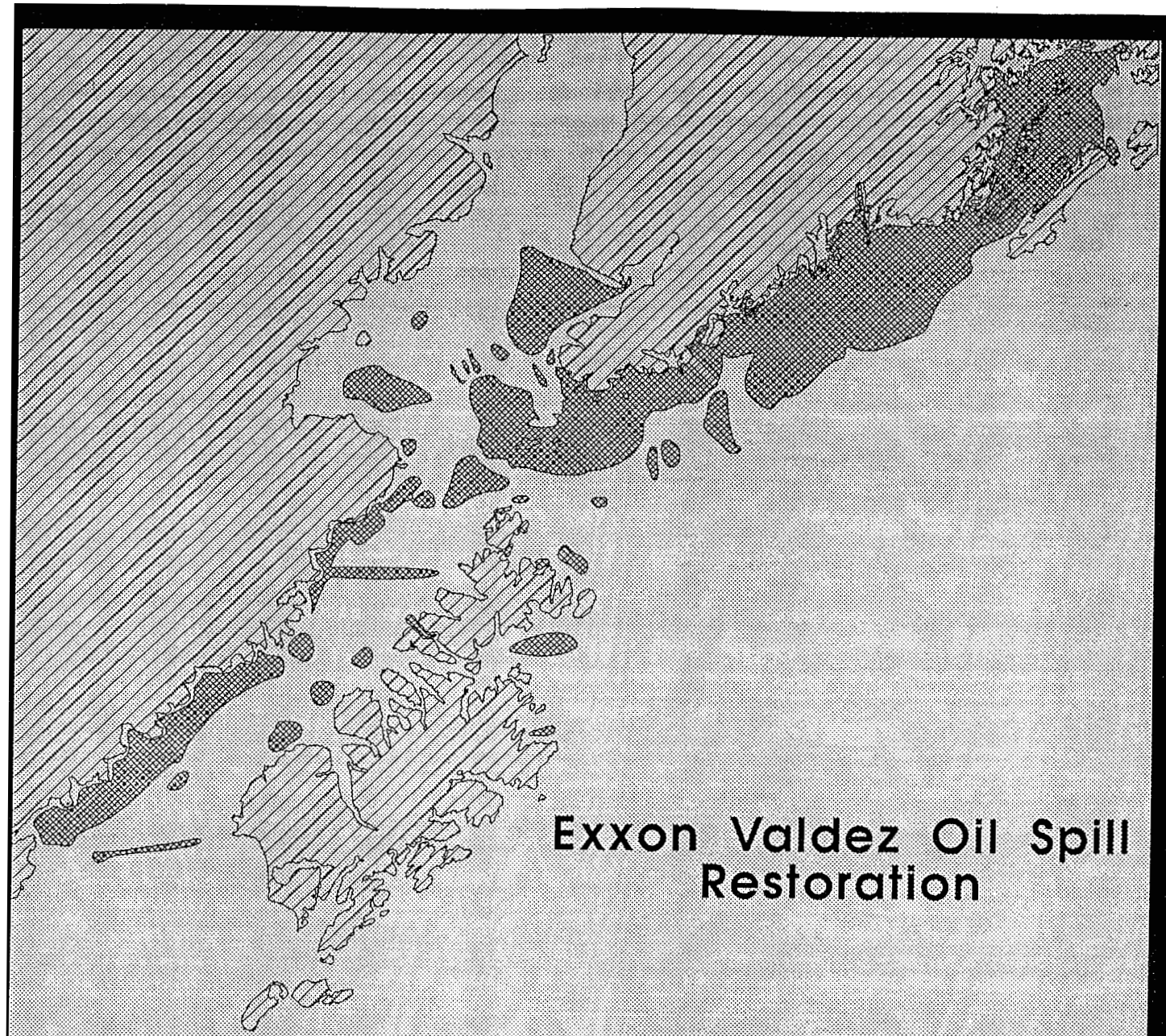


Exxon Valdez Oil Spill Restoration

1993 FINAL WORK PLAN

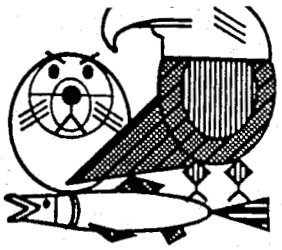
Prepared by:
Exxon Valdez Oil Spill Trustees
645 "G" Street
Anchorage, Alaska
99501
(907) 278-8012

July 1993

State of Alaska: Departments of Fish & Game, Law, and Environmental Conservation
United States: NOAA, Departments of Agriculture and Interior

Exxon Valdez Oil Spill Trustee Council

Restoration Office
645 G Street, Suite 402, Anchorage, Alaska 99501
Phone: (907) 278-8012 Fax: (907) 276-7178



July 22, 1993

Dear Concerned Citizen:

The following is the 1993 Final Work Plan as approved by the *Exxon Valdez* Oil Spill Trustee Council.

The 1993 Work Plan Summary Recommendation Matrix reveals the decisions and the amounts approved by the Trustee Council for each project. Also included are the 3-page project descriptions for the approved projects.

