage. Study results will also be presented at public Trustee Council-sponsored meetings and workshops, and other scientific conferences. Any vessels/aircraft needed for travel to/from the Barren Islands during the project will be chartered locally. Also, most supplies will be purchased locally (i.e., in Homer). At present, there do not appear to be any sources of traditional ecological knowledge on the Barren Islands seabird colony that can be incorporated into the proposed FY 99 studies.

PROJECT DESIGN

A. Objectives

The project is designed to test the null hypotheses that murre populations have not increased at the Barren Islands colonies since 1989, the year of the spill. Specific objectives will be to census the East Amatuli Island - Light Rock and Nord Island - Northwest Islet murres colonies and statistically compare the estimates with counts made during the 1989-1997 FWS, 1990-1992 University of Washington (UW), and 1991 Dames & Moore (D&M) studies.

B. Methods

Field work will be conducted during about 16 July - 19 August. As in past years, a 15-25 meter-long vessel will be hired to support the work. Data will be collected and analyzed by the same basic methods used during the FY 93 - FY 94 and FY 96 - FY 97 common murre population monitoring studies (Projects 93049, 94039, 96144, and 97144; see Roseneau *et al.* 1995, 1996a, 1997a, 1998a, respectively).

Data Collection

Counts will be made by experienced observers. The observers will simultaneously count birds on plots from small boats using 7x42 binoculars and hand-held tally meters (plot boundaries will be located using photographic guides). One person will record the plot scores without revealing his/her own count to the other observer. The recorder will compare the scores as they are being made to see if they fall within 10% of each other (i.e., within 5% of their average; in some cases at the Barren Islands, the 15% level will be used as the guideline—see Roseneau *et al.* 1995, 1996a, 1997a, 1998a). If they do not and time allows, the observers will recount the plots until both scores fall within this range. Counts will be made by 10's or 1's, depending on plot histories during the part of the nesting season and times of day when attendance is most stable (i.e., between the peak of egg-laying and first sea-going of chicks, and between 1100 hrs and 2000 hrs Alaska Daylight Time, respectively—see Byrd 1989; Hatch and Hatch 1989; Dragoo *et al.* 1995; Roseneau *et al.* 1995, 1996a, 1997a, 1998a).

Data Analysis

To analyze the data, one-day totals will be calculated for the monitoring plot sets (see Roseneau *et al.* 1995, 1996a, 1997a, 1998a). Results will be pooled and averaged with counts made during the 1989-1997 FWS, 1990-1992 UW, and 1991 D&M postspill studies (i.e., Nysewander and Dipple 1990, 1991; Dipple and Nysewander 1992; Nysewander *et al.* 1993; Dragoo *et al.* 1995; Roseneau *et al.* 1995, 1996a, 1997a, 1998a; Boersma *et al.* 1995; Erikson 1995). Linear regressions will be run to check for trends, and differences among years will be tested with ANOVA. The 0.1 significance level will be used to increase the power of the tests and reduce Type II error (the 0.9 confidence interval will adequate for our purposes; also see Appendix 1 for a power analysis).

C. Cooperating Agencies, Contracts and Other Agency Assistance

As in FY 96 - FY 97, a vessel will be contracted to support the FY 99 Barren Islands murre population census work. The Alaska Maritime National Wildlife Refuge will furnish all office and warehouse space, computers, and radio communications services needed by the study. The refuge will also donate up to 2 months of the project manager's time (G.V. Byrd) to the project. In addition, the refuge will provide several pieces of field equipment (e.g., back-up outboard motors, hand-held and base radios, survival suits) and miscellaneous supplies for the work, and emergency medical consultation services for field personnel under its refuge-wide remote emergency medical services contract.

SCHEDULE

A. Measurable Project Tasks for FY 99 (1 October 1998 - 30 September 1999)

1 Jan - 30 Apr 1999:	Arrange for vessel contract, hiring of seasonal assistant, coordinate logistics with APEX project 96163J, check and repair equipment and other gear (e.g., boats, outboard motors, radios, binoculars, survival suits).
1-31 May 1999:	Finalize vessel contract, check and update census plot guides for the colonies, finish checking and repairing equipment and other gear.
1-30 Jun 1999:	Purchase supplies.
1-15 Jul 1999:	Pack equipment and supplies and load them on contract vessel.
16 Jul 1999:	Depart Homer for Barren Islands study area.
16 Jul - 19 Aug 1999:	Collect data.
20 Aug 1999:	Depart Barren Islands study area and return to Homer.
21-25 August 1999:	Unload vessel, clean and store equipment.
5-30 Sep 1999:	Enter data.
1 Oct - 30 Nov 1999:	Analyze data.
1 Dec 1999 - 15 Jan 2000:	Prepare posters for public display, prepare for PSG conference.
15 Jan - 15 Mar 2000:	Prepare draft final report of combined 1989-1999 results.

16 Mar 2000:	Submit draft final report of combined 1989-1999 results for in-house review.
25 Mar - 10 Apr 2000:	Finalize report of combined 1989-1999 results to Chief Scientist and Science Coordinator for peer review.
13 Apr 2000:	Submit final report of combined 1989-1999 results to Chief Scientist and Science Coordinator.

B. Project Milestones and Endpoints

Early July 1999	Preparations for field work completed.
Mid-July 1999	Field work initiated at East Amatuli Island.
Mid-August 1999	Field work completed at East Amatuli Island.
Mid-March 2000	Draft final report of FY 99 completed and submitted for in-house review.
Mid-April 2000	Final report of combined 1989-1999 results submitted to Chief Scientist and Science Coordinator.

C. Completion Date

Field work will be completed in FY 99 and a final report will be submitted to the Chief Scientist by 15 April 2000.

PUBLICATIONS AND REPORTS

A final report of FY 99 results will be prepare and submitted to EVOS Trustee Council Chief Scientist and Science Coordinator by 15 April 2000. A manuscript is currently being prepared on 1989-1997 postspill trends in murre population numbers at the Barren Islands colonies. This paper will be submitted to a peer-reviewed journal in FY 98; it will also be the basis for an oral presentation on murre population recovery in the spill area at the Trustee Council's 10th anniversary symposium in March 1999.

PROFESSIONAL CONFERENCES

Results from the FY 99 field season will be combined with FY 89-FY 97 Barren Islands murre data and presented at the Pacific Seabird conference in January 2000 (1989-1997 results were presented at the PSG 25th anniversary meeting in Monterey, California in January 1998). Travel and lodging costs for attending the meeting are included in the budget. Also, results from FY 99 may be presented at other conferences and symposiums scheduled for 2000, if they are appropriate forums for the work (e.g., Alaska Bird Conference).

NORMAL AGENCY MANAGEMENT

The proposed common murre population census work at the Barren Islands is not something that AMNWR or the FWS is required to do by statute or regulation. Until recently, the Barren Islands were listed as an intermittent monitoring site for tufted puffins and fork-tailed storm-petrels

(Oceanodroma furcata) in the refuge's seabird monitoring program. In 1994, these islands were also designated as an annual population monitoring site for murres and kittiwakes, primarily because the 1993-1994 EVOS-sponsored restoration studies (Projects 93049 and 94039) demonstrated that data could be collected at them that satisfied standard refuge monitoring protocols for these species. Designating the Barren Islands as a annual monitoring site has improved the refuge's chances of obtaining funding for conducting studies of murre populations at them. However, because the islands are not part of the FWS's highest priority ecosystem, the Bering Sea, monetary support for this kind of annual work will not be available until overall FWS priorities change (i.e., from the Bering Sea to other officially designated ecosystems within Alaska).

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

The proposed project will be fully coordinated and integrated with the FY 99 APEX Barren Islands seabird studies (Project 99163J). As in FY 96 - FY 97, the vessel hired to support population counts of murres at the East Amatuli Island - Light Rock and Nord Island - Northwest Islet colonies will provide support for the FY 99 APEX project, and in return, the APEX project will supply camp and radio communications facilities, a rigid-hulled inflatable boat, and personnel to help make population counts, thereby reducing overall costs of both studies. The restoration monitoring project is also coordinated with Alaska Maritime National Wildlife Refuge work at other locations in the Gulf of Alaska. The refuge will provide several items (e.g., office supplies; computers; spare backup radios, inflatable rafts, outboard motors, and binoculars) that are not needed for other AMNWR projects. During the field work, feeding concentrations of seabirds and whales will be noted to assist APEX investigators conducting hydroacoustic and trawl surveys in the area (e.g., J. Piatt, Project 99163M), and at the conclusion of the study, results from the population counts will be provided to APEX for use during a multiyear, multispecies analysis of seabird productivity and energetics.

EXPLANATION OF CHANGES IN CONTINUING PROJECTS

The FY 99 study design and schedules are the same as those used during the FY 96 - FY 97 common murre population monitoring projects (Projects 96144 and 97144; see the respective project DPD's).

PROPOSED PRINCIPAL INVESTIGATOR, IF KNOWN

Name: David G. Roseneau
Affiliation: Alaska Maritime National Wildlife Refuge
Mailing address: 2355 Kachemak Bay Drive (Suite 101), Homer, Alaska 99603-8021
Phone number: (907) 235-6546
Fax number: (907) 235-7783
E-mail address: dave_roseneau@mail.fws.gov

Appendix 1. Power analysis of common murre counts in the Barren Islands, Alaska.[1]

We know from prior work that a total of about 5-7 counts made on separate days are needed in each year to detect among-year differences of 20% at the $P = 0.1$ level with 90% power (see Byrd 1989, Hatch and Hatch 1989). Using a computer program called "TRENDIO" written by T. Gerrodette (i.e., Gerrodette 1987), we ran a series of simulations to predict the number of surveys needed and the number of years required at different survey intervals to detect a significant positive trend in murre populations with the following assumptions:

1. *Rate of Change*: 2 levels (8% yr^{-1} and 13% yr^{-1}) — these levels were chosen because they represent the normal range of values reported in the literature for common murres.

2. *Coefficient of Variation CV)*: 15% was used because that is the average value recorded for counts made in the Barren Islands during 1992-1994.

3. Alpha (α) and Beta (β) Levels: We were more concerned about Type II errors than Type I errors; therefore we relaxed Alpha to 0.1 and set the power at 0.9.

4. *Model Selection*: Murre populations are expected to grow exponentially rather than in a linear fashion.

Table 1. Summary of power analysis simulation for detecting a significant positive trend (1-tailed) in murre populations in the Barren Islands.

Rate of Change ($year^{-1}$)	Years Between Surveys	CV	α	β	Number of Surveys Required[a]	Number of Years Required to Detect Trends
0.8	1	0.15	0.1	0.9	7	7
	2	0.15	0.1	0.9	5	10
	3	0.15	0.1	0.9	4	12
	4	0.15	0.1	0.9	4	16
	5	0.15	0.1	0.9	4	20
0.13	1	0.15	0.1	0.9	5	5
	2	0.15	0.1	0.9	4	8
	3	0.15	0.1	0.9	4	12
	4	0.15	0.1	0.9	3	12
	5	0.15	0.1	0.9	3	15

[a] Each survey would include 5 replicate counts. Increasing the number of replicate counts to 10 would reduce the CV to 0.10 and generally reduce the number of surveys needed by 1 in each category.

Conclusions: If murre populations in the T/V *Exxon Valdez* oil spill area are increasing at 8% yr^{-1}, it would require 7 years of annual surveys (at 5 replicate counts yr^{-1}) to detect a significant trend at the 0.1 level with 90% power. However, if the number of replicates yr^{-1} were increased to 10, it would take only 6 years of annual surveys to detect a significant trend at the same level. If populations were increasing at 13% yr^{-1}, the same comparisons listed above would require 4 and 5 years, respectively. If surveys were conducted every 3 years (5 replicate counts yr^{-1}), it would take 12 years, whether the rate of increase was 8% or 13% (rounding in the reason the values are the same), but increasing the number of replicates yr^{-1} to 10 would reduce the time required to detect a trend to 9 years. Surveys conducted at 5-year intervals would take 15 to 20 years (at 5 replicate counts yr^{-1}) to detect a significant trend in population size.

[1] Copies of this power analysis can be obtained from the Alaska Maritime NWR upon request. Contact D.G. Roseneau or G.V. Byrd at (907) 235-6546.

Approved TC 12-13-96

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

Budget Category:	Authorized FY 1998	Proposed FY 1999						
Personnel		$16.7						
Travel		$3.5						
Contractual		$43.2						
Commodities		$2.5						
Equipment		$1.2	LONG RANGE FUNDING REQUIREMENTS					
Subtotal		$67.1		Estimated FY 2000	Estimated FY 2001	Estimated FY 2002		
General Administration		$5.5						
Project Total		$72.6		$23.0				
Full-time Equivalents (FTE)		0.0						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

FY 99

Project Number: 99144
Project Title: Common Murre Population Monitoring
Agency: DOI-FWS

FORM 3A
TRUSTEE
AGENCY
SUMMARY

1999 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FFY 1997
David G. Roseneau	Project Leader (Principal Investigator)	GS11/5	2.5	4.6	0.0	11.5
(To be selected)	Biological Science Tech. (Wildlife)	GS6/1	2.0	2.2	0.8	5.2
G. Vernon Byrd	Project Manager	GS12/5	1.0	0.0	0.0	0.0
C. Berg	Program Manager	GS12	0.5	0.0	0.0	0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		6.0	6.8	0.8	
					Personnel Total	$16.7

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FFY 1997
2 helicopter round trips @ $1.1K/trip, Homer-Barren Is.-Homer to	1.1	2	0	0.0	2.2
transport personnel to & from Amatili Camp (a helicopter is more efficient					0.0
& cost effective than a vessel for some needs--e.g., to quickly get people					0.0
to East Amatuli I. where the APEX Barren Is. seabird studies (99163J)					0.0
team can provide use of small boats & help make counts).					0.0
					0.0
Per diem for field crews (per diem for field personnel is calculated at $3.00					0.0
per day times 30 person days = $0.09K--this token amount must be paid to					0.1
all FWS employees & non-SCA volunteers for each day spent in the field.					0.0
					0.0
Travel to Anchorage EVOS workshop (1 people)	0.2	1	5	0.2	1.2
					0.0
				Travel Total	$3.5

1999

Prepared: 04/10/96

Project Number: 99144
Project Title: Common Murre Population Monitoring
Agency: DOI-FWS

FORM 3B
Personnel
& Travel
DETAIL

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

Contractual Costs:	Proposed FFY 1999
Description	
24 vessel days @ $1.8K/day = $43.2K	43.2
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$43.2

Commodities Costs:	Proposed FFY 1999
Description	
Food for 2 people @ $12.00/day/person for 12.5 days (25 person days x $12.00/day = $0.3K)	0.3
Fuel (outboard gas & oil; estimated @ $0.15K)	1.7
Other field supplies (maps, notebooks, film =$ 0.2K; boating supplies, including ropes, spark-plugs, emergency flares & other survival gear = $0.8K; miscellaneous camping supplies replacement of rain gear, rubber boots, waterproof bags = $0.7K)	0.0
Costs of producing & printing 2 large format posters for public display of project results	0.5
[Note: FWS will furnish office materials and additional camping, boating, & survival supplies.]	
Commodities Total	$2.5

1999

Prepared: 04/10/96

Project Number: 99144
Project Title: CommonMurre Population Monitoring
Agency: DOI-FWS

FORM 3B
Contractual & Commodities DETAIL

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

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FFY 1997
Equipment cleaning/repair/service (includes checking, cleaning, repairing & servicing binoculars, cameras, rafts, radios, outboard motors, survival suits, emergency locator beacons)			1.2
			0.0
			0.0
			0.0
			0.0
			0.0
[Note: FWS will supply other necessary equipment, including back up boats, outboard motors, radios, binoculars, and computers]			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
Those purchases associated with replacement equipment should be indicated by placement of an R.		**New Equipment Total**	$1.2

Existing Equipment Usage: Description	Number of Units	Inventory Agency
Inflatable raft	1	FWS
Outboard motors	2	FWS
Hand-held VHF radios	2	FWS
Camera	2	FWS
Computer	1	FWS
Binoculars	4	FWS
Office space, supplies, and equipment (e.g., computers) will be supplied by the FWS	0	FWS
[Note: FWS will also supply other items, including, including 1 tent, 3 sleeping bags, 3 survival suits, & 3 Mustang suits.]		

1999

Prepared: 04/10/96

Project Number: 99144
Project Title: Common Murre Population Monitoring
Agency: DOI-FWS

FORM 3B
Equipment
DETAIL

Cutthroat Trout and Dolly Varden: Relation Among and Within Populations of Anadromous and Resident Forms

Project Number:	99145-CLO
Restoration Category:	Research
Proposer:	G. Reeves/USFS, K. Currens/Northwest Indian Fisheries Commission
Lead Trustee Agency:	USFS
Cooperating Agencies:	None
Alaska SeaLife Center:	No
New or Continued:	Cont'd
Duration:	4th yr. 4 yr. project
Cost FY 99:	$50.1
Cost FY 2000:	$0.0
Cost FY 01:	$0.0
Cost FY 02:	$0.0
Geographic Area:	Prince William Sound
Injured Resource/Service:	Dolly Varden, cutthroat trout

ABSTRACT

This project is determining the relation between resident and anadromous forms of Dolly Varden and cutthroat trout within the same watershed and between watersheds in Prince William Sound. In FY 99, analysis will continue of genetic, meristic, and life-history features of each group, which were sampled in FY 96 and FY 97. This project received close-out funds in FY 98; this one-year extension is requested because it has taken longer to complete the genetic analysis than originally thought. Results from this study will allow development of a long-term, comprehensive and ecologically sound restoration strategy for these fish.

INTRODUCTION

Dolly Varden (*Salvelinus malma*) and cutthroat trout (*Oncorhynchus clarki clarki*) are important fish resources in Prince William Sound and are listed as injured resources whose recovery is unknown. This project is designed to gain an understanding of the relation between populations of cutthroat trout and of populations of Dolly Varden within Prince William Sound. In FY98, it will complete analysis of the genetic, life-history, and meristic features of these populations sampled in FY96 and FY97. Results from the study will form the foundation for the development of an ecologically sound restoration strategy for these resources, which are important for recreation and ecological purposes.

Dolly Varden and cutthroat trout were believed to be negatively impacted by the oil spill based on differences in growth rates between fish from oiled and unoiled sites. Recovery is assumed to occur when growth rates in oiled and unoiled areas are similar. Results from the our proposed new work on comparison of growth rates will help determine if these species have recovered.

NEED FOR THE PROJECT

A. Statement of Problem

Dolly Varden and cutthroat trout are important ecological and recreational resources in Prince William Sound. Populations of each species are found throughout Prince William Sound (Mills 1988). There are resident and anadromous (i.e. sea-going) forms of each species. Anadromous individuals spend varying amounts of time in freshwater (up to 4 years) before going to the marine environment (Scott and Crossman 1979). There, both species feed in nearshore and estuary areas (Scott and Crossman 1979, Morrow 1980). Dolly Varden feed on crustaceans, small invertebrates, and fish (Armstrong 1971) and cutthroat feed on fish (Narver and Dahlberg 1965).

Areas used by these fish were impacted by petrogenic hydrocarbons from the *Exxon Valdez* oil spill. Benthic organisms in nearshore areas are particularly susceptible to petrogenic hydrocarbons (Teal and Howarth 1984). In Prince William Sound, the size of epifauna and numbers of amphipods, which are food sources for Dolly Varden, decreased in areas exposed to the spill (Jewett and Dean 1993, Jewett et al.1993). Hepler et al. (1993) found that Dolly Varden and cutthroat trout populations in oiled areas had slower growth rates compared to populations in unoiled streams from 1989 to 1990, the year of the spill. A similar pattern was observed for cutthroat trout in 1990 to 1991. However, growth rates of Dolly Varden in oiled areas did not differ from those in unoiled areas during that period (Hepler et al. 1993). Survival rates for each species from 1989 to 1990 were less in oil impacted areas than in unimpacted areas (Hepler et al. 1993). Hepler et al. (1993) hypothesized that chronic starvation and/or direct exposure to petrogenic hydrocarbons were responsible for the differences in growth and survival of the species in oiled and unoiled areas. The *Exxon Valdez* Oil Spill (EVOS) Trustee Council officially lists these species as injured resources whose recovery is unknown.

B. Rationale/Link to Restoration

Reduced growth and survival rates could have long-term impacts on populations of Dolly Varden and cutthroat trout in areas exposed to oil. These species may live up to 8 years (Morrow 1980) and the

expected persistence of oil in the nearshore environment (Lee et al. 1979) suggests the potential exists for long-term impacts to these species. Decreased survival would have obvious population implications. The extent would depend on population size; smaller populations would be most susceptible to eventual extinction (Rieman et al. 1993). There may be less obvious impacts also. The potential for loss of genetic variability, which is needed for long term adaptation, increases as population size decreases (Nelson and Soule 1987). Reduced growth rates of individuals can lead to increased susceptibility to mortality and decreased reproductive potential (Adams 1990). If any of these impacts were to occur for extended periods, even at low levels, affected populations would face increased probability of extinction.

A course of action to reduce the probability of loss of populations in areas impacted by the oil spill was initiated in FY92. The focus of this recovery efforts was on opening up new areas for rearing and population supplementation. Between FY92 and FY95, $173,000 was expended on these efforts. Monitoring the effectiveness of some of these actions is proposed for FY96-98.

The EVOS Trustee Council calls for an ecosystem approach to restoration. Specifically, they say that restoration "will take an ecosystem approach to better understand what factors control the populations of injured resources" (*Exxon Valdez* Restoration Plan). We define ecosystems in a general sense to include the physical and biological factors that influence a population of organisms. This can include members of its own species as well as other species. Thus, understanding the interaction or potential interaction between and among populations of a species can provide valuable information on developing effective restoration programs.

Collections of interacting populations of the same species can be termed a metapopulation (Hanski and Gilpin 1991). Features of such populations include local populations that are more likely to interbreed and interact among themselves than with other groups, but exchange of individuals occurs through various dispersal mechanisms. There may be local extirpation of populations as a consequence of catastrophic events. Surrounding populations then serve as sources of individuals for recolonization and recovery of impacted populations (Brown and Kodric-Brown 1977, Sjogren 1991). The dynamics of metapopulations are particularly important to the persistence and recovery of populations following catastrophic events (Yount and Niemi 1990).

Metapopulation dynamics are an important consideration in the development of conservation and restoration programs (Murphy and Noon 1992, Noon and McKelvy 1992). Restoration strategies for a metapopulation would differ from those for single populations in regards to such features as recolonization potentials, time to recovery, etc. Importantly, a recovery strategy that considers metapopulations may require less investment of resources than that required for single populations.

Many salmonid populations exist as part of metapopulations. Homing and fidelity to spawning and nursery areas results in some isolation of populations (Ricker 1972). Local adaptations provide further isolation. Dispersal among groups may be maintained through straying of migrating adults (Simon 1972, Labell 1992), density displacement of individuals (McMahon and Tash 1988, Northcote 1992), or maintenance of pioneering or colonizing phenotypes (Northcote 1992).

Results of this study will provide the foundation for the development of proactive, ecologically based restoration strategies and provide valuable information for management of these species in Prince William

Sound. Knowledge about the relation of resident and anadromous forms within the same watershed will provide insight into the potential response of a population to any long-term negative impacts of the exposure to oil. For example, if resident forms of a species contribute to the anadromous forms then there may be a buffer against potential long-term declines of anadromous forms. In such a case, the most prudent restoration activity may be to protect these resident populations and their habitat in streams with populations exposed to the oil spill. Knowledge about the relation among populations of each species will provide additional insight into the potential long-term impacts of exposure to oil. If the populations are a metapopulation, any long-term impacts on a population segment could possibly be mitigated by recruitment from other population segments. Conversely, if the populations are unique this indicates that there is little exchange with nearby populations. Consequently, the ability of surrounding populations to aid a declining population would be reduced. Mitigation measures focused on individual populations would be required in such a case.

C. Location

This study examined sites located throughout Prince William Sound. Knowledge of the range of diversity within and among populations of each species within Prince William Sound will aid in the development of general management policies and decisions. Benefits should be realized in communities throughout the Prince William Sound.

COMMUNITY INVOLVEMENT

We quartered out of Cordova, AK for field collections. All remaining work is laboratory analysis and will be done in Corvallis, OR.

PROJECT DESIGN

A. Objectives

The objectives of this proposed study are to:

1. Determine for both Dolly Varden and cutthroat trout whether anadromous and resident forms in the same watershed are part of one population or different populations.
2. Determine for both Dolly Varden and cutthroat trout whether spawning aggregations in different streams in Prince William Sound are part of one population or different populations of a metapopulation.
3. Develop a restoration strategy for Dolly Varden and cutthroat trout based on the results of this study.

Knowledge of this relation between the resident and anadromous forms will be an integral component of any restoration program. Figure 1 illustrates the relation among objectives 1-3 and shows how this information could be used in developing a restoration program for Dolly Varden and cutthroat trout in Prince William Sound.

We will test the following hypotheses:

1. Resident and anadromous forms of each species from a watershed will exhibit similar genetic and meristic features.

   Corollaries

   1.1 Similarities will be strongest in watersheds where resident forms have been isolated the least amount of time.

   1.2 Similarities will be strongest in watersheds where isolating barriers allow a flow of individuals from the resident to the anadromous populations.

2. Populations of each species in Prince William Sound will exhibit similar genetic and meristic features and can be considered a metapopulation.

B. Methods

We sampled 8-10 streams with anadromous populations and 2 streams with resident populations of each species in FY96 and FY97. Sites were distributed across Prince William Sound and included areas impacted and not impacted by the oil spill.

We collected up to 100 individuals, representing the size distribution of individuals (adult and juveniles) found in a population, from the resident and anadromous populations in each stream. We took fin punches from all individuals for DNA analysis. We took 20-40 individuals from each site for meristic and electrophoretic analysis. Anadromous forms of each species were sampled when individuals returned to freshwater. Collection of each species in freshwater should increase the likelihood that individuals are members of a single population rather than a collection from different populations. Fish were collected by various techniques, including baited minnow traps, seining, and hook and line. All captured fish will be weighed and measured. Those kept for electrophoretic and meristic analysis had appropriate tissues removed, were given an identification number, and were frozen immediately on dry ice. Meristic analysis will be conducted in the laboratory. Otoliths will be removed and prepared for microchemistry analysis in the laboratory. We examined molecular genetic, morphological, and life history variation in resident and anadromous Dolly Varden and cutthroat trout in Prince William Sound using four different techniques: 1) protein electrophoresis; 2) microsatellite DNA markers; 3) meristic variation; and 4) otolith microchemistry. Each technique has unique advantages for this study.

Protein electrophoresis is a reliable, inexpensive, rapid technique for examining geographical or temporal genetic variation in salmonids. It uses the differential migration of different forms of an enzyme encoded by a locus (allozyme) in an electrical field to identify different alleles. Genotype and allelic proportions inferred from different allozymes in different samples can be used to test for nonrandom patterns of variation. However, it may not be precise enough to detect differences among life-history forms or closely related populations.

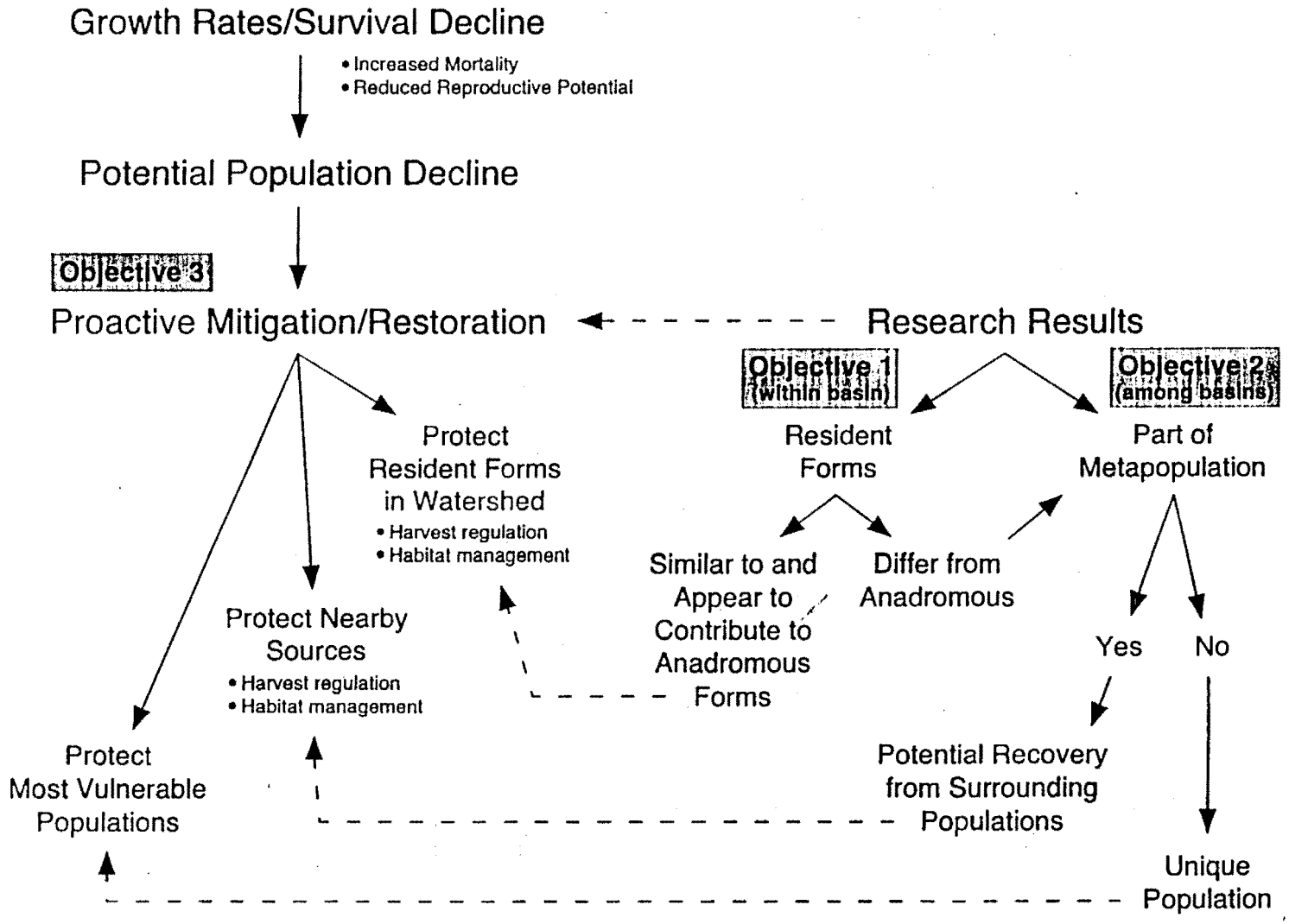

Figure 1. Flow diagram of possible research outcomes and feedback to mitigation and restoration.

We screened 48 loci encoding 20 enzymes following the methods of Aebersold et al. (1987). Allele designations of the cutthroat trout were determined relative to the mobility of the common allele in a rainbow trout. Analysis of this data was completed with computer software program GENEPOP version 3.1. Nei's genetic distance (Nei 1972, 1978) were used as a measure of genetic differentiation among sites. Because sample sizes for allele frequencies may be small enough to expect departures from known X^2 distributions in some groups, X^2 analyses were examined by a Monte Carlo procedure using 1000 randomizations (Roff and Bentzen 1989).

Results of this analysis are presented in Figure 2. Allozyme variation in coastal cutthroat trout suggest that there is moderate population variation among sampling areas (Gst=0.095). However, there does not appear to be a geographic pattern to these differences (Figure 2).

Future annual reports, final reports and peer reviewed publications will include statistical tests outlined in our proposal for FY96 and FY97.

Although allozyme variation is usually treated as having no selective advantage in population studies, under some conditions, it may be associated with physiological or morphological components of fitness, such as enhanced growth, fecundity, survivorship, and developmental rate and stability (Mitton and Grant 1984, Vrijenhoek 1985, Allendorf and Leary 1986, Zouros and Foltz 1987, Quatro and Vrijenhoek 1989). Where it is possible to appropriately measure altered patterns of growth, fecundity, or developmental instability as might be caused by exposure to strong environmental stressors - such as oil spills - allozyme variation may also show correlated changes in enzyme heterozygosity.