If you have any comments or questions regarding the 1993 Final Work Plan, please contact:

Exxon Valdez Restoration Office
645 G Street Suite 402
Anchorage AK 99501
(907) 278-8012

Sincerely,

Dave R. Gibbons, Ph.D.
Interim Administrative Director

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1993 WORK PLAN

SUMMARY RECOMMENDATION MATRIX

INCLUDING TRUSTEE COUNCIL ACTIONS

PROJECT Number and Brief Description	RESTORATION TEAM Recommended/ Not Recommended	CHIEF SCIENTIST Recommended/ Not Recommended	PUBLIC ADVISORY GROUP Recommended/ Not Recommended	TRUSTEE COUNCIL ACTION Approved/ Not Approved/ Withdrawn	APPROVED '93 BUDGET INFORMATION
93002 - Sockeye Overescapement	Recommended Y-5 N-1	Recommended	Recommended Y-9 N-5	Approved [1]	$ 714,600
93003 - Pink Salmon Egg to Pre-emergent Fry Survival in PWS	Unanimously Recommended	Recommended	Unanimously Recommended	Approved	$ 686,000
93004 - Documentation, Enumeration and Preservation of Genetically Discrete Wild Populations of Pink Salmon Impacted by EVOS in PWS	Recommended Y-5 N-1	Enhancement Project	Recommended Y-8 N-3 A-2	Not Approved	------

[1] Approved contingent upon review of potential modifications resulting from sockeye synthesis (peer review) meeting in March and a detailed review of the overall budget by ADF&G and discussion at the next Trustee Council meeting. Only essential commitments should be expended until that time.

PROJECT Number and Brief Description	RESTORATION TEAM Recommended/ Not Recommended	CHIEF SCIENTIST Recommended/ Not Recommended	PUBLIC ADVISORY GROUP Recommended/ Not Recommended	TRUSTEE COUNCIL ACTION Approved/ Not Approved/ Withdrawn	APPROVED '93 BUDGET INFORMATION
93005 - Cultural Resources, Information, Education and Interpretation	Unanimously Recommended	No Opinion	Recommended with Qualifications	Not Approved	------
93006 - Site-Specific Archeological Restoration	Unanimously Recommended	Recommended	Recommended with Qualifications	Approved	$ 260,100
93007 - Archeological Site Stewardship Program	Unanimously Recommended	No Opinion	Recommended with Qualifications	Not Approved	------
93008 - Archeological Site Patrol and Monitoring	Unanimously Recommended	No Opinion	Recommended with Qualifications	Not Approved	------
93009 - Public Information, Education and Interpretation	Recommended Y-5 N-1	No Opinion	Recommended with Qualifications	Not Approved	------
93010 - Reduce Disturbance Near Murre Colonies Showing Indications of Injury From the EVOS	Not Recommended Tie Vote Y-3 N-3	Recommended	Unanimously Not Recommended	Not Approved	------
93011 - Develop Harvest Guidelines to Aid Restoration of River Otters and Harlequin Ducks	Recommended Y-5 N-1	Recommended	Recommended Y-9 N-3 A-1	Not Approved	------

PROJECT Number and Brief Description	RESTORATION TEAM Recommended/ Not Recommended	CHIEF SCIENTIST Recommended/ Not Recommended	PUBLIC ADVISORY GROUP Recommended/ Not Recommended	TRUSTEE COUNCIL ACTION Approved/ Not Approved/ Withdrawn	APPROVED '93 BUDGET INFORMATION
93012 - Genetic Stock Identification of Kenai River Sockeye Salmon	Recommended Y-5 N-1	Recommended	Unanimously Recommended Look at reducing budget combine with 93015	Approved[1]	$ 300,600
93014 - Quality Assurance for Coded-Wire Tag Application in Fish Restoration Projects	Not Recommended Tie Vote Y-3 N-3	Enhancement Project	Unanimously Not Recommended	Withdrawn	-----
93015 - Kenai River Sockeye Salmon Restoration	Recommended Y-5 N-1	Recommended	Unanimously Recommended Look at reducing budget	Approved[1]	$ 732,600

[1] Approved contingent upon review of potential modifications resulting from sockeye synthesis (peer review) meeting in March and a detailed review of the overall budget by ADF&g and discussion at the next Trustee Council meeting. Only essential commitments should be expended until that time.

PROJECT Number and Brief Description	RESTORATION TEAM Recommended/ Not Recommended	CHIEF SCIENTIST Recommended/ Not Recommended	PUBLIC ADVISORY GROUP Recommended/ Not Recommended	TRUSTEE COUNCIL ACTION Approved/ Not Approved/ Withdrawn	APPROVED '93 BUDGET INFORMATION
93016 - Chenega Chinook and Coho Salmon Release Program	Recommended Y-5 N-1	No Opinion	Unanimously Recommended Increase budget to $50.9K to cover Hatchery costs	Funded $10,000 for NEPA Compliance 3/10/93	Include in Draft 1994 Work Plan
93017 - Subsistence Food Safety Survey and Testing Restoration Project	Unanimously Recommended	No Opinion	Unanimously Recommended More local community involvement	Approved with Modifications Remove $53.5 for Transportation Costs	$ 307,100
93018 - Enhanced Management for Wild Stocks in PWS, Special Emphasis on Cutthroat Trout and Dolly Varden	Recommended Y-5 N-1	Not Recommended	Unanimously Recommended	Not Approved	-----
93019 - Chugach Region Village Mariculture Project	Unanimously Not Recommended	Not Recommended	Recommended Y-8 N-4 Contingent upon legal approval	Not Approved	-----