We examined two different classes of DNA marker. The two kinds of DNA markers we have considered are: 1) mitochondrial DNA (mtDNA) polymorphisms and 2) microsatellite DNA polymorphisms. Mitochondrial DNA variation can potentially show greater genetic structure among populations than allozyme variation, because the mitochondrial genome in vertebrates may evolve more rapidly than many nuclear genes and it is maternally inherited without recombination (Brown et al. 1979, Avise 1986). Analysis of mtDNA is especially appropriate for studying maternal lineages. It uses very little tissue, and consequently, does not require sacrificing fish. In general, DNA techniques provide a greater probability of detecting differences between life-history forms or closely related populations than does protein electrophoresis. However, it is more expensive than protein electrophoresis. We have used it successfully in our laboratory to study geographical genetic differences in rainbow trout (*O. mykiss*), chinook salmon (*O. tshawytscha*), and coho salmon (*O. kisutch*).

Microsatellite DNA polymorphisms is based on variation in the number of short tandem repeats in nuclear DNA of a core DNA sequence of 2-6 nucleotide based pairs. Microsatellites can be amplified using small amounts of DNA in a PCR reaction and the different alleles seen directly by electrophoretic separation on an audoradiogram. Because microsatellite loci mutate 3-5 times faster than mtDNA or some nuclear DNA, it is a potentially powerful tool for examining relationships between individuals within and between populations. There have been some recent studies that have employed microsatellites to successfully identify salmonids populations at large (e.g. McConnell et al 1995a, b) and small spatial scales (e.g. Angers 1995).

ALLOZYME DATA

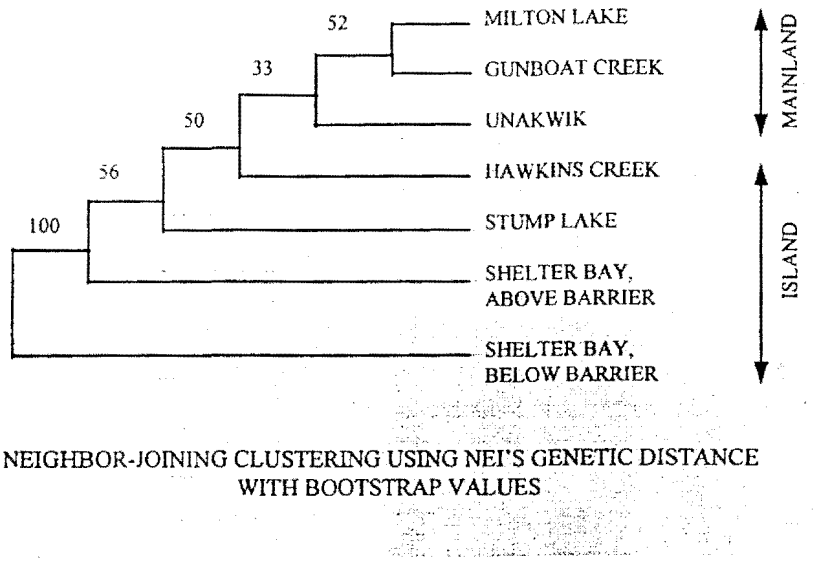

Figure 2. Allozyme data of coastal cutthroat trout from Prince William Sound, Alaska.

MICROSATELLITE DNA DATA

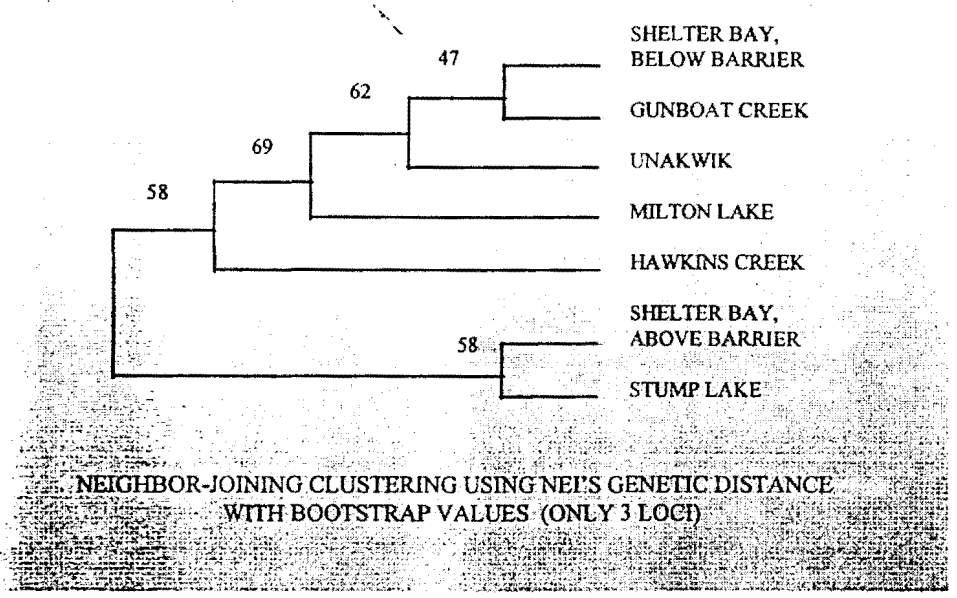

Figure 3. Microsatellite data of coastal cutthroat trout from Prince William Sound, Alaska.

We compared the power, reliability, and efficiency of the mtDNA and microsatellite DNA techniques and chose one to complete our study of cutthroat trout in Prince William Sound. Analysis of mtDNA polymorphism using polymerase chain reaction (PCR) was completed for the cutthroat trout in October of 1997. We used muscle samples from eight samples from eight sites in Prince William Sound for this screening. We extracted DNA with the cell lysis method as reported by Olson (1996) and for some samples with phenol-chloroform. Three segments of mtDNA- NADH dehydrogenase-1 (ND-1), ND-2 and D-loop- were amplified. Amplified DNA was digested with fifteen restriction enzymes following the methods of Cronin et al. (1993). The same protocol and restriction enzymes were used for a subsample of 94 Dolly Varden from ten sites.

All coastal cutthroat trout possessed a single mtDNA haplotype for fifteen restriction enzymes. Dolly Varden possessed a single mtDNA haplotype for fourteen of the restriction enzymes, however they appear to possess multiple haplotypes at a single restriction site.

Development of microsatellite protocol was initiated in July 1996. Selection of primer pairs for microsatellite analysis was based on Wenberg's (1996) work with coastal cutthroat trout and steelhead. Primer pairs were synthesized and labeled with three specific fluorescent tags, which allows for more than one primer pair to be separated on a gel at a time. We amplified DNA from cutthroat trout using PCR with the primer pairs that follow: Sfo8, Omy77, Ssa85, Oneμ11, Oneμ14, Ots1, Oneμ2, Omy325, Ssa14. PCR products from these primer sets were separated on a denatured polyacrylamide gel using a Perkin Elmer Applied Biosystems, Inc. (ABI) 377 automated sequencer and analyzed using ABI GeneScan 672, anlysis software, version 2.0.2. A subsample of 95 coastal cutthroat trout was screened with nine microsatellite loci. Peak height and base pair size was determined with genotyper 2.1 software. Analysis of four of these loci is presented in Figure 3. A small sample of Dolly Varden have been screened with the same nine microsatellite loci.

In coastal cutthroat trout, we have detected high genetic variation among populations based on analysis of 4 microsatellite loci. Base pair sizes were in the range of those detected by Wenberg (1996). There does not appear to be a geographic pattern to these differences (Figure 3).

Because mtDNA revealed no detectable variation in coastal cutthroat trout and microsatellites were highly variable we believe that, of the two DNA techniques, microsatellites will provide better information for population structure of this species. However, because Dolly Varden possess multiple haplotypes we will continue to explore both techniques for this species.

Meristic data are based on counts of body parts. Meristic variation reflects both genetic and environmental variation, although the relative contribution of the genetic component is high (Leary et al. 1985a). Analysis of meristic variation has two uses. First, when patterns of geographical meristic variation covary among samples with allozyme or DNA variation, they provide supporting evidence of genetic differentiation among populations or groups of populations. Some meristic features may diverge more rapidly than genetic frequencies in isolated populations (Lewontin 1984) and thus provide additional insight into potential relations among populations. Second, fluctuating asymmetry in meristic traits - the unpredictable differences in a trait between the left and right side of the fish - may be a sensitive indicator of environmental stress or loss of genetic diversity within a population (Leary et al.

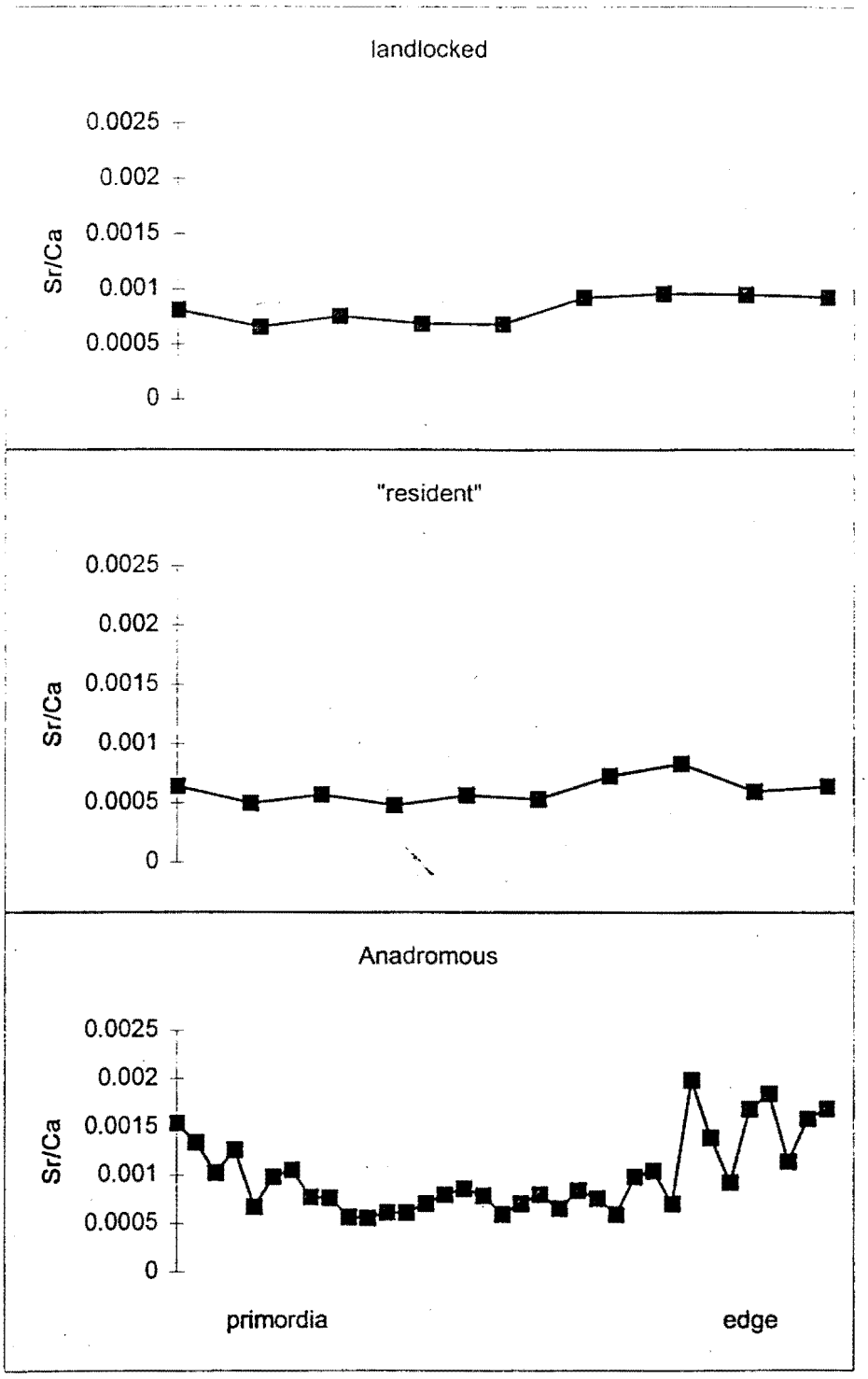

Figure 4. Otolith microchemistry of Sr/Ca in Dolly Varden from Power Creek, near Cordova, Alaska. Landlocked sample a) came from above a waterfall barrier, resident and anadromous samples b) and c) were collected from below a waterfall barrier.

Individuals for meristic analysis will be randomly selected from collections of each group at a sampling location, preserved in 10% formalin, and stored in 70% isopropanol. Meristic data will be collected on 11 meristic characters: 1) scales above the lateral line (scale rows); 2) scales in the lateral series; 3) proximal pterygiophores of the dorsal fin; 4) proximal pterygiophores of the anal fin; 5) left and right pelvic fin rays; 6) left and right pectoral fin rays; 7) left and right branchiostegal rays; 8) gill rakers on the upper limb of the first, left gill arch; 9) gill rakers on the lower limb of the first, left and right gill arch; 10) pyloric caeca; 11) vertebrae; and 12) left and right mandibular pores. Two measures of asymmetry will be calculated on the pair counts: the number of asymmetrical characters per individual and total asymmetry (Leary et al. 1984, 1985a,b).

Meristic differences among all possible pairs of samples, among genetically similar groups identified by cluster analysis of allozyme and microsatellite DNA variation, and among different life histories may be examined by analysis of variance (ANOVA) or multivariate analysis of variance (MANOVA).

Otoliths provide a record of an individual fish's life history. Otoliths are composed of calcium carbonate and other trace elements and are formed by the successive growth of concentric rings around dense primordia. Wave-length dispersive electron microprobe sampling can be used to detect proportions of trace elements in low concentrations in otoliths and can thus provide an environmental history of an individual associated with age and growth (Radtke 1989, Gunn et al 1992). Strontium is freely substituted for calcium during calcium carbonate deposition in bones in proportion to its concentration in the environment. Marine environments have elevated Sr/Ca ratios relative to most freshwater environments. Higher Sr/Ca ratios leave a detectable signature on the otolith which can reflect the movement of an individual from freshwater to saltwater (Kalish 1990). Primordia are deposited from maternally derived nutrients (yolk sac) and reflect the maternal environment during egg development (Kalish 1990). Researchers have been successful in discriminating the origin of resident and anadromous sockeye salmon (*O. nerka*) (Rieman et al. 1994) and brown trout (*Salmo trutta*) (Kalish 1990) in controlled experiments.

Based on otolith microchemistry measures of variance of Sr/Ca of Dolly Varden and coastal cutthroat trout are within the detection limits of this technique (Griswold 1996). Initial results suggest that Dolly Varden from three sampling locations from within a drainage basin show distinct patterns that may be related to life history (Figure 4). Coastal cutthroat trout show greater variation in levels of Sr/Ca and do not show distinctive patterns based on life history.

Otolith microchemistry analysis provides a powerful tool to reconstruct detailed life history information, potentially including origin of the maternal parent. A low Sr/Ca ratio in the otolith suggests the maternal parent was a resident fish. A high ratio would suggest the maternal parent was anadromous. Rieman et al. (1994) used the technique to identify the maternal parent of sockeye salmon smolts migrating from Redfish Lake, Idaho.

Further elemental analysis of Dolly Varden and cutthroat trout otoliths in conjunction with genetic analysis will contribute to the understanding of relationships among populations within the Prince William Sound and ultimately their management and recovery. For instance, within a population that contain two distinctive patterns in age first seaward migration comparisons of the genetic relationship

of the two groups can also be made. If, for example, it is found that the groups are genetically distinct as
well as possessing unique life history characteristics special attention would have to be focused on each segment of the population to ensure the persistence of the populations in the long-term.

C. Cooperating Agencies, Contracts, and Other Agency Assistance

Funds from FY98 are available to complete the remaining analyses at Oregon State University. We will renew the cooperative agreement to allow these funds to be used.