PROJECT Number and Brief Description	RESTORATION TEAM Recommended/ Not Recommended	CHIEF SCIENTIST Recommended/ Not Recommended	PUBLIC ADVISORY GROUP Recommended/ Not Recommended	TRUSTEE COUNCIL ACTION Approved/ Not Approved/ Withdrawn	APPROVED '93 BUDGET INFORMATION
93020 - Bivalve Shellfish Hatchery and Research Center	Not Recommended Tie Vote Y-3 N-3	Recommended Closer Study for Feasibility	Unanimously Recommended Contingent upon legal review	Not Approved	------
93022 - Evaluating the Feasibility of Enhancing Productivity of Murres by Using Decoys, Dummy Eggs and Recordings of Murre Calls to Simulate Normal Densities at Breeding Colonies Affected by EVOS and Monitoring the Recovery of Murres in the Barren Islands	Unanimously Recommended	Recommended	Unanimously Not Recommended	Approved Monitoring Component only	$ 177,200
93024 - Restoration of the Coghill Lake Sockeye Salmon Stock	Recommended Y-5 N-1	Enhancement Project	Unanimously Recommended	Approved	$191,900
93025 - Montague Island Chum Salmon Restoration	Recommended Y-5 N-1	Enhancement Project	Unanimously Recommended	Not Approved	------
93026 - Fort Richardson Hatchery Water Pipeline	Not Recommended Tie Vote Y-3 N-3	No Opinion	Recommended Y-9 N-4	Not Approved	------

PROJECT Number and Brief Description	RESTORATION TEAM Recommended/ Not Recommended	CHIEF SCIENTIST Recommended/ Not Recommended	PUBLIC ADVISORY GROUP Recommended/ Not Recommended	TRUSTEE COUNCIL ACTION Approved/ Not Approved/ Withdrawn	APPROVED '93 BUDGET INFORMATION
93028 - Restoration and Mitigation of Wetland Habitats for Injured PWS Fish and Wildlife Species	Recommended Y-5 N-1	Enhancement Project	Not Recommended Y-3 N-8	Not Approved	-----
93029 - PWS Second Growth Management	Recommended Y-5 N-1	Enhancement Project	Tie Vote Y-5 N-5 A-1	Withdrawn	-----
93030 - Red Lake Restoration	Recommended Y-5 N-1	Recommended	Unanimously Recommended	Deferred until 3/29/93 meeting	Approved pending NEPA Compliance
93031 - Red Lake Mitigation for Red Salmon Fishery	Recommended Y-5 N-1	No Opinion	Recommended Y-10 N-1 A-2	Not Approved	-----
93032 - Pink and Cold Creek Pink Salmon Restoration	Recommended Y-5 N-1	Enhancement Project	Recommended Y-12 N-1 Consult w/ Landowner	Not Approved	-----
93033 - Harlequin Duck Restoration Monitoring Study in PWS, Kenai and Afognak Oil Spill Areas	Unanimously Recommended	Recommended	Unanimously Recommended	Approved at Reduced Level	$ 300,000
93034 - Pigeon Guillemot Colony Survey	Recommended Y-5 N-1	Recommended	Unanimously Recommended	Approved	$ 165,800

PROJECT Number and Brief Description	RESTORATION TEAM Recommended/ Not Recommended	CHIEF SCIENTIST Recommended/ Not Recommended	PUBLIC ADVISORY GROUP Recommended/ Not Recommended	TRUSTEE COUNCIL ACTION Approved/ Not Approved/ Withdrawn	APPROVED '93 BUDGET INFORMATION
93035 - Potential Impacts of Oiled Mussel Beds on Higher Organisms: Contamination of Black Oystercatchers Breeding on Persistently Oiled Sites in PWS	Unanimously Recommended	Recommended	Unanimously Recommended	Approved	$ 107,900
93036 - Recovery Monitoring and Restoration of Intertidal Oiled Mussel Beds in PWS and the GOA Impacted by EVOS	Unanimously Recommended	Recommended	Unanimously Recommended	Approved	$ 404,800
93038 - Shoreline Assessment	Unanimously Recommended	Recommended	Unanimously Recommended	Approved	$ 539,200[2]
93039 - Herring Bay Experimental and Monitoring Studies	Unanimously Recommended	Recommended	Recommended Y-12 N-0 A-1 Look at reducing budget	Approved	$ 507,500
93041 - Comprehensive Restoration Monitoring Program Phase 2: Monitoring Plan Development	Unanimously Recommended	Recommended	Recommended Y-8 N-4 A-1	Approved	$ 237,900

[2] This includes $15,000 for U.S. Coast Guard travel.

PROJECT Number and Brief Description	RESTORATION TEAM Recommended/ Not Recommended	CHIEF SCIENTIST Recommended/ Not Recommended	PUBLIC ADVISORY GROUP Recommended/ Not Recommended	TRUSTEE COUNCIL ACTION Approved/ Not Approved/ Withdrawn	APPROVED '93 BUDGET INFORMATION
93042 - Recovery Monitoring of PWS Killer Whales Injured by EVOS Using Photo Identification Techniques	Recommended Y-4 N-2 At the request of the Trustee Council	Enhancement Project	Unanimously Recommended	Approved	$ 127,100
93043 - Sea Otter Population Demographics and Habitat Use in Areas Affected by EVOS	Recommended Y-5 N-1	Recommended with reduced budget	Recommended Look at contracting Y-8 N-5	Approved	$ 291,900
93045 - Surveys to Monitor Marine Bird and Sea Otter Populations in PWS During Summer and Winter	Unanimously Recommended	Recommended	Previously Approved by Trustee Council	Previously Approved 12/11/92	$ 262,400
93046 - Habitat Use, Behavior and Monitoring of Harbor Seals in PWS, Alaska	Unanimously Recommended	Recommended	Unanimously Recommended Look at more local involvement	Approved	$ 230,500
93047 - Subtidal Monitoring: Recovery of Sediments, Hydrocarbon-degrading Microorganisms, Eelgrass Communities and Fish in the Shallow Subtidal Environment	Unanimously Recommended	Recommended	Recommended Y-12 N-0 A-1 Look at reducing costs	Approved	$ 1,000,800

PROJECT Number and Brief Description	RESTORATION TEAM Recommended/ Not Recommended	CHIEF SCIENTIST Recommended/ Not Recommended	PUBLIC ADVISORY GROUP Recommended/ Not Recommended	TRUSTEE COUNCIL ACTION Approved/ Not Approved/ Withdrawn	APPROVED '93 BUDGET INFORMATION
93050 - Update: Restoration Feasibility Study #5 (Identification and Recordation of Information Sources Relevant to Land and Resources Affected by EVOS)	Not Recommended Tie vote Y-3 N-3	Recommended	Agency will do work with existing in-house funding	Withdrawn	------
93051 - Habitat Protection Information for Anadromous Streams and Marbled Murrelets	Unanimously Recommended	Recommended with removal of channel typing	Recommended with removal of channel typing portion Y-9 N-4	Approved	$ 1,222,300
93052 - Identification and Protection of Important Bald Eagle Habitats	Unanimously Not Recommended	Not Recommended	Not Recommended Y-3 N-8	Withdrawn	------
93053 - Hydrocarbon Data Analysis, Interpretation and Database Maintenance for Restoration and NRDA Environmental Samples Associated with the EVOS	Unanimously Recommended	Recommended	Unanimously Recommended	Approved	$ 105,500
93057 - Damage Assessment GIS	Unanimously Recommended	Recommended	Unanimously Recommended	Approved	$ 67,500
93059 - Habitat Identification Workshop	Unanimously Recommended	Recommended	Previously approved by the Trustee Council	Previously Approved 12/11/92	$ 42,300

PROJECT Number and Brief Description	RESTORATION TEAM Recommended/ Not Recommended	CHIEF SCIENTIST Recommended/ Not Recommended	PUBLIC ADVISORY GROUP Recommended/ Not Recommended	TRUSTEE COUNCIL ACTION Approved/ Not Approved/ Withdrawn	APPROVED '93 BUDGET INFORMATION
93060 - Accelerated Data Acquisition	Unanimously Recommended	Recommended	Previously approved by the Trustee Council	Previously Approved 12/11/92	$ 43,900
93061 - New Data Acquisition	Unanimously Recommended	Recommended	Recommended Y-11 N-2	Rolled into 93064	----
93062 - Restoration GIS	Unanimously Recommended	Recommended	Unanimously Recommended	Approved	$ 123,300
93063 - Survey and Evaluation of Instream Habitat and Stock Restoration Techniques for Anadromous Fish	Unanimously Recommended	Enhancement Project	Unanimously Recommended	Approved	$ 59,400
93064 - Habitat Protection Fund	Unanimously Recommended	Recommended	Recommended PAG request review before acquiring parcels Y-10 N-1 A-2	Approved[3,4]	$20,000,000

[3] Now includes 93061.

[4] Funds for Kachemak Purchase included in the Project.

PROJECT Number and Brief Description	RESTORATION TEAM Recommended/ Not Recommended	CHIEF SCIENTIST Recommended/ Not Recommended	PUBLIC ADVISORY GROUP Recommended/ Not Recommended	TRUSTEE COUNCIL ACTION Approved/ Not Approved/ Withdrawn	APPROVED '93 BUDGET INFORMATION
93065 - Prince William Sound Recreation Plan			None	Approved 3/10/93	$ 71,000
93066 - Kodiak Archeological Artifact Repository	Not Recommended		Unanimously Recommended	Approved 3/10/93	$ 1,500,000
93067 - Pink Salmon Coded-Wire Tag				Approved 5/13/93	$ 150,000[5] plus 70,000[6] total $220,000
93068 - Coded-Wire Tag Recoveries in Chinook, Sockeye, Chum, and Coho Salmon				Approved 6/2/93	$ 126,400

[5] Funds to be transferred from project 93015.

[6] Approved additional $70,000 on June 2, 1993. Funds to be also transferred from project 93015.