SCHEDULE

A. Measurable Project Tasks for FY 99 (October 1, 1998 - September 30, 1999)

Genetics and Meristics

October 1998- July 1999:	Renew cooperative agreement with OSU Continue genetic and meristic analysis of cutthroat trout and Dolly Varden collected in July and September, FY97 Continue otolith microchemistry analysis
March 1999:	Attend Tenth Anniversary Workshop
August - September 1999:	Final Report and manuscript preparation

B. Project Milestones and Endpoints

All objectives will be met in FY99.

Major tasks and dates over the projected duration of the study are as follows:

June 1999:	Prepare report on preliminary analysis of genetic, meristic, and otolith microchemistry from FY96 and FY 97.
September 1999:	Report final results and articulation of restoration strategy Submit papers on results to peer-reviewed journals

C. Completion Date

This project was scheduled to be completed in FY98. Howver, the genetic analysis has taken longer than anticipated. We were required to develop the procedures for the mdDNA and microsatellite analysis for each species. This was more complicated than originally thought and subsequently has taken more time than expected. We now have the procedure developed and are proceeding with the analyses. We re requesting the additional year to complete the study.

PUBLICATIONS AND REPORTS

It is unlikely that we will be preparing or submitting any manuscripts to peer-reviewed journals in FY99 We will complete data analysis until late in FY99. We will prepare our final report and anticipate having at least one manuscript ready for submission to a peer-review journal.

PROFESSIONAL CONFERENCES

We anticipate presenting results of at least the genetic analyses at the Tenth anniversary Meeting. We will also be looking for opportunities to make presentations at professional conferences.

NORMAL AGENCY MANAGEMENT

Examination of features of and relation among populations of fish (or other organisms), with perhaps the exception of migratory waterfowl, is not required by statute or regulation for management responsibilities of the USDA Forest Service. Consequently, the agency does not normally fund this type of research, even though it is valuable in planning and development of management programs. For this study, the USFS is contributing the salary of one of the principal investigators (G. H. Reeves), and assistance with lab work.

There will be no additional injury to Dolly Varden and cutthroat trout populations from the oil spill itself if this study is not funded. However, there could be potential risks to the populations if some mitigation actions were undertaken without an understanding of the relation among populations that this project will provide. For example, introduction of individuals from outside populations could potentially have detrimental impacts on a populations if the new individuals introduce maladaptive traits into the population of concern. This could exacerbate any potential impacts from the oil spill. An understanding of the relation among and within relations of these fish is essential for the development of a proactive restoration and increases the likelihood of a recovery plan being successful. (Refer to more detailed discussion in Need for the Project, Part B of this proposal for discussion of importance of this project.) While this project has application in applied and basic science arenas, it is not clear what agency or organization would be interested in funding this project or one like it in the near future.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

We will continue to coordinate about results from this study with appropriate agencies as they become available.

PROPOSED PRINCIPAL INVESTIGATORS

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Revis 7/8/98
Approved TC 8-13-98

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1998 - September 30, 1999

Budget Category:	Authorized FY 1998	Proposed FY 1999
Personnel	$64.8	$40.8
Travel	$2.4	$3.2
Contractual	$40.0	$0.0
Commodities	$0.0	$0.0
Equipment	$1.0	$0.0
Subtotal	$108.2	$44.0
General Administration	$12.5	$6.1
Project Total	$120.7	$50.1
Full-time Equivalents (FTE)		0.9

LONG RANGE FUNDING REQUIREMENTS

	Estimated FY 2000	Estimated FY 2001	Estimated FY 2002		

Dollar amounts are shown in thousands of dollars.

Other Resources

Comments: Continuation of 98145

FY 99

Project Number: 99145
Project Title: CT/DV Relations
Agency: U S Forest Service

FORM 3A
TRUSTEE
AGENCY
SUMMARY

Prepared:4/7/98, KEH

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 1999
K. Griswald	Fish Biologist		10.2	4.0		40.8
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		10.2	4.0	0.0	
					Personnel Total	$40.8

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 1999
Corvallis, Or. To Anchorage to attend work shop	0.7	2	9	0.2	3.2
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$3.2

FY 99

Prepared:

Project Number: 99145
Project Title: CT/DV Relations
Agency: U S Forest Service

FORM 3B
Personnel
& Travel
DETAIL

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

Contractual Costs:	Proposed FY 1999
Description	
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$0.0

Commodities Costs:	Proposed FY 1999
Description	
Commodities Total	$0.0

FY 99

Prepared:

Project Number: 99145
Project Title: CT/DV Relations
Agency: U S Forest Service

FORM 3B
Contractual & Commodities DETAIL

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1998 - September 30, 1999

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

Existing Equipment Usage:	Number	Inventory
Description	of Units	Agency

FY 99

Project Number:99145
Project Title:CT/DV Relations
Agency:U S Forest Service

FORM 3B
Equipment
DETAIL

Prepared:

Approved TC 8-13-98

Archaeological Site Stewardship

Project Number:	99149-CLO
Restoration Category:	Monitoring
Proposer:	D. Reger/ADNR
Lead Trustee Agency:	ADNR
Cooperating Agencies:	DOI
Alaska SeaLife Center:	No
New or Continued:	Cont'd
Duration:	4th yr. 4 yr. project
Cost FY 99:	$15.2
Cost FY 2000:	$0.0
Cost FY 01:	$0.0
Cost FY 02:	$0.0
Geographic Area:	Kenai Peninsula, Kodiak Island, Alaska Peninsula
Injured Resource/Service:	Archaeological resources

ABSTRACT

The archaeological site stewardship program has been aimed at providing training and coordination for a cadre of volunteers to monitor vandalized sites in the oil spill area beyond the ability of agency monitoring. Volunteer site stewards monitored damaged sites on the Kenai Peninsula, Kachemak Bay, Uganik Bay, Uyak Bay, and the Chignik area of the Alaska Peninsula. Closeout of the project will summarize accomplishments of the past three years of activity, outline conclusions about usefulness and structure of the program and identify future directions for similar programs.

INTRODUCTION

An important key to saving Alaska's cultural heritage sites from continuing loss is promotion of local stewardship of historic and prehistoric sites. The idea of site stewardship is to get local people to take an interest in sites and the information they contain and to convince people to report site destruction or damage to sites. Other states, notably Arizona and Texas, have created organizations in which people with interest in archaeology but with very little training can cooperate with professional archaeologists in monitoring sites. The Arizona program links a system of volunteer site stewards with governmental archaeologists. The system involves stewards in monitoring selected sites in danger of looting. In return, the stewards receive schooling in the history and prehistory of the state and training in data collection. A successful site stewardship program must depend very heavily on interest, education and active involvement of the public.

An attempt was made to start a stewardship program in Southcentral Alaska during 1992, when the Exxon Valdez Oil Spill Trustee Council funded development of a manual and fieldbook suitable for beginning a program in the spill area. A first draft of the manual and fieldbook were written with the intent of revising them to fit specific situations in different areas. The manual and fieldbook have been modified during FY 96 and training materials specific to each program area have been compiled. Sites to be monitored by the stewards enlisted are being selected and the program implemented during FY 96.

Resident fishermen in the areas of Uganik Bay and Uyak Bay on Kodiak Island have expressed to U.S. Fish and Wildlife Service archaeologists monitored sites near their setnet locations. Those sites have suffered depredations from vandals.

The Office of History and Archaeology met with archaeologists in Homer and the Kenai-Soldotna area during 1994 to develop a site monitoring program. Sites selected in the central part of the Kenai Peninsula include prehistoric sites eroding from natural and human causes and a historic cabin which has frequently been used for shelter by transient visitors. The latter attempts were developed with University of Alaska, Anchorage, Kenai campus staff and student volunteers. Representatives from a local Native organization have become actively involved in the program and developed their own programs beyond the scope of the Trustee Council supported program.

The Kachemak Bay area which contains many sites rich in valuable artifacts also has many people interested in seeing the sites protected from vandals and erosion. Two residents of Homer trained as archaeologists serve as regional coordinators for the program.

The basis of a site stewardship program is effective creation of a partnership between interested individuals of the general public, professional archaeologists and historians, and government responsible for protecting those resources. Successful stewardship depends on close cooperation and identifiable benefit to all participants. Because of the remote location of many Alaskan sites and lack of funding to protect them, education of the public and

recruitment of their help may be the best chance to protect Alaska's heritage in the future.

NEED FOR THE PROJECT

A. Statement of Problem

Vandalism of archeological sites during the cleanup phase of the Exxon Valdez Oil Spill was well documented in the Oil Spill area, particularly in Prince William Sound and the Kodiak Island area. Vandalism during cleanup appears to have been associated with people placed near sites while living on chartered boats. Many of the boats working on the cleanup effort were from local coastal communities and crews were local residents. Circumstantial evidence indicates that some crew members were involved in the looting of sites. The fear among cultural resource managers is that knowledge about site locations and the practice of site looting accelerated during oil spill cleanup, continued and spread outside the oil spill area. Recent events of site looting by crew members from Gulf of Alaska herring fishing boats at the Old Togiak Site indicate the pattern has continued, very probably at a more intensive rate. The Alaska Office of History and Archaeology and the National Park Service recently sent a joint letter to fishermen active in the Bristol Bay herring fishery which states the case against and legal penalties for looting sites. The funding sought for closeout will compile findings and accomplishments of the three year field program into a single report and outline for future directions.

B. Rationale

Continuing loss of sites and data to vandals reduces the finite number of sites which exist in the spill area. Unless a means to stop the destruction is found, the ability of the archaeological resources to address questions important to the cultural heritage of Alaskans will be diminished beyond the ability to achieve answers. Agencies concerned with archaeological sites have attempted to monitor damaged sites but with little success due to lack of sufficient personnel for the work load. Other duties of the agency employees do not allow adequate time to be spent monitoring and protecting damaged sites.

C. Location

The project occurred in the Chignik, Kodiak Island, Kachemak Bay and Kenai areas. The communities of Chignik, Kodiak, Homer, Seldovia, Kenai, and Soldotna were affected by the project.

COMMUNITY INVOLVEMENT

The archaeological site stewardship project has been based on involvement of individuals in Homer and Chignik and in remote areas of Uyak and Uganik Bays on Kodiak Island. Site

stewards recruited in and around those communities were provided some material and logistic support. The project depended on the interest and cooperation of the local stewards in providing their time and knowledge. Agency archaeologists met singly and with groups of local stewards for training and provided materials needed for site monitoring.

PROJECT DESIGN

A. Objectives

The findings and accomplishments of the past three years of project work will be compiled into a single summary document. Appendices of support materials developed during the project will be presented as attachments to the document.

B. Methods

The closeout report will be prepared as a reproducible document which can be distributed to local groups interested in similar programs.

C. Cooperating Agencies, Contracts and Other Agency Assistance

There will be no contracts in this phase of this project. As needed, photos and information will be solicited from the National Park Service and U.S. Forest Service.

SCHEDULE

A. Measurable Project Tasks for FY 99 (October 1, 1998 - September 30, 1999)

The steps to be accomplished during the second year of this project will be:

October 1 - November 15, 1998:	Beginning of FY 99. No NEPA finding required.
April 15, 1999:	Completion of final report.

B. Project Milestones and Endpoints

The endpoint of this project is completion of the final report by April 15, 1999.

C. Completion Date

The closeout report will constitute the final report for the project to be completed by April 15, 1999 (FY 99).

PUBLICATIONS AND REPORTS

The report produced will be the final report of project activities during the lifetime of the project. No manuscript publishable in a peer reviewed publication is anticipated.

PROFESSIONAL CONFERENCES

No professional conference presentations are anticipated.

NORMAL AGENCY MANAGEMENT

Federal and state laws assign general responsibility for dealing with cultural resource matters to the various land managing agencies. None of the agencies cooperating in the site stewardship project has ever funded such a program. The project has been linked to expected increases in vandalism due to cleanup associated vandalism.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

Because this proposal is for writeup time and expenses, no coordination with other agencies is necessary except between participating agencies.

EXPLANATION OF CHANGES IN CONTINUING PROJECTS

This proposal is for closeout of the three year project.

PROPOSED PRINCIPAL INVESTIGATOR

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Approved TC 13-98

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1997 - September 30, 1998

Budget Category:	Authorized FY 1998	Proposed FY 1999	PROPOSED FY 1999 TRUSTEE AGENCIES TOTALS					
			ADEC	ADF&G	ADNR	USFS	DOI	NOAA
Personnel	$40.1	$13.2						
Travel	$16.0	$0.0						
Contractual	$3.4	$0.0						
Commodities	$1.2	$0.0						
Equipment	$0.0	$0.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	$60.7	$13.2		Estimated FY 2000	Estimated FY 2001	Estimated FY 2002		
General Administration	$6.2	$2.0						
Project Total	$66.9	$15.2		$0.0	$0.0	$0.0		
Full-time Equivalents (FTE)	0.7	0.2						
			Dollar amounts are shown in thousands of dollars.					
Other Resources	$0.0	$0.0		$0.0	$0.0	$0.0		

Comments: This the close-out of projects 96149, 97149, and 98149.

1999

Project Number: 99149
Project Title: Archaeological Site Stewardship
Lead Agency: AK Department of Natural Resources

FORM 2A
MULTI-TRUSTEE
AGENCY
SUMMARY

4/10/98

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1997 - September 30, 1998

Budget Category:	Authorized FY 1998	Proposed FY 1999						
Personnel	$29.3	$8.6						
Travel	$3.7	$0.0						
Contractual	$2.1	$0.0						
Commodities	$1.0	$0.0						
Equipment		$0.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	$36.1	$8.6		Estimated FY 2000	Estimated FY 2001	Estimated FY 2002		
General Administration	$4.5	$1.3						
Project Total	$40.6	$9.9		$0.0	$0.0	$0.0		
Full-time Equivalents (FTE)	0.4	0.1						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments:

1999

Project Number: 99149
Project Title: Archaeological Site Stewardship
Agency: AK Department of Natural Resources

FORM 3A
TRUSTEE
AGENCY
SUMMARY

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

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 1999
Douglas R. Reger		18M	1.3	6.6		8.6
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		1.3	6.6	0.0	
					Personnel Total	$8.6

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 1999
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$0.0

1999

Project Number: 99149
Project Title: Archaeological Site Stewardship
Agency: AK Department of Natural Resources

FORM 3B
Personnel
& Travel
DETAIL

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

Contractual Costs:	Proposed
Description	FY 1999
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$0.0

Commodities Costs:	Proposed
Description	FY 1999
Commodities Total	$0.0

1999

Project Number: 99149
Project Title: Archaeological Site Stewardship
Agency: AK Department of Natural Resources

FORM 3B
Contractual & Commodities
DETAIL

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

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

Existing Equipment Usage:	Number of Units	Inventory Agency
Description		

1999

Project Number: 99149
Project Title: Archaeological Site Stewardship
Agency: AK Department of Natural Resources

FORM 3B
Equipment
DETAIL

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

Budget Category:	Authorized FY 1998	Proposed FY 1999
Personnel	$10.8	$4.6
Travel	$12.3	$0.0
Contractual	$1.3	$0.0
Commodities	$0.2	$0.0
Equipment		$0.0
Subtotal	$24.6	$4.6
General Administration	$1.7	$0.7
Project Total	$26.3	$5.3
Full-time Equivalents (FTE)	0.3	0.1
Other Resources		

LONG RANGE FUNDING REQUIREMENTS					
	Estimated FY 2000	Estimated FY 2001	Estimated FY 2002		
	$0.0	$0.0	$0.0		

Dollar amounts are shown in thousands of dollars.