PROJECT Number and Brief Description	RESTORATION TEAM Recommended/ Not Recommended	CHIEF SCIENTIST Recommended/ Not Recommended	PUBLIC ADVISORY GROUP Recommended/ Not Recommended	TRUSTEE COUNCIL ACTION Approved/ Not Approved/ Withdrawn	APPROVED '93 BUDGET INFORMATION
93 AD - Administrative Director's Office	Unanimously Recommended	------	Increase Public Advisory Group Budget to $225,000	Approved Long-Term contracts and 3 months funding for the rest pending further Trustee Council Review	$ 1,702,200
93 FC - Finance Committee	Unanimously Recommended	------	------		$ 105,200
93 RT - Restoration Team Support	Unanimously Recommended	------	------		$ 2,328,400

1993 Additional Projects
Recommended by the
Public Advisory Group
on 1/7/93

	Project	Cost	
1.	Planning for expansion of the Kodiak Industrial Technology Center Public Idea #310 VOTE: Y-7 N-4 A-1	$ 100,000	Not approved
2.	First phase construction of a Kodiak Archeological Museum Public Idea #298-17 VOTE: Unanimously Recommended	1,500,000	Approved 3/10/93[1]
3.	Prince William Sound Herring Damage Assessment Vote: Unanimously Recommended	237,889	Not approved
4.	Prince William Sound Pink Salmon Coded Wire Tag Project Vote: Y-7 N-4	773,600	Not approved
5.	Prince William Sound Chum, Sockeye, Coho and Chinook Salmon Coded Wire Tag Project VOTE: Y-9 N-2	249,590	Not approved
	TOTAL	$ 2,861,079	

[1] See project 93066 in previous table.

EXXON VALDEZ OIL SPILL PROJECT DESCRIPTION

Project Number: 93002

Project Title: Sockeye Overescapement

Project Category: Damage Assessment

Project Type: Fish and Shellfish

Lead Agency: Alaska Department of Fish and Game

Cooperating Agencies: U.S. Fish and Wildlife Service

Project Term: October 1, 1992 to September 30, 1993

INTRODUCTION

A. Background

The sockeye salmon resources of Kodiak Island lakes affected by overescapement comprise approximately 20% of the Kodiak Island long-term commercial sockeye salmon harvest. The Kenai River sockeye salmon lakes affected by the *Exxon Valdez* oil spill (EVOS) are the major income producers for commercial fishermen in Cook Inlet. Sockeye salmon spawn in lakes associated with river systems. Adult salmon serve an important role in the ecosystem, providing food for marine mammals, terrestrial mammals, and birds. Additionally, carcass decomposition serves to charge freshwater lake systems with important nutrients. Juvenile salmon, which rear in lakes for one or two years, serve as a food source for a variety of fish and mammals. Sockeye salmon are also an important subsistence, sport, and commercial species. The ex-vessel value of the commercial catch of sockeye from these lake systems has averaged about $42 million per year since 1979, with the 1988 catch worth $115 million. Sockeye salmon returns to the Kenai River system support some of the largest recreational fisheries in the State.

B. Summary of Injury

Commercial fishing for sockeye salmon in 1989, was curtailed in upper Cook Inlet, the outer Chignik districts, and the Kodiak areas due to presence of oil in the fishing areas from the EVOS. As a result, the number of sockeye salmon entering four important sockeye-producing systems (Kenai/Skilak, Chignik/Black, Red, and Frazer Lakes) and two less important lake systems (Akalura and Afognak or Litnik lakes) greatly exceeded levels that are thought to be most productive.

Overly large spawning escapements may result in poor returns by producing more rearing juvenile sockeye than can be supported by the nursery lake's productivity (Kyle et al. 1988). In general, when rearing fish abundance greatly exceeds the lake's carrying capacity, prey (zooplankton) are altered by changes in species and size composition (Mills and Schiavone 1982, Koenings and Burkett 1987, Kyle et al. 1988) and concomitant effects on all trophic levels can occur (Carpenter et al. 1985). Because of such changes, juvenile sockeye growth is reduced, mortality increases, larger percentages holdover for another year of rearing; and the poor quality of smolts increases

marine mortality. Where escapements are two to three times normal levels, the resulting high juvenile densities crop the prey resources to the extent that more than one year is required to return to normal productivity. Rearing juveniles from subsequent brood years suffer from both the poor quality of forage and from the increased competition for food by holdover juveniles (Townsend 1989; Koenings and Kyle 1991). This is the brood year interaction underlying cyclic variation in the year class strength of anadromous fish. Smolt production from the Kenai River in 1991 was extremely low as was production of smolt from Red Lake. In the spring of 1992, the Kenai River smolt estimates dropped by another order of magnitude, suggesting severe declines in sockeye salmon returns in future years. Counts of smolt migration in Red River (on Kodiak Island) were relatively higher in 1992, but still insufficient to provide an average return for this system. The effects of overescapement can cause continued adversity because of multiple-year impacts on the zooplankton community or other critical juvenile life-history habitat components. Consequently, damage assessment studies require continuation until the juvenile sockeye salmon habitat is restored or naturally recovers.

C. Location

The studies to be conducted on the Kenai Peninsula include the Tustumena and Kenai River lake systems. In addition, studies will continue on Kodiak Island to assess the damage to the Red Lake system with Upper Station Lake acting as a control.

WHAT

A. Goals

The goal of these studies is to determine the impacts of the overescapement of 1989 that was associated with fishery closures due to the EVOS. The studies have specifically focused on Red Lake and the major rearing lakes of the Kenai River system. Study activities include the enumeration of smolt production and sampling of smolt population characteristics, and monitoring of subsequent adult returns from these systems as well as measuring the changes in the rearing habitat of the effected lakes and nearby unaffected lake systems. A secondary benefit of these studies may be to provide insight as to what, if anything, can facilitate rapid recovery of these systems.

B. Objectives

1. Estimate the number, age, and size of sockeye salmon juveniles rearing in selected freshwater systems.

2. Estimate the number, age, and size of sockeye salmon smolts migrating from selected freshwater systems.

3. Determine effects of large escapements resulting from fishery closures caused by the EVOS on the rearing capacity of selected nursery lakes through:

    a. Analysis of age and growth of juveniles and smolts
    b. Examination of nutrient budgets and plankton populations.

4. In addition, evaluation of diel vertical migration induced by sockeye salmon

predation on subsequent growth and survival of juvenile sockeye will be made. Also, assessment of the role of egg-bearing copepods as an essential diet component of sockeye salmon juveniles in glacial lakes will be conducted.

WHY

Before any mitigation and restoration of sockeye salmon in the effected lakes can be undertaken, the extent and cause of damage needs to be established. The resource in question has major implications for the commercial fishing industry on Kodiak Island and in Cook Inlet, where sockeye salmon provide the major source of income. In addition, heavy use of the Kenai River by subsistence, personal use, and sport fishermen has much importance to the Alaskan economy.

To restore lost resources it is essential that a clear understanding of damages be assessed. In the case of overescapement, a lake may require many years to recover, as the extent of damage may persist. Thus, to prevent recurrence and compounding damage, and to expedite natural restoration of the system, an understanding of the mechanism is essential.

HOW

From early May to early July, two inclined plane traps will be operated daily in the outlet stream of Red Lake about one mile below the lake's outlet. The catch will be counted by species, and sockeye smolts will be sampled daily for age, length, weight, and condition factor. Each week, 500 sockeye smolts will be marked (biologically inert dye), and released about 0.5 mile above the traps to determine trap efficiency. A similar operation will occur at Upper Station Lake which is the study control. This project will also provide support for the assessment conducted by FRED Division (fall fry tow netting) of pre-smolt sockeye rearing conditions (biomass and growth data) in Red and Upper Station Lakes.

On the Kenai River, expanded smolt enumeration is proposed for the lower river through increased marking and recovery effort. In addition, coded-wire tagging of smolts is proposed on the Moose River and a smolt project is planned for the Russian River system.

Limnology studies will continue on Upper Station and Red lakes on Kodiak, the major lakes of the Kenai River (Skilak and Kenai lakes), and on Tustumena Lake which is the control for the Kenai system. In addition, an optical plankton counter will be used to assist in determining the effects of predator-induced diel vertical migration in Skilak Lake. These studies will be coupled with expanded tow netting on Skilak and Kenai Lake to obtain juvenile sockeye salmon specimens throughout their rearing cycle in freshwater. Water quality and physical measurements from all of the lakes will continue to be monitored. Disease screening of fish specimens is also planned.

ENVIRONMENTAL COMPLIANCE

None of the proposed projects are intrusive. They involve collection of data and do not affect fish and wildlife populations or their habitat.

WHEN

The studies are continuous and will most likely continue beyond the end of the upcoming fiscal year (September 30, 1993). The studies will terminate when the sockeye salmon populations or their habitat recover to pre-spill conditions. Progress reports and interim findings will be released annually in a progress report issued in late November. Major discoveries are issued through news releases or through scientific publication.

BUDGET ($K)

	ADF&G
Personnel	$ 465.1
Travel	7.5
Contractual	63.9
Commodities	54.7
Equipment	20.5
Capital Outlay	0.0
Sub-total	611.7
General Administration	74.1
Project Total	$ 685.8

EXXON VALDEZ OIL SPILL PROJECT DESCRIPTION

Project Number: 93003

Project Title: Pink Salmon Egg to Pre-emergent Fry Survival in Prince William Sound

Project Category: Damage Assessment/Restoration Monitoring

Project Type: Fish and Shellfish

Lead Agency: Alaska Department of Fish and Game

Cooperating Agencies: National Marine Fisheries Service (NOAA)

Project Term: March 1, 1992 to July 30, 1995

INTRODUCTION

Each year approximately one-half billion wild pink salmon fry emerge from the streams of Prince William Sound (PWS) and migrate seaward. Adult returns of wild pink salmon to PWS average from 10-15 million fish annually. These huge outmigrations of wild pink salmon and subsequent adult returns play a major role in the PWS ecosystem. Both juveniles and adults are important sources of food for many fish, birds, and mammals. Adults returning from the high seas also convey needed nutrients and minerals from the marine ecosystem to estuaries, freshwater streams, and terrestrial ecosystems. Wild pink salmon also play a major role in the economy of PWS because of their contribution to commercial, sport, and subsistence fisheries in the area.