Comments:

1999

Prepared: 6 of 13

Project Number: 99149
Project Title: Archeaeological Site Stewardship
Agency: DOI-Fish and Wildlife Service

FORM 3A
TRUSTEE
AGENCY
SUMMARY

4/10/98

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1997 - September 30, 1998

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 1999
Debra Corbett	Archaeologist	GS-9	1.2	3.8		4.6
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		1.2	3.8	0.0	
					Personnel Total	$4.6

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 1999
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$0.0

1999

Project Number: 99149
Project Title: Archaeological Site Stewardship
Agency: DOI-Fish and Wildlife Service

FORM 3B
Personnel
& Travel
DETAIL

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

Contractual Costs:	Proposed FY 1999
Description	
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$0.0

Commodities Costs:	Proposed FY 1999
Description	
Office supplies	
Commodities Total	$0.0

1999

Project Number: 99149
Project Title: Archaeological Site Stewardship
Agency: DOI-Fish and Wildlife Service

FORM 3B
Contractual & Commodities
DETAIL

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

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

Existing Equipment Usage:	Number of Units	Inventory Agency
Description		

1999

Project Number: 99149
Project Title: Archaeological Site Stewardship
Agency: DOI-Fish and Wildlife Service

FORM 3B
Equipment
DETAIL

Approved TC 8-13-98

Project Title: **Surveys to Monitor Marine Bird Abundance in Prince William Sound during Winter and Summer; Report and Publication Writing**

Project Number:	99159
Restoration Category:	Monitoring
Proposer:	Migratory Bird Management, U. S. Fish and Wildlife Service
Lead Trustee Agency:	U. S. Department of the Interior, Fish and Wildlife Service
Cooperating Agencies:	None
Alaska SeaLife Center:	No
Duration:	6 years of surveys completed, will continue surveying on alternating years until recovery
Cost FY 99:	$~37,000 report and publication writing
Cost FY 00:	$~242,000 surveys
Cost FY 01:	$~38,500 report and publication writing
Cost FY 02:	$~251,000 surveys
Cost FY 03:	$~40,000 report and publication writing
Geographic Area:	Prince William Sound
Injured Resource/Service:	All marine birds and sea otters

ABSTRACT

We conducted small boat surveys to monitor abundance of marine birds in Prince William Sound, Alaska during March 1990, 1991, 1993, 1994, 1996, and 1998 and July 1989, 1990, 1991, 1993, 1996, and 1998. We will use the data to examine trends by determining whether populations in the oiled zone changed at the same rate as those in the unoiled zone. We will also examine overall population trends for Prince William Sound from 1989-98. We will prepare an annual report and a paper for publication.

RECEIVED
APR 15 1998
EXXON VALDEZ OIL SPILL
TRUSTEE COUNCIL

INTRODUCTION

The waters and shorelines of Prince William Sound support abundant marine bird and sea otter (*Enhydra lutris*) populations throughout the year (Isleib and Kessel 1973, Hogan and Murk 1982, Irons et al. 1988a). Potential injuries to marine birds from exposure to the *T/V Exxon Valdez* oil spill included, but were not limited to death, changes in behavior, and decreased productivity. U. S. Fish and Wildlife Service, Migratory Bird Management conducted boat surveys in Prince William Sound prior to the *Exxon Valdez* oil spill in 1972-73 (Dwyer et al. 1976) and 1984-85 (Irons et al. 1988a,b). After the oil spill, Natural Resource Damage Assessment Bird Study Number 2 (Burn 1994, Klosiewski and Laing 1994) was initiated to document damage from the oil spill on the marine bird and sea otter populations of Prince William Sound. Data from these surveys indicated that populations of sea otters (Burn 1994) and several marine bird species (Klosiewski and Laing 1994) declined in the oil spill area. Thus, restoration projects 93045 (Agler et al. 1994c), 94159 (Agler et al. 1995a), 96159 (Agler and Kendall 1997), and 98159 were initiated to continue monitoring marine bird and sea otter population abundance to assess recovery of injured species. Restoration projects 93045, 94159, 96159, and 98159 continued the original *Exxon Valdez* oil spill damage assessment study (Bird Study Number 2, Burn 1994, Klosiewski and Laing 1994) from 1989-91.

Surveys will be conducted in March and July of 1998. Based on conclusions from a power analysis (Agler 1995), we have proposed conducting the surveys every other year, until restoration has occurred. We will use data collected in 1998 to monitor the distribution and abundance of marine birds and sea otters in Prince William Sound. These data will be combined with data collected in 1989-91 (Klosiewski and Laing 1994), 1993 (Agler et al. 1994c), 1994 (Agler et al. 1995a), and 1996 (Agler and Kendall 1997) to examine trends in marine bird and sea otter distribution and abundance. This project will benefit restoration of Prince William Sound by determining whether populations that declined due to the spill are recovering and by identifying what species are still of concern.

Funding this year will provide the opportunity to complete an annual report from the 1998 surveys and to publish a paper relating to the spill. We have already written three final reports (Agler et al. 1994c, 1995a; Agler and Kendall 1997) and presented papers on Prince William Sound at scientific meetings. With no field work scheduled for 1999 we plan to use the time to complete the annual report and to synthesize the data from 6 years of surveys into a paper for publication. We plan to write a paper on marine bird population trends since the oil spill.

NEED FOR THE PROJECT

A. Statement of the Problem

Almost 30,000 marine bird (Piatt et al. 1990) and 900 sea otter (DeGange and Lensink 1990) carcasses were recovered following the *Exxon Valdez* oil spill. Based on modeling studies using carcass search effort and population data, an estimated 300,000 - 645,000 marine birds were killed in Prince William Sound and the northern Gulf of Alaska (Ecological Consulting, Inc. 1991). Garrott et al. (1993) estimated that 2,800 sea otters were killed. These estimates were probably low, because they only included direct mortality occurring in the first five months after the spill.

The U. S. Fish and Wildlife Service conducted boat surveys of marine bird and sea otter populations in Prince William Sound in 1972-73 (Dwyer et al. 1976), 1984-85 (Irons et al. 1988a,b), and several years following the spill (1989, 1990, 1991, Klosiewski and Laing 1994; 1993, Agler et al. 1994c; 1994, Agler et al., 1995a; and 1996, Agler and Kendall 1997). Additional surveys will be conducted in winter and summer of 1998. Klosiewski and Laing (1994) documented overall declines in 15 species or species groups between 1972-73 (Dwyer et al. 1976) and the years after the spill. When comparing population estimates with 1984-85 data, Klosiewski and Laing (1994) documented decline of six species or species groups.

Burn (1994), using data from the boat surveys, documented declines in sea otter abundance in shoreline habitats of Prince William Sound following the spill. Burn (1994) detected a continuing pattern of significantly lower sea otter densities in oiled coastal areas, suggesting mortality in or displacement of sea otters from these areas.

Agler et al. (1994c, 1995a) and Agler and Kendall (1997) examined whether species shown as injured (Klosiewski and Laing 1994) had recovered. Agler et al. (1995a) found no evidence of recovery for any of the injured species. Inclusion of 1996 survey data (Agler and Kendall 1997) revealed additional information on population trends. Cormorants (*Phalacrocorax* spp.), bald eagles (*Haliaeetus leucocephalus*), and sea otters exhibited significant trends, indicating that these populations show continued injury from the spill. In addition, the other injured species, loons (*Gavia* spp.), harlequin ducks (*Histrionicus histrionicus*), black oystercatchers (*Haematopus bachmani*), common murres (*Uria aalge*), pigeon guillemots (*Cepphus columba*), and marbled murrelets (*Brachyramphus marmoratus*), did not show any significant trends (Agler and Kendall 1997) suggesting these populations have not recovered. Additionally, Agler et al. (1995a) and Agler and Kendall (1997) found that some bird populations not designated as injured (ie. goldeneyes, scoters (*Melanitta* spp.), black-legged kittiwakes (*Rissa tridactyla*), may now be showing trends consistent with injury from an oil spill. The one remaining injured species, Kittlitz's murrelet (*Brachyramphus brevirostris*), exhibited trends consistent with recovery, but since their population was declining in the unoiled zone and slightly increasing in the oiled zone it is questionable if this really indicated recovery (Agler and Kendall 1997).

B. Rationale/Link to Restoration

Restoration of marine bird and sea otter populations requires population estimates to determine whether recovery is occurring or if species are still affected by the oil spill. This project will benefit marine birds and sea otters by revealing species that show continuing injury due to the *T/V Exxon Valdez* oil spill. Agler et al. (1994a, 1995a; Agler and Kendall 1997) found additional populations that were not previously shown to be injured (ie. goldeneyes). Survey data from this project have also been used by investigators of other studies on pigeon guillemots (Greg Golet, pers. comm.), marbled murrelets (K. Kuletz, pers. comm.), Kittlitz's murrelets (B. Day, per comm.), harlequin ducks (D. Rosenberg, pers. comm.), sea ducks (D. Rosenberg, pers. comm.), black oystercatchers (B. Andres, pers. comm.), birds and forage fish (W. Ostrand, pers. comm.), herring (E. Brown, pers. comm.), and sea otters (Burn 1994).
Determination of restoration of marine bird populations requires population estimates to monitor whether recovery is occurring or if species are still affected by the oil spill. This project will benefit marine birds by using data collected from 1998 surveys to monitor population trends of species injured by the *T/V Exxon Valdez* oil spill.

This project relates to the restoration objectives of several species. The *Exxon Valdez Oil Spill Restoration Plan* (*Exxon Valdez* Oil Spill Trustee Council 1994) lists each species' restoration objectives separately. We only included objectives relating to this project:

> Cormorants - "will have recovered when their populations return to prespill levels in the oil-spill area. An increasing population trend in Prince William Sound will indicate that recovery is underway."
>
> Harlequin duck - "will have recovered when breeding and postbreeding season densities and production of young have returned to estimated pre-spill levels, or when there are no differences in these parameters between oiled and unoiled areas."
>
> Bald eagle -"will have recovered when their population and productivity return to pre-spill levels."
>
> Black oystercatchers - "will have recovered when populations attain pre-spill levels"
>
> Marbled murrelet - "will have recovered when population trends are increasing."
>
> Pigeon guillemot - "will have recovered when populations are stable or increasing."
>
> Sea otter - "will be considered recovered when population abundance and distribution are comparable to pre-spill abundance and distribution"

All of the above recovery objectives relate to determining the population abundance of injured species. This is critical to determining recovery for most species. Kittlitz's murrelet (*Brachyramphus brevirostris*) and common loons (*Gavia immer*) have been added to the injured

species list, but their restoration objectives have not yet been determined. We propose to use data from a survey of Prince William Sound during March and July 1998 to estimate population abundance and distribution of marine birds. Data will be comparable with pre- and post-spill data collected by the U. S. Fish and Wildlife Service (Dwyer et al. 1976, Irons et al. 1988a,b, Agler et al. 1994c, Klosiewski and Laing 1994, Agler et al. 1995a, Agler and Kendall 1997) and can be used to examine trends in abundance for these species. There are no other studies monitoring the populations of loons and cormorants.

Additionally, Klosiewski and Laing (1994) found evidence of oil spill damage for scoters (*Melanitta* spp.), mew gull (*Larus canus*), arctic tern (*Sterna paradisaea*), and northwestern crow (*Corvus caurinus*). These species have never been added to the list of injured species and do not have restoration objectives. At the present time, this proposed study is the only study continuing to consider these species and track their populations.

Frequent monitoring needs to be conducted to ascertain trends in population abundance within Prince William Sound. We proposed conducting biannual surveys, with the years between surveys used to write reports and publications (Agler 1995). By using data from previous surveys we have conducted power analyses to examine the power to detect trends in population abundance (Taylor and Gerrodette 1993). If all other parameters are equal, power is determined by the number of surveys conducted in a given period of time. As the number of surveys increases the ability to detect a trend increases. For example, if a population had a coefficient of variation (C.V.) of 0.30 (this is higher than that of 73% of the injured species; (Agler and Kendall 1997) the ability to detect an average annual 10 % change in population is 25% with 5 surveys (Fig. 1). By conducting surveys in 1998 the number of surveys increases to 6 and the power to detect same population change increases to 40% (Fig. 1). If we continue biannual surveys, when we have completed 10 surveys the power to detect this change would be 90% (Fig. 1). Thus we feel it is important to continue these surveys to enable us to increase the ability to detect population trends. Also, we need to continue to monitor marine bird populations within the Sound in the unlikely event that another environmental perturbation occurs. Few pre-spill data were available before the *Exxon Valdez* oil spill, making it extremely difficult to determine what species were injured and to what extent (Klosiewski and Laing 1994).

C. Location

This study will be conducted in Prince William Sound. The study area includes all waters within Prince William Sound, as well as land within 100 m of the shore. Villages within Prince William Sound may be interested in the results of this study, since we will be reporting on the status of several wildlife species that are used for subsistence as well as describing the health of the Prince William Sound ecosystem.

COMMUNITY INVOLVEMENT

Copies of our reports and publications will be available for communities within Prince William Sound and other areas affected by the spill. We have and will continue to use charter boats and

crews from the local area.

PROJECT DESIGN

A. Objectives

The purpose of this study is to obtain population estimates of marine birds in Prince William Sound to monitor the recovery of species whose populations may have declined due to the *T/V Exxon Valdez* oil spill and to determine whether additional species may still be affected by the oil spill. The specific objectives of this project include:

1. determine distribution and estimate population abundance, with 95% confidence limits, of marine bird populations in Prince William Sound during March and July 1998;

2. determine whether the marine bird species whose populations declined more in oiled areas than in non-oiled areas of Prince William Sound have recovered;

3. determine whether additional species show any oil spill effects;

4. support restoration studies on harlequin duck, black oystercatcher, pigeon guillemot, marbled murrelet, Kittlitz's murrelet, sea ducks, and sea otters by providing data on population changes, distribution, and habitat use of Prince William Sound populations.

5. prepare a paper for publication.

B. Methods

1. Study Area

Our study area includes all waters within Prince William Sound and all land within 100 m of shore (Fig. 2). We exclude Orca Inlet, near Cordova, Alaska and the southern sides of Montague, Hinchinbrook, and Hawkins Islands (Klosiewski and Laing 1994).

2. Sampling Methods

Surveys will be conducted in FY98, using methods described in 1998 detailed project description (Agler 1997).

3. Statistical Analyses

As in previous surveys (Klosiewski and Laing 1994, Agler et al. 1994a,b,c, 1995a,b, Agler and Kendall 1997), we will use a ratio estimator (Cochran 1977) to estimate population abundance. Shoreline transects will be treated as a simple random sample; whereas, the coastal-pelagic and pelagic transects will be analyzed as two-stage cluster samples of unequal size (Cochran 1977). To do this, we will estimate the density of birds counted on the combined transects for a block

and multiply by the area of the sampled block to obtain a population estimate for each block. We then will add the estimates from all blocks surveyed and divide by the sum of the areas of all blocks surveyed. We will calculate the population estimate for a stratum by multiplying this estimate by the area of all blocks in the strata. Population estimates for each species and for all birds in Prince William Sound will be calculated by adding the estimates from the three strata, and we will calculate 95% confidence intervals for these estimates from the sum of the variances of each stratum (Klosiewski and Laing 1994).

Population estimates for each species will be combined with other post-oil spill population estimates to determine population trends. We plan to use a homogeneity of slopes test (Freud and Littell 1981) to compare population trends between the oiled and unoiled zones of Prince William Sound to examine whether species with population estimates of >500 individuals have changed over time. To do this, we must assume that marine bird and sea otter populations increase at the same rate in the oiled and unoiled zones of Prince William Sound. The $\log_{10}$ of each population estimate will be calculated after adding 0.5 to the estimate to prevent effects from using log 0. Significantly different slopes would indicate that population abundance of a species or species group changed at different rates. With the homogeneity of slopes test the probability of finding significant trends may be reduced due to annual variation among populations (J. Bart, pers comm.). To reduce the effect of annual variation, we will calculate the ratio of a species' or species group's estimated population in the oiled zone to that in the unoiled zone. We will then use linear regression analyses to determine whether there is a trend among the ratios (Agler and Kendall 1997). For species or species groups showing a significant difference in slopes or ratios, we will determine the rate of change in each zone by linear regression analyses.

To examine population trends from 1989-96 for the entire Sound, we will calculate linear regressions of the total population estimates of each species and species group.

To map species distribution, densities will be calculated from the number of sightings on transects. For shoreline transects, we will map the density per transect, but for the pelagic and coastal-pelagic strata, we will map the density by block.

5. Statistical Justification for Proposed Monitoring Schedule

Currently, these surveys are scheduled to occur every 2 years over an unspecified time period. This schedule should be considered in light of the results of a power analysis.

To determine optimum survey frequency, we conducted a power analysis to estimate the probability of detecting trends in abundance using linear regression from a given number of samples (Taylor and Gerrodette 1993). We examined our power to detect trends when coefficient of variation (CV) of the population was 0.30 (greater than the mean CV from previous surveys for 73% of the injured species; Fig. 1) and when the CV = 0.13 (the mean summer CV for *Brachyramphus* murrelets, an injured species; Fig. 3). Models of seabird population growth predict most species increase no more than 12% per year (Nur and Ainley 1992), so we used 10% for our comparisons.