Up to 75% of pink salmon spawning in PWS occurs in intertidal areas. In the spring of 1989, oil from the *Exxon Valdez* oil spill (EVOS) was deposited in layers of varying thickness in intertidal portions of many western PWS streams utilized by spawning salmon. Pink salmon eggs and fry rearing in these intertidal areas appear to have been adversely affected by the oil. Salmon egg mortalities were 70%, 65%, and 115% higher in oiled streams than in comparable and nearby unoiled streams in 1989, 1990, and 1991. Differences between oiled and unoiled streams in 1989 and 1990 were confined to intertidal spawning areas and may be attributed to direct lethal effects of oil. Large differences observed across all tide zones in 1991 may be the consequence of damage to germ cells of the adults which originated from the 1989 brood year when egg and larval exposures to intertidal oil were greatest. A consequence of this genetic damage may be persistent functional sterility and reduced returns per spawner for populations from oiled streams.

The proposed damage assessment and resource monitoring study will consist of field and laboratory studies conducted in western PWS and additional laboratory studies at the National Marine Fisheries Service (NMFS) Research facility at Little Port Walter in southeastern Alaska. The majority of project funds will be spent to support the portion of the project located in PWS and will contribute to the local economy of Cordova. Results of the project will direct future restoration efforts for pink salmon and may impact future harvest management strategies in PWS fisheries.

WHAT

A. Goal

The project will continue to monitor egg mortalities in the oiled and unoiled wild pink salmon streams previously studied, examine stream characteristics unrelated to oiling which may partially or completely explain observed mortality differences, and provide laboratory verification that field results observed for eggs in 1989, 1990 are consistent with lethal effects of oil contamination of intertidal pink salmon spawning habitat. The laboratory verification experiment will also test the hypothesis that oil contamination during incubation can result in functional sterilization of exposed animals at sexual maturity and may explain the persistence of higher egg mortalities observed in all tide zones of oiled streams in 1991.

B. Objectives

The specific objectives of the project are as follows:

1. Estimate the density, by tide zone, of eggs and pre-emergent fry in 31 streams using numbers of live and dead eggs and fry.

2. Estimate egg mortality and overwinter survival of pink salmon eggs in the oiled and unoiled streams among the 31 sampled.

3. Determine whether the increased pink salmon egg mortalities observed in oiled streams in 1989, 1990, and 1991 can be attributed to the physical characteristics of the study streams.

4. Determine survival, genetic damage, hydrocarbon uptake, mixed function oxidase activity, and sublethal teratogenic effects from long-term exposures to oil in each of two exposure groups:
    a. Green eggs to eyeing, and
    b. Green eggs to swim-up.

5. Determine survival, genetic damage, hydrocarbon uptake, and mixed function oxidase activity from long-term exposures of juvenile pink salmon fed oil-contaminated food.

6. Determine growth characteristics from each exposure group from juvenile stage to maturity.

7. Assess whether differences exist among exposure groups with respect to fecundity, fertilization rate, genetic damage, and sublethal teratogenic effects in the second generation progeny through swim-up.

8. Compare lab study with field observations:
    a. Determine if the elevated egg mortalities in 1989 and 1990 were potentially caused by oiling in the environment.

b. Determine if the elevated egg mortalities in oiled streams in 1991 were potentially caused by genetic damage to 1989 eggs.

WHY

Information from this study will provide resource managers insight to the magnitude and persistence of damages sustained by wild pink salmon due to EVOS. Efforts to restore damaged pink salmon populations depend upon the ability to identify sources of reduced survival and to monitor their persistence. Information on the potential of oil exposures causing genetic damage is needed so spawning escapement goals can be reevaluated and adjusted if necessary. Verification of the genetic hypothesis would also provide the first evidence that reproductive capacity of fish exposed to chronic or acute sources of oil pollution would be compromised.

HOW

A. Field Studies

A systematic sampling program stratified by stream and tide zone will be used to collect egg and fry density and survival data from 11 oiled and 14 unoiled sites sampled previously in *NRDA* Fish/Shellfish Study 2, *Injury to Salmon Eggs and Fry in PWS.* Sampling will consist of egg-digs conducted in late September and early October, and fry-digs conducted in mid-March. Egg and pre-emergent fry data will be summarized by date, stream, level of hydrocarbon impact, stream zone, and number of live and dead eggs and fry. Density estimates will be used to assess adult spawning success. Relative numbers of live and dead eggs and fry will be used to test for continued reductions in survival in oiled streams.

B. Laboratory Study 1

Intra-stream crosses will be made using within stream pools of randomly combined gametes from six oiled and six unoiled streams from southwestern PWS. Eggs from the crosses will be incubated through hatching in a controlled laboratory environment. Egg mortalities will be compared for all crosses. Crossing results will be compared to results from field studies to determine the effect of stream characteristics on egg mortality differences previously observed between oiled and unoiled sites.