With CV=0.30 the probability of detecting an average annual change of 10% would be 28% with

the 5 surveys completed to date (Fig 1). The probability would increase to 41% in 1998 (6 surveys). If we continue on a biannual survey schedule, 2 more surveys would be completed by 2002. With 8 surveys the probability of detecting a trend would increase to 71%. If 10 surveys were completed the probability would be 92%. For murrelets the power to detect a 10% change is now 80% (Fig. 3). This would increase to 95% with the completion of the 1998 surveys (Fig. 3).

Based on these calculations, we recommend a monitoring schedule of every two years for these surveys. The years between surveys should be used for report and publication writing.

C. Cooperating Agencies, Contracts and Other Agency Assistance

No contracts or other agency assistance will be required for data analysis and publication of results.

SCHEDULE

A. Measurable Project Tasks for FY 99 (October 1, 1998 - September 30, 1999)

October - January 15:	Prepare draft report of 1998 surveys
March 1:	In-house review of marine bird population trends since the oil spill paper
March 24-27 :	Attend Annual Restoration Workshop
April 15:	Annual report complete
July 1:	Submit trends since the oil spill paper to journal

B. Project Milestones and Endpoints

We will examine the project objectives after each set of surveys and publish a report.

C. Completion Date

Work will be complete when all injured species covered by the surveys have met their restoration objective and are listed as recovered.

PUBLICATIONS AND REPORTS

We plan to complete an annual report and submit 1 publication in FY 99.

1.) A draft report will be submitted for peer review on January 15, 1999. The annual report will be completed on April 15, 1999. We estimate 3.5 months of personnel time provided by *Exxon Valdez* Oil Spill Trustee Council (EVOS) to prepare the draft report for review. An additional month of personnel time will be required to incorporate the reviewers' comments and complete the annual report.

2.) A paper on marine bird population trends since the oil spill will be completed for in-house review in May. The annual report will be revised for this publication. A month and a half of personnel time will be required to prepare this publication for the Condor. We are requesting funding from EVOS for this publication.

PROFESSIONAL CONFERENCES

We request no funds in FY99 from EVOS for travel to professional conferences..

NORMAL AGENCY MANAGEMENT

This project is not a part of normal agency management for the U. S. Fish and Wildlife Service in Alaska. Although considered an important ecosystem within Alaska, there are no agency funds available to survey Prince William Sound or any other region in Alaska. Although there are few agency funds to pay salaries during the report writing and publication preparation phase of the project, the Office of Nongame Migratory Bird Management is committed to this process and will donate funds needed to ensure publication of the results.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

This project will provide valuable information on the distribution and habitat use of marine birds and sea otters in Prince William Sound. Principle investigators from other EVOS trustee council funded projects have used our survey data in the past. Data from these surveys would be helpful for the sea otter, harlequin duck, and pigeon guillemot portions of the nearshore vertebrate predator project (\025); the black-legged kittiwake, marbled murrelet, and seabird foraging portions of the Alaska predator ecosystem experiment (\163); Kittlitz's murrelet status and ecology (\142); and harbor seal monitoring (\064).

EXPLANATION OF CHANGES IN CONTINUING PROJECTS

During FY97 we requested ~$47,000 for writing reports and publications. Due to a reduction in personnel we are only requesting ~$37,000 for FY99. With the completion of the 1998 surveys, we will have collected 6 years of data. With the additional data from 1998 and the time available due to no field season scheduled for FY99, we have the opportunity to concentrate on disseminating our findings through a publication in a scientific journal. We will also be able to develop guidelines for future monitoring of Prince William Sound.

We are requesting funds to cover salaries and the expenses needed to prepare publications and to travel to professional meetings. In the past, the salaries for the Co-Principal Investigators were partially covered by other U.S. Fish and Wildlife Service projects. Cuts in the Federal budget preclude access to these other sources of funding. To ensure continuation of this important monitoring project every other year as suggested, it's essential that knowledgeable staff be

retained to coordinate these surveys. The Co- Principal Investigator (Brian Lance) will spend 6 months working on other projects funded through the Trustee Council. In the years of no surveys his knowledge of computers, seabird ecology, and field skills can be utilized, promoting cooperation among projects.

PROPOSED PRINCIPAL INVESTIGATORS

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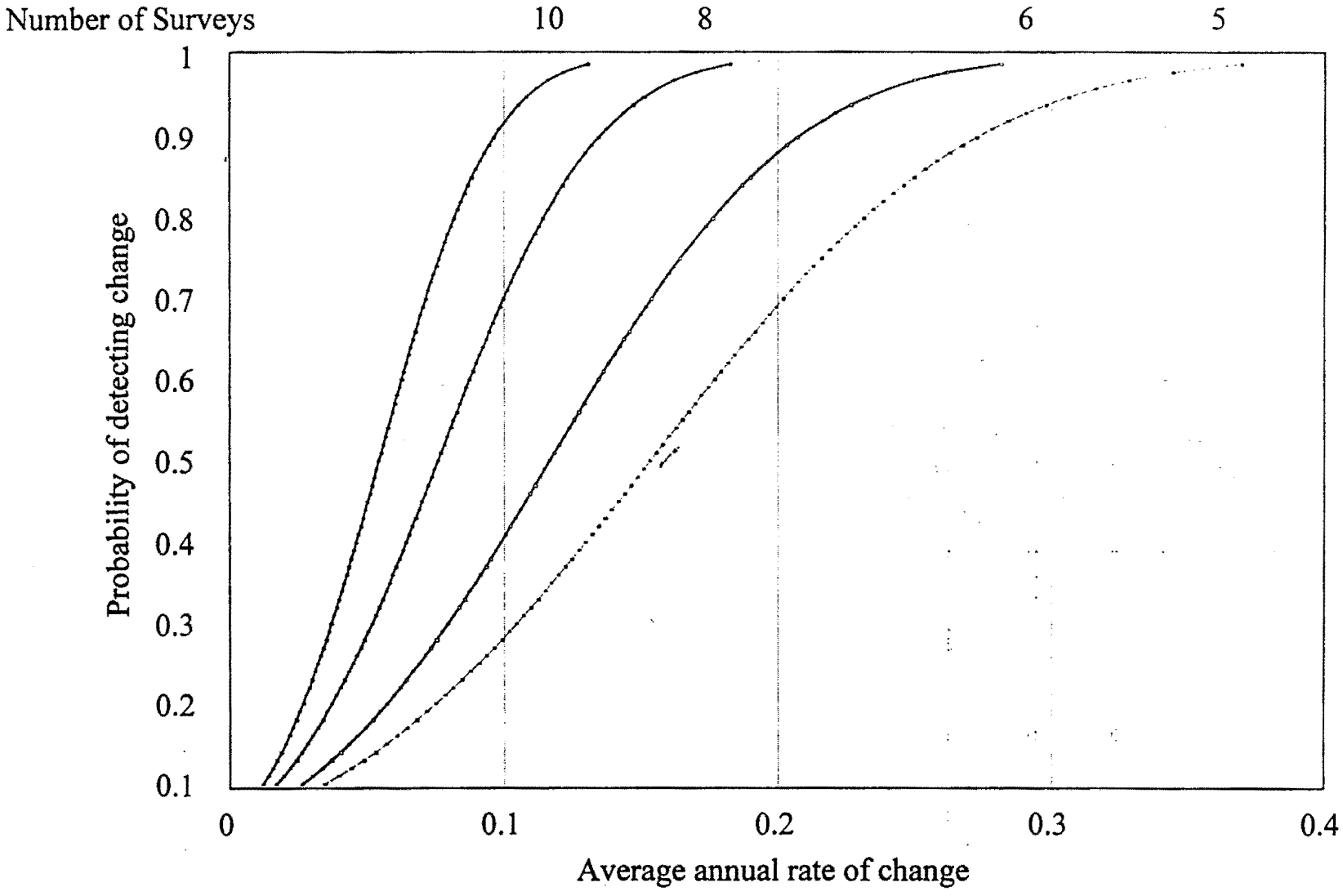

Figure 1. Estimated power (probability of detection) based on number of surveys conducted to detect a trend of marine bird and sea otter populations in Prince William Sound when CV = 0.30.

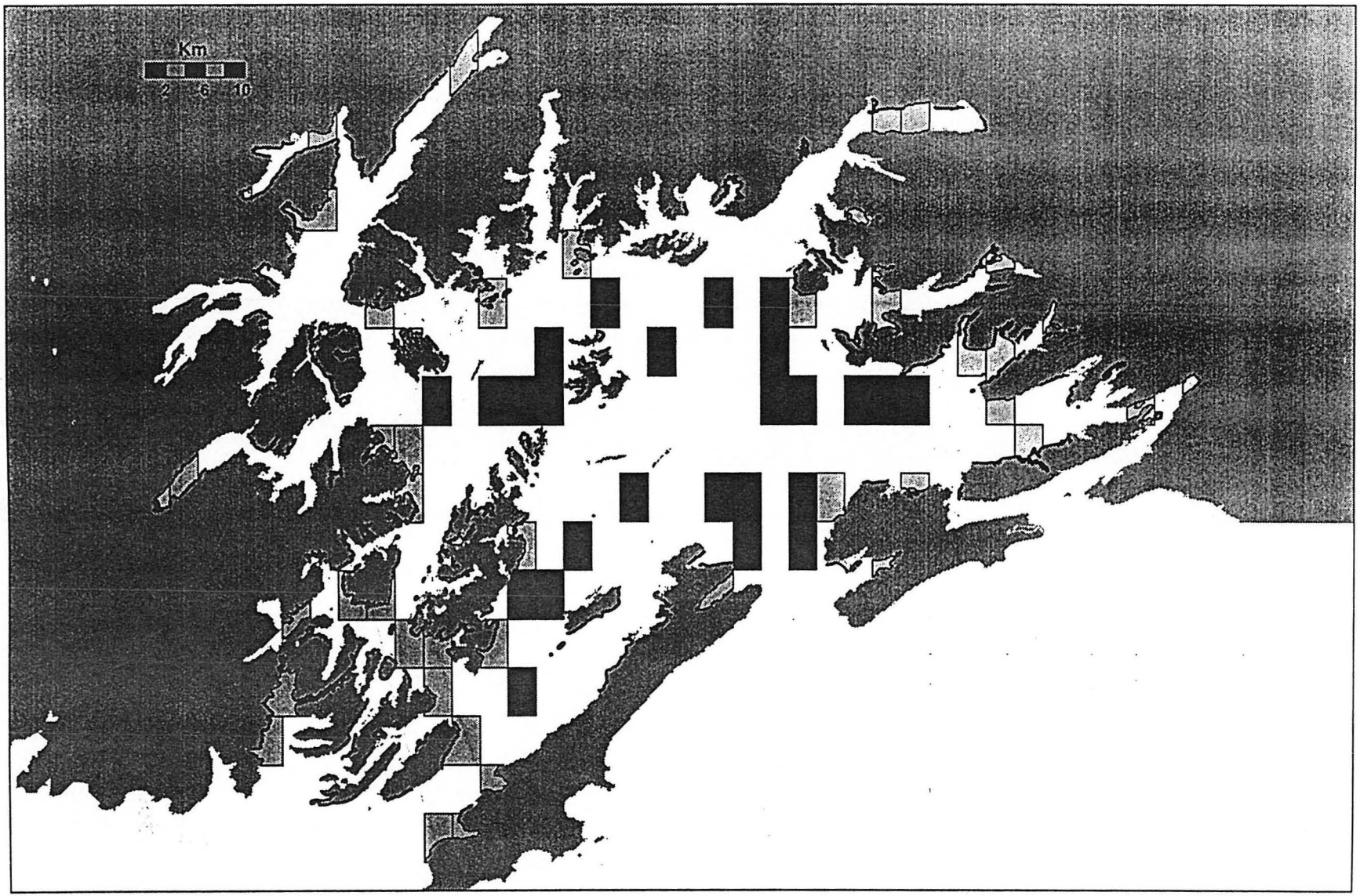

Figure 2. Transects and blocks surveyed during July small boat surveys of Prince William Sound. Transects were classified into 3 strata; the shoreline stratum, (<200 m from land), the coastal-pelagic stratum (lighter shaded blocks), and the pelagic stratum (darker shaded blocks).

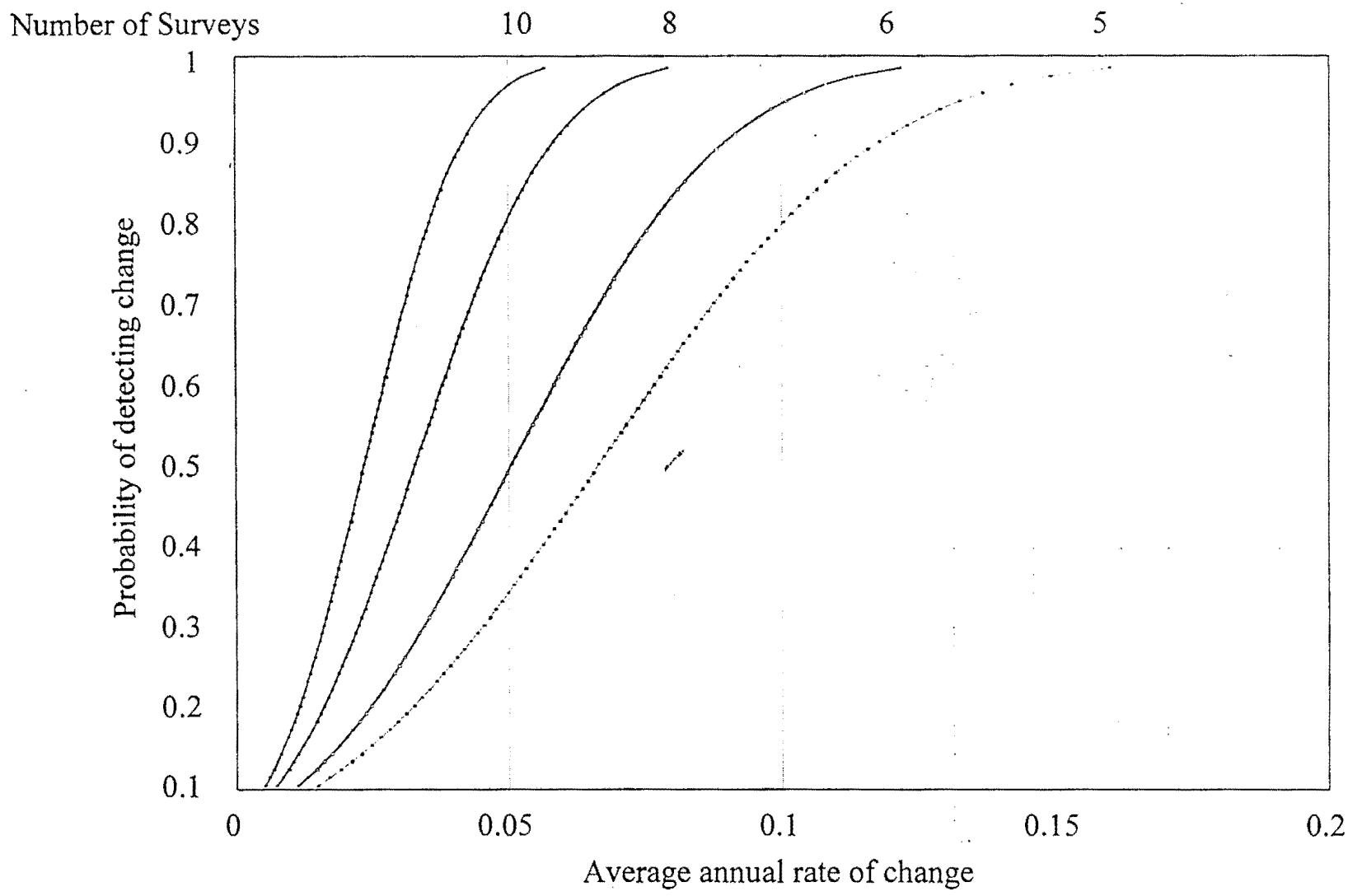

Figure 3. Estimated power (probability of detection) based on numbers of surveys conducted to detect a trend in the July *Brachyramphus* murrelet population in Prince William Sound. The CV = 0.13.

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

Approved TC 8-13 98

Budget Category:	Authorized FFY 1998	Proposed FFY 1999						
Personnel	$106.7	$31.3						
Travel	$8.9	$0.0						
Contractual	$47.0	$0.0						
Commodities	$34.0	$1.0						
Equipment	$1.5	$0.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	$198.1	$32.3	Estimated FFY 2000	Estimated FFY 2001	Estimated FFY 2002	Estimated FFY 2003		
General Administration	$19.3	$4.7						
Project Total	$217.4	$37.0	$242.0	$38.5	$251.0	$40.0		
Full-time Equivalents (FTE)	2.6	0.6						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments: Justification of Personnel Costs:

Publications & Personnel Time

Final Report, 6 months (EVOS Funded)

Population Trends in PWS after the Oil Spill, 1.5 months (EVOS Funded)

Proposals

FY2000 DPD, 1.5 months (EVOS Funded)

1999

Prepared: 1 of 4

Project Number: 99159
Project Title: Marine Bird Surveys
Agency: DOI - Fish and Wildlife Service

FORM 3A
TRUSTEE
AGENCY
SUMMARY

4/15/98

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

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FFY 1999
Lance	Co-Project Leader	GS/9/ 1	6.0	4.1		24.6
Irons	Co-Project Leader	GS/12/5	1.0	6.7		6.7
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		7.0	10.8	0.0	
					Personnel Total	$31.3

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FFY 1999
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$0.0

1999

Prepared:

Project Number: 99159
Project Title: Marine Bird Surveys
Agency: DOI - Fish and Wildlife Service

FORM 3B
Personnel
& Travel
DETAIL

4/15/98

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

Contractual Costs:	Proposed FFY 1999
Description	
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$0.0

Commodities Costs:	Proposed FFY 1999
Description	
Page charges and reprints for 1 publication	1.0
Commodities Total	$1.0

1999

Project Number: 99159
Project Title: Marine Bird Surveys
Agency: DOI - Fish and Wildlife Service

FORM 3B
Contractual & Commodities DETAIL

Prepared:

4/15/98

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

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

Existing Equipment Usage:	Number	Inventory
Description	of Units	Agency

1999

Project Number: 99159
Project Title: Marine Bird Surveys
Agency: DOI - Fish and Wildlife Service

FORM 3B
Equipment
DETAIL

Prepared: 4 of 4

4/15/98

Approved TC 8-13-98

Preparation of Manuscripts Dealing with Disease Factors Affecting Declines of Pacific Herring Populations in Prince William Sound, AK

Project number:	99162A
Restoration Category:	Research
Lead Agency:	Alaska Department of Fish and Game
Proposer:	University of Washington
Cooperating Agencies:	USGS-Marrowstone Island Marine Station
Duration:	FY 99
Cost FY 99:	$58,600
Geographic area:	Prince William Sound, AK & Puget Sound, WA
Injured resource:	Herring

RECEIVED
APR 14 1998
EXXON VALDEZ OIL SPILL
TRUSTEE COUNCIL

ABSTRACT

This proposal covers the preparation of at least 5 manuscripts dealing with the research activities funded by the Exxon Valdez Trustee Council under contract numbers 95320S, 96162, 97162, and 98162. Two papers on the pathogenicity of viral hemorrhagic septicemia virus (VHSV) and the fungal pathogen, *Ichthyophonus hoferi* have already been submitted for publication in refereed journals. At least 5 additional subjects are covered by the existing data: 1) Survival of VHS virus in sea water, 2) The natural history of VHS in wild herring, 3) Serologic conversion and immunity in wild herring following and epizootic of VHS, and 4) Age-related immunity demonstrated in laboratory-reared herring. Additional publications on the effect of net pens on VHSV transmission and the presence of VHS-RNA in wild herring tissue as demonstrated by PCR are anticipated, depending on results of FY-98 studies.

INTRODUCTION

Publication of scientific data in refereed journals disseminates the knowledge acquired during the course of research. Publication of scientific findings is also a requirement of the Trustee Council as a condition of funding. In light of these general and specific requirements, it is proposed that following the completion of the FY-98 study year, that appropriate salary and publication expenses be provided to the PI for the purpose of writing, editing, preparing graphics and photos, and submitting scientific manuscripts to refereed journals. These publications will serve as a partial fulfillment of the Trustee's requirement of a Final Report.

Studies relating to at least 5 manuscripts are underway and will be completed in FY-98. Thus, a minimum of 5 scientific papers will be produced and submitted for publication in FY-99, with a high probability of two more depending on the results of several ongoing FY-98 studies. In all, production of these manuscripts will require approximately 6 months of effort and support.

NEED FOR THE PROJECT

A. Statement of Problem

Research data is often accumulated from a number of unrelated studies and over a long period of time. Because of this, a complete understanding of the data requires that all of the studies be completed before meaningful analyses can be undertaken, thus resulting in a delay in the dissemination (eg. publication) of the results - often months or years after the work has been completed. Herring disease studies conducted under restoration contracts from the Exxon Valdez Trustee Council will be completed in September of 1998 and will require approximately 0.5 - 1.5 month per study to write-up for publication in refereed scientific journals. Consequently, because funding for continuation of herring disease studies is not anticipated, it will be necessary to write-up these data under a separate contract that specifically covers publication costs, graphics, reprints and writing time.

B. Rationale - Link to Restoration

In order to make the most efficient use of scientific data, it must be published in the open literature and disseminated to as many scientists as possible. In this way the information can be used to manage resources, design projects to answer new questions, answer existing questions and educate the general population, through the popular media, with the best available scientific information on a specific subject.

Losses of PWS herring in 1992 - 1993 significantly impacted the economy of the region as well as upsetting the PWS ecosystem by removing a major food source low on the food chain. Data collected from disease studies over the past four years partly explains what may have happened to these fish and proposes actions that might prevent repeat occurrences in the future. Consequently, it is imperative that as much scientific information as possible be put into the open literature as soon as possible, for use by other

scientists and the general public. Availability of such information will also assist scientists and regulators in the event of an oil spill at some future date.

C. Location

Manuscript preparation will take place at three locations. The affected site, Prince William Sound, AK, the site of the original problem, the Marrowstone Island Marine Station, Nordland, WA, where most of the studies were carried out and specimens are archived and the School of Fisheries, University of Washington, Seattle, WA, where the PI is based. Because critical information on population density, fishing pressure and predation is located in Alaska, it is important to spend some time there reviewing the relevant data. The Marrowstone Island Laboratory, where most of the experimental work was carried out has archived samples, data storage and collection records. Preparation of final copies, editing, graphics and photography will be conducted at the University of Washington.

COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE

A summary of progress is presented at a Restoration Science Workshop, held in Anchorage, AK early each year (March 1999). The principal investigators will be available to speak with the media and public while preparing manuscripts and at the annual workshops. If requested, seminars and / or demonstrations will be arranged for community members and the media at any time of the year.

PROJECT DESIGN

A. Objectives

Proposed titles and time)

- Title: *Survival and infectivity of VHS virus in natural and filtered sea water.* (1 month)
- Title: *Natural history of and development of immunity to VHS virus in free-ranging wild herring.* (1.5 months)
- Title: *Antibody production in wild herring following survival of an epizootic.* (1.5 months)
- Title: *Evidence for age-related immunity to VHS in laboratory -reared herring* (1.5 months)
- Title: *Capture-induced expression of VHS in Pacific herring: Net pen effect* (0.5 months) In conjunction with student Paul Hershberger

o Title: *Pre and post-epizootic evidence for VHS-RNA in herring tissue as determined by PCR analysis*
(Possibly ready for publication in FY-99)

B. Methods

Manuscripts will be prepared in accordance with the "Instructions to Authors" associated with the various journals where publications will be sent.

These journals include:

1) Can. Journal of Fisheries & Aquatic Sciences
2) Aquatic Animal Diseases
3) Diseases of Aquatic Organisms

Some journals require page charges and all journals charge for reprints. It is anticipated that 100 reprints of each article will be ordered.

C. Cooperating Agencies, Contracts and Other Agency Assistance

No outside contracts are anticipated; the School of Fisheries Publication Office will prepare the final manuscripts as a part of the service provided to Fisheries faculty.

SCHEDULE

A. Measurable Project Tasks for FY 99

Prepare and submit manuscript on VHSV survival in seawater.

Prepare and submit manuscript on natural history of VHSV in juvenile herring.

Prepare and submit manuscript on antibody production in wild herring.

Prepare and submit manuscript on age-related immunity to VHS in herring.

Prepare and submit net-pen related disease studies in herring

Modify manuscripts according to referee's recommendations and edit galley proofs. Return manuscripts to Journal editors.

B. Project Milestones and Endpoints (FY 99)

October '98 - November '98: Prepare and submit manuscript on VHSV survival in seawater.

December '98 - January '99: Prepare and submit manuscript on natural history of VHSV in juvenile herring.

February '99 - March '99: Prepare and submit manuscript on antibody production in wild herring.

April '99 - May '99: Prepare and submit manuscript on age-related immunity to VHS in herring.

June '99 - July '99: Prepare and submit net-pen related disease studies in herring

March '99 - September '99: Modify manuscripts according to referee's recommendations , edit galley proofs and return manuscripts to Journal editors.

C. Completion Date

Final report for FY 99: April. '99

PUBLICATIONS AND REPORTS

Kocan, R.M., M. Bradley, N. Elder, T. Meyers, W. Batts, J. Winton (1997) The North American strain of viral hemorrhagic septicemia virus is highly pathogenic for laboratory-reared Pacific herring (*Clupea pallasi*). J. Aquatic Animal Health. 9: 279-290.

Kocan, R., Hershberger, P., Mehl, T., Elder, N., Bradley, M., Wildermouth, D., Stick, K. (1998) Pathogenicity of *Ichthyophonus hoferi* for laboratory-reared Pacific herring (*Clupea harengus*) and its prevalence in wild Puget Sound herring. Dis. Aquat. Organisms

Marty, G.D, Hinton, D. E, Kocan, R.M., Winton, J.R., Kennedy, C.J. and Farrell, A.P. 1997. Investigations of disease factors affecting declines of Pacific herring populations in Prince William Sound. *Exxon Valdez* Oil Spill Restoration Project Annual Report (Restoration Project 96162), Alaska Department of Fish and Game, Anchorage, Alaska. 114.

PROFESSIONAL CONFERENCES

SEATAC Annual Conference; San Francisco, CA. November 1997

Pathogens and Diseases of Fish in Aquatic Ecosystems; Portland, OR June 1997
Two posters: *Ichthyophonus* and VHSV in herring

EVOS Annual Workshop; January 1998
Posters from FY97 studies

Puget Sound Research Conference; March 1998, Seattle, WA
Posters on VHS and *Ichthyophonus* in herring

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

N/A

EXPLANATION OF CHANGES IN CONTINUING PROJECTS

N/A

PRINCIPAL INVESTIGATOR

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4/15 TRC
Approved TC 8-13-98

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

Budget Category:	Authorized FY 1998	Proposed FY 1999
Personnel		$0.0
Travel		$0.0
Contractual		$54.8
Commodities		$0.0
Equipment		$0.0
Subtotal	$0.0	$54.8
General Administration		$3.8
Project Total	$0.0	$58.6
Full-time Equivalents (FTE)		0.5
Other Resources	$12.0	$14.0

LONG RANGE FUNDING REQUIREMENTS

Dollar amounts are shown in thousands of dollars.

Estimated FY 2000	Estimated FY 2001	Estimated FY 2002
$0.0	$0.0	$0.0

Comments: Indirect costs include the standard overhead rates and applications for the University of Washington (26%)

USGS-BRD, Marrowstone Island Field Station provides computer stations, phones, FAX and specimen archives. On-site facilities and are being supplied to the project by USGS (equivalent value of $12K for office/equip.).

UW Fisheries provides computing and communications equipment, photography, libraries and publication service (~$14K).

FY 99

Prepared: 3/31/98
Revised: 4/13/98, JRS

Project Number: 99162A
Project Title: Manuscript Preparation of Herring Diseases
Agenct: ADFG

FORM 3A
TRUSTEE
AGENCY
SUMMARY

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1998 - September 30, 1999

Budget Category:		Proposed FFY 1999						
Personnel		$42.0						
Travel		$0.0						
Contractual		$0.5						
Commodities		$1.0						
Equipment		$0.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal		$43.5						
Indirect		$11.3						
Project Total		$54.8						
Full-time Equivalents (FTE)		0.5						
	Dollar amounts are shown in thousands of dollars.							
Other Resources	$12.0	$14.0						

Comments: Indirect costs include the standard overhead rates and applications for the University of Washington (26%)

USGS-BRD, Marrowstone Island Field Station provides computer stations, phones, FAX and specimen archives. On-site facilities and are being supplied to the project by USGS (equivalent value of $12K for office/equip.).

UW Fisheries provides computing and communications equipment, photography, libraries and publication service (~$14K).

FY 99

Prepared: 3/31/98
Revised: 4/13/98, JRS

Project Number: 99162A
Project Title: Manuscript Preparation of Herring Diseases
Name: University of Washington

FORM 4A
Non-Trustee
DETAIL

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

Personnel Costs: University of Washington School of Fisheries			Months	Monthly		Proposed
	Name	Position Description	Budgeted	Costs	Overtime	FFY 1998
	Kocan, RM	PI, author; prepare manuscripts for publication in scientific journals	6.0	7	0	42.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
		Subtotal	6.0	7	0	
					Personnel Total	$42.0

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

FY 99

Prepared: 3/31/98
Revised: 4/13/98, JRS

Project Number: 99162A
Project Title: Manuscript Preparation of Herring Diseases
Name: University of Washington

FORM 4B
Personnel
& Travel
DETAIL

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1998 - September 30, 1999

Contractual Costs:	Proposed
Description	FFY 1998
* Long distance	0.5
FAX	
photocopies	
postage	
photography	
graphics & illustrtion	
Contractual Total	**$0.5**

Commodities Costs:	Proposed
Description	FFY 1998
computer, discs	
paper	1.0
Publication costs	
Commodities Total	**$1.0**

FY 99

Prepared: 3/31/98
Revised: 4/13/98, JRS

Project Number: 99162A
Project Title: Manuscript Preparation of Herring Diseases
Name: University of Washington

FORM 4B
Contractual & Commodities DETAIL

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1998 - September 30, 1999

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

Existing Equipment Usage: Description	Number of Units
Power Mac 7600 (SOF; U.W)	1
Power Mac 7600 (Marrowstone Island Field Station)	1
specimin archive (Marrowstone Island)	N/A
FAX, phone, e-mail: UW and MI	N/A
Publication Office - U.W. SOF	1

FY 99

Project Number: 99162A
Project Title: Manuscript Preparation of Herring Diseases
Name: University of Washington

FORM 4B
Equipment
DETAIL

Prepared: 3/31/98
Revised: 4/13/98, JRS

Approved TC 8-13-98

Manuscript Preparation and Conference Attendance from 'Investigations of Disease Factors Affecting Declines of Pacific Herring Populations in Prince William Sound, AK. Section III. Effects of Environmental Contamination and Disease on Herring Fitness'.

Project number:	99162B
Restoration Category:	Research Publications and Presentations
Proposer:	Dr. Christopher J. Kennedy, Simon Fraser University
Lead Agency:	ADFG
Cooperating Agencies:	None
Duration:	1st year, 1-year project
Cost FY99:	$13,400
Geographic area:	N/A
Injured resource:	Herring

RECEIVED
APR 14 1998
EXXON VALDEZ OIL SPILL
TRUSTEE COUNCIL

ABSTRACT

This project is directed at publishing and presenting several manuscripts of the results of a previously funded Trustee Council Project 'Investigations of disease factors affecting declines of Pacific herring populations in Prince William Sound, AK. Section III. Effects of environmental contamination and disease on herring fitness'. The effects of Viral Hemorrhagic Septicemia Virus (VHSV), *Ichthyophonus hoferi* (ITP), and hydrocarbon exposure were examined to determine their role in population declines experienced by Pacific herring populations in Prince William Sound in 1993 and 1994. Both adult and juvenile herring were used to determine the effects of these stressors on ecologically relevant aspects of herring fitness which include herring biochemistry, immunocompetence, performance and reproduction. These studies have determined the time course and extent of health recovery in fish which survive exposure to hydrocarbons or disease. The results of these studies have direct implications in the management of the herring fisheries, in identifying potential monitoring tools to determine herring health in wild Pacific herring, and in understanding the relationships between environmental contamination and disease in marine fish. In order to fulfill the objectives of the funded project, i.e. to aid in the restoration of this resource, it is necessary to ensure that its results are communicated as widely as possible, both nationally and internationally. The most appropriate vehicles for the communication of these results is the publication of manuscripts in peer reviewed journals of high quality and wide readership, as well as through the presentation of results to the scientific community in appropriate conferences and proceedings.

INTRODUCTION

The Pacific herring (*Clupea harengus pallasi*) spawning population in 1989 was the largest in many years when the *Exxon Valdez* oil spill occurred in Prince William Sound (PWS). Although near-record spawning biomass returns were predicted for 1993, the population crashed when less than half of the >100,000 tons of spawning herring returned to PWS. Several hypotheses have been put forward to explain the population decline which include the direct or indirect effects of oil or its components on herring habitat, food resources or their survival and fitness. Due to the prevalence of VHSV and ITP in spawning herring sampled from Prince William Sound (PWS), these two pathogens have been considered likely to be involved in the morbidity of herring in PWS. However, from the information that had existed prior to the start of this project in 1995, there had been no definitive evidence on whether VHSV, ITP or oil exposure through the *Exxon Valdez* oil spill, or some combination of these stressors had caused a decline in herring populations.

A previously funded (1995-1998) Trustee Council project entitled 'Investigations of disease factors affecting declines of Pacific herring populations in Prince William Sound, AK. Section III. Effects of environmental contamination and disease on herring fitness' had as its main objective to determine definitive links and relationships between VHSV, ITP and hydrocarbon exposure and the morbidity, mortality, pathogenicity, and overall fitness and 'health' of Pacific herring. The results are aimed at answering questions such as 'Are herring that survive exposure to VHSV, ITP or hydrocarbons 'healthy' or are they surviving at a reduced fitness level? If full recovery occurs, what is the time frame? What are the effects of multiple stressors and recovery from such cumulative stresses?' This information has particular relevance to herring management practices such as the Pound Fishery (Roe-on-Kelp). In the absence of such information, sound management of the herring stock in PWS will be a difficult task.

NEED FOR THE PROJECT

A. Statement of Problem

Pacific herring are an injured biological resource in Prince William Sound and are classified as 'not recovered' in 1997. Population crashes in 1993 and 1994 and the lowest spawning population ever recorded in 1995, have led to both economic and environmental concerns. Reductions in herring populations has the potential to be devastating to the ecology of PWS and surrounding areas since herring are a major food resource for several trophic levels. Following population declines in herring there have been reported impacts throughout the ecosystem. Significant declines in marine bird and mammal numbers which eat forage fish have been reported in PWS. On an economic basis, because of the small population sizes, commercial fishing was severely curtailed in 1993 and closed entirely in 1994, 1995, and 1996, resulting in economic losses and lost services. Five commercial herring fisheries in PWS have an average annual combined ex-vessel value of $8.3 M. The ex-vessel value of the herring fisheries in 1992 was $12.0 M and the average annual value for the previous 10 years was $8.3M. In 1993, the ex-vessel value dropped to $2.0 M. As well, several thousand pounds of herring and herring spawn on kelp are harvested annually for subsistence purposes and form an important part of the local native culture of the Chenega and Tatitlek.

B. Rationale/Link to Restoration

The project which is being completed in FY98 will aid in restoration of this resource by determining probable causes of population decline in herring in PWS and by providing information on the health and fitness of fish and their recovery following exposure to stressors such as oil or disease. This project will also identify biomonitoring tools which can be used to monitor the health of the wild population and the effects of various fisheries management practices.

In order to fulfill the objectives of the funded project, i.e. to aid in the restoration of this resource, it is necessary to ensure that its results are communicated as widely as possible, both nationally and internationally. The most appropriate vehicles for the communication of these results is the publication of manuscripts in peer reviewed journals of high quality and wide readership, as well as through the presentation of results to the scientific community in appropriate conferences and proceedings.

C. Location

The funded project took place in Prince William Sound, AK, at the Marrowstone Biological Station, WA and at the Bamfield Marine Station, CAN. As the resource is enhanced, end users in PWS will benefit as well as others where a healthy fishery has economic spinoffs. The information gathered will be useful to the public, policy and decision makers, scientists involved in research in many areas of fisheries science, and in particular to managers for managing Pacific herring stocks in both the USA and internationally.

COMMUNITY INVOLVEMENT

The results of the funded project will be disseminated in the peer-reviewed literature and also presented at scientific workshops such as the 10th Anniversary of the Exxon Valdez Oil Spill Workshop which will be open to interested community groups and the public.

PROJECT DESIGN

A. Objectives

General Objectives:

1. To write, submit and publish four (4) peer reviewed manuscripts in respected and high quality scientific journals. The manuscripts will describe the nature of Section III (Stressor effects on herring fitness) of the previously funded Herring Disease Project, its methods, results and major conclusions.

2. To prepare two presentations of the major findings of Section III (Stressor effects on herring fitness)of the funded Herring Disease Project, and to present these findings at two meetings: a) The American Fisheries Society in July 1999, and b) The 10th Anniversary of the Exxon Valdez Workshop in January 1999.

B. METHODS

N/A

C. Cooperating Agencies, Contracts and Other Agency Assistance:

N/A

SCHEDULE

A. Measurable Project Tasks for FY 99

October 1-30:	Prepare manuscript 1.
November 1-31:	Prepare manuscript 2.
November 15:	Submit manuscript 1 to peer reviewed journal.
December 15:	Submit manuscript 2 to peer reviewed journal.
December 1-31:	Prepare presentation for at 10th Anniversary Symposium.
March 23-27:	Attend and present at 10th Anniversary Symposium.
January 2-31:	Prepare manuscript 3.
February 1-28:	Prepare manuscript 4.
February 15:	Submit manuscript 3 to peer reviewed journal.
March 15:	Submit manuscript 4 to peer reviewed journal.
April 1-30:	Prepare presentation for American Fisheries Society meeting.
July 26-30:	Attend and present at American Fisheries Society meeting.

B. Project Milestones and Endpoints

All four manuscripts will be submitted to peer reviewed journals by March 15 to ensure that publication occurs in FY99. The final conference date is July 30, 1999.

C. Completion date

The projects objectives will be met July 30 of FY 99

PUBLICATIONS AND REPORTS

The following 4 manuscripts will be written and submitted in FY99:

Manuscript 1:

Author: Kennedy, C.J.

Title: Effects of an oil-water dispersion on swimming performance and exercise recovery in juvenile Pacific herring, *Clupea harengus pallasi* .

Journal: Mar. Env. Res.

Submission date: November 15, 1998

Abstract: The swimming performance and recovery of juvenile Pacific herring from exhaustive exercise were determined following exposure to an oil-water dispersion (OWD) of North Slope crude oil. Fish were exposed to several concentrations of OWD (54 ppb, 156 ppb and 342 ppb) for either 24h, 48h or two weeks before swim trials began. Swimming performance was estimated by critical swimming speed (ucrit). Critical swimming speed was not affected by a 24 h exposure to OWD at any concentration, however, reductions in swimming performance of 16 and 32% were seen in the two highest OWD concentrations at 48h exposure. Swimming speed was affected for up to 2 weeks of exposure. High mortalities occurred in groups of fish following exhaustive exercise, although no significant differences were seen between control and exposed fish. Due to the high mortalities in the swim trials, exercise recovery was examined in fish which were subject to 'burst swimming' instead of continuous swimming. Exercise caused alterations in the following parameters: increases in plasma RBCs, plasma Hb, plasma lactate, decreases in muscle and liver glycogen levels and increases in the plasma ions Na+, Cl- and K+. In control fish, all values returned to pre-exercise levels by 24h. Recovery of fish from exercise, as measured by these parameters, was impaired in OWD-exposed fish in a dose-dependent manner. There were no significant effects of exposure duration on exercise recovery.

Manuscript 2:

Author: Kennedy, C.J.

Title: Stress responses in juvenile Pacific herring, *Clupea harengus pallasi,* exposed to an oil-water dispersion on North Slope crude oil

Journal: Can. J. Fish. Aquat. Sci.

Submission date: December 15, 1998.

Abstract: In this study, both lethal and sublethal stress responses were examined in juvenile Pacific herring, *Clupea harengus pallasi,* exposed to varying concentrations (control-undetectable, low: 57 ppb, medium: 128 ppb and high: 345 ppb total hydrocarbons) of an oil-water dispersion (OWD) of North Slope crude oil. OWD was lethal to herring in a concentration-dependent manner with the majority of fish mortalities occurring within the first 96 hours of exposure. Cumulative mortalities at 96 hours were 2%, 6%, 12%, and 15%, respectively. Herring underwent a 'classical' stress response at sublethal concentrations which involved primary (hypersecretion of corticosteroids), secondary (hyperlacticemia, hyperglycemia and reductions in liver glycogen), and tertiary (reductions in swimming performance and alterations gill morphology) effects. Alterations in herring biochemistry occurred within 1 hour of exposure to OWD, and returned to preexposure levels by 96 hours with the exception of plasma ions. Reductions in swimming performance by 16% and 37% occurred by 96 hours in the two highest concentrations, respectively, and remained impaired for up to 2 weeks. Alterations in gill morphology including minor hyperplasia and epithelial lifting were evident in fish in the two highest doses of OWD by 96 h, and persisted for at least 2 weeks. These effects were accompanied by persistent alterations in ion balance. This study indicates that exposure of

juvenile herring to the OWD of crude oil can cause a significant but transitory biochemical stress response followed by tertiary stress effects that can continue for a longer duration.

Manuscript 3:

Author: Kennedy, C.J., A. P. Farrell and S. Sanders.

Title: Alterations in the immunocompetence and disease resistance of juvenile Pacific herring exposed to the oil-water dispersion fraction of crude oil.

Journal: Aquat. Toxicol.

Submission date: February 15, 1999.

Abstract: unavailable, experiments complete, data analysis underway.

Manuscript 4:

Author: Sanders, S., C.J. Kennedy, A. P. Farrell and R. Kocan.

Title: *Ichthyophonus hoferi* and viral hemorrhagic septicemia virus infection in Pacific herring: effects on herring biochemistry and immunology.

Journal: Dis. Aquat. Organisms

Submission date: March 15, 1999.

Abstract: unavailable, experiments complete, data analysis underway.

PROFESSIONAL CONFERENCES

Two conference meetings are proposed: 1) the 10th Anniversary Workshop in AK in March 1999, and b) the American Fisheries Society, in August 1999. Attendance for the Alaska workshop will enable the communication of results to those interested in the effects of oil spills and injured resources in AK. The AFS meeting is, in our opinion the premiere toxicology meeting for investigators particularly interested in fish and fisheries and our participation at this international meeting will communicate results to a much wider scientific audience of special relevance to the protection of fish species worldwide.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

Alaska Dept. of Fish and Game will coordinate and communicate information relevant to this close-out phase of the original project to ensure fulfillment of the projects objectives.

PROPOSED PRINCIPAL INVESTIGATOR

Christopher J. Kennedy
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email: ckennedy@sfu.ca

PRINCIPAL INVESTIGATOR

Christopher J. Kennedy, Ph.D.

Dr. Kennedy is an Assistant Professor in the Department of Biological Sciences at Simon Fraser University. Dr. Kennedy has over 17 years experience in aquatic toxicology with special emphasis on fish biochemistry, immunology and physiology. He has strong research experience in subcellular, organismal and ecosystem level studies in aquatic toxicology as well as in analytical chemistry. He has produced 27 primary research publications, 4 book chapters, 11 reports under contract, and 32 published abstracts in conference proceedings. Dr. Kennedy is the principle investigator on the Trustee Council funded projects on Herring Disease #95320, 96162, 97162 and 98162. This proposal to write manuscripts and for conference travel funds is based on results of those studies.

Approved TC 8-5-98

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1998 - September 30, 1999

Budget Category:	Authorized FY 1998	Proposed FY 1999
Personnel		$0.0
Travel		$0.0
Contractual		$12.5
Commodities		$0.0
Equipment		$0.0
Subtotal	$0.0	$12.5
General Administration		$0.9
Project Total	$0.0	$13.4
Full-time Equivalents (FTE)		0.2
Other Resources		

LONG RANGE FUNDING REQUIREMENTS

Estimated FY 2000	Estimated FY 2001	Estimated FY 2002
$0.0	$0.0	$0.0

Dollar amounts are shown in thousands of dollars.

Comments:

Only 33% of allowable manscript costs allowed by the Trustee Council guidelines are requested.

This allows a savings of 67% for the project since that portion of C. Kennedy's salary is covered by S.F.U.
Indirect costs include the standard overhead rate for Simon Fraser University (30% on salaray only).

FY 99

Prepared: 4/7/98
Revised: 4/13/98, JRS

Project Number: 99162B
Project Title: Manuscript Preparation for Herring Disease Studies: Section III. Stressor Effects on Herring Fitness
Agency: ADF&G

FORM 3A
TRUSTEE
AGENCY
SUMMARY

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1998 - September 30, 1999

Budget Category:	Authorized FY 1998	Proposed FY 1999
Personnel		$8.0
Travel		$2.1
Contractual		$0.0
Commodities		$0.0
Equipment		$0.0
Subtotal	$0.0	$10.1
Indirect		$2.4
Project Total	$0.0	$12.5
Full-time Equivalents (FTE)		0.2

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

Dollar amounts are shown in thousands of dollars.

Other Resources

Comments:

FY 99

Project Number: 99162B
Project Title: Manuscript Preparation for Herring Disease Studies: Section III. Stressor Effects on Herring Fitness
Name: Simon Fraser University
Agency: ADF&G

FORM 4A
Non-Trustee
SUMMARY

Prepared: 4/7/98
Revised: 4/13/98, JRS

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

Personnel Costs:			Months	Monthly		Proposed
	Name	Position Description	Budgeted	Costs	Overtime	FY 1999
	Kennedy, C. J.	PI, manuscript preparation and submission, conference presenter	2.0	4.0		8.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
		Subtotal	2.0	4.0	0.0	
					Personnel Total	$8.0

Travel Costs:		Ticket	Round	Total	Daily	Proposed
	Description	Price	Trips	Days	Per Diem	FY 1999
	Kennedy attends 10th Annual Workshop:	0.6	1	5	0.1	1.1
	Vancouver, BC, Canada to Anchorage, RT					0.0
						0.0
	Kennedy attends AFS conference:	0.6	1	4	0.1	1.0
	Vancouver, BC, Canada to Hartford, RT					0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
					Travel Total	$2.1

FY 99

Prepared: 4/7/98
Revised: 4/13/98, JRS

Project Number: 99162B
Project Title: Manuscript Preparation for Herring Disease Studies:
Section III. Stressor Effects on Herring Fitness
Name: Simon Fraser University
Agency: ADF&G

FORM 4B
Personnel
& Travel
DETAIL

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1998 - September 30, 1999

Contractual Costs:	Proposed
Description	FY 1999
Contractual Total	$0.0

Commodities Costs:	Proposed
Description	FY 1999
Commodities Total	$0.0

FY 99

Prepared: 4/7/98
Revised: 4/13/98, JRS

Project Number: 99162B
Project Title: Manuscript Preparation for Herring Disease Studies: Section III. Stressor Effects on Herring Fitness
Name: Simon Fraser University
Agency: ADF&G

FORM 4B
Contractual & Commodities DETAIL

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1998 - September 30, 1999

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

Existing Equipment Usage:	Number
Description	of Units
Computers and software	2
Scanner	1
Photography for illustrations	1

FY 99

Project Number: 99162B
Project Title: Manuscript Preparation for Herring Disease Studies: Section III. Stressor Effects on Herring Fitness
Name: Simon Fraser University
Agency: ADF&G

FORM 4B
Equipment
DETAIL

Prepared: 4/7/98
Revised: 4/13/98, JRS