C. Laboratory Study 2

This study consists of three experiments. The first will examine the effects of six levels of intertidal gravel oil contamination and two durations of exposure on responses to various life history stages of cultured eggs and fry. Responses measured in the first generation will include survival to eyeing, survival to emergence, hydrocarbon uptake, survival to maturity, growth to maturity, and fecundity. Responses measured in the second generation will include fertilization rate and number of defective progeny. Samples for use in genetic analyses will be collected from first generation eyed eggs, emergent fry, juveniles, and mature adults. Genetic analyses will include flow cytometry methods and examination of metaphase germ cells. Second generation eyed eggs and emergent fry will be similarly sampled. The second experiment will determine if cultured fish fed oiled food for 6 weeks experience genetic damage and reduced gamete viability.

Treatments will consist of 6 concentrations of oil in the feed (1 control and 5 different oil levels). Biological responses to be measured between emergence and the first 6 weeks of feeding will include growth, survival, hydrocarbon concentration, chromosome damage, and MFO incidence. Subsequent response measurements will include growth to maturity, fecundity, fertilization rate and number of defective progeny. Flow cytometry samples and samples for examination of metaphase cells will be taken after the first 6 weeks and will mirror those taken in the first experiment. The third experiment will determine if there is evidence of differential gamete survival to emergence between ten randomly paired families of cultured fish for five different treatment regimes. The treatments will be a combination of oiling concentrations from study 1 (Ci) and duration of exposure as follows:

1. Control,
2. C_2 through eyeing,
3. C_2 through emergence,
4. C_4 through eyeing, and
5. C_4 through emergence.

The fertilized gametes from ten randomly selected pairs of pink salmon (family) will be divided into aliquots, each aliquot will be randomly assigned one of the five treatments (3 aliquots per treatment). Ten family groups will be created and assigned in this manner. Individual aliquots will be incubated in pipe incubators and all fish culture practices will be randomized between families. Families will be incubated until emergence when they will be inspected, counted, and terminated.

ENVIRONMENTAL COMPLIANCE

Egg and pre-emergent fry sampling will require an ADF&G Title 16 Permit and an ADF&G Biological Collections Permit. Transport of wild gametes to the PWSAC hatchery will require an ADF&G Fish Transport Permit for each stock and a Permit Alteration may be required to rear and incubate the wild eggs at the AFK Hatchery. This project received a categorical exclusion under the National Environmental Policies Act.

WHEN

August 1993	Interim Report 1 including: instream egg density and survival results, intra-stream crossing results, first generation doses response results for eggs and fry.
August 1994	Interim Report 2 including: update of Interim Report 1, first generation doses response results through year 1.
July 1995	Final Report

BUDGET ($K)

	ADF&G	NOAA	TOTAL
Personnel	$ 201.0	$ 117.9	$ 310.6
Travel	9.6	10.0	21.4
Contractual	65.4	116.0	199.0
Commodities	30.5	54.0	75.5
Equipment	2.1	19.0	19.0
Capital Outlay	0.0	0.0	0.0
Sub-total	$ 308.6	$ 316.9	$ 625.5
General Administration	34.7	25.8	60.5
Project Total	$ 343.3	$ 342.7	$ 686.0

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EXXON VALDEZ OIL SPILL PROJECT DESCRIPTION

Project Number: 93006

Project Title: Site-Specific Archeological Restoration (Interagency)

Project Category: Restoration Management Actions

Project Type: Archeology

Lead Agency: National Park Service

Cooperating Agencies: Alaska Department of Natural Resources; Department of Interior, Fish and Wildlife Service; Department of Agriculture, U.S. Forest Service

Project Term: Five years for restoration action component; ten years for monitoring component January 1, 1993 to December 30, 2002

INTRODUCTION

A two-phase archeological restoration assessment of all existing and accessible oil spill response documentation has revealed that there is solid evidence for substantive injury to 24 known archeological sites that can be directly linked to the *Exxon Valdez* oil spill event. The sources of injury include oiling, oil spill beach clean-up actions, and vandalism. Of these three identified sources, clean-up activities and vandalism appear to have resulted in the most clear-cut cases of injury to archeological sites (e.g. loss or destruction of diagnostic artifacts, illegal excavation, disturbance of human remains). The effects of oiling are more problematical, but the available evidence indicates that oil penetration impairs the ability of radiocarbon samples to yield accurate dates and may alter archaeologically-relevant soil chemistry.

In June 1992 the Trustees convened a multi-agency panel of experts in the archeology of the oil spill region chaired by Martin McAllister, the nation's foremost expert in archeological restoration. This panel gave thorough review to all available oil spill injury data and arrived at the following conclusions:

1. Nineteen known archeological sites had been injured by clean-up activities or vandalism related to the oil spill event.

2. A total of 10 known sites had been affected by moderate to heavy oiling (5 of which are also among the 19 sites injured by cleanup and vandalism).

3. Based on the total known sites and projected archeological sites in the oil spill pathway supplied by the Exxon Company contractors and a special Trustee-sponsored GIS/statistical study by the State University of New York, it is estimated that:

    a. A total of 112 archeological sites suffered substantive injury from oil spill cleanup or vandalism tied to the oil spill event.

b. A total of 59 archeological sites were subjected to moderate to heavy oiling during the oil spill event (at least half of these sites also number among the 112 sites affected by other sources of injury).

Note: These numbers represent the most conservative, statistically-derived estimate of injury endorsed by the "McAllister Panel." The next-lowest estimates put forward by Dr. Al Dekin's injury study are 338 and 155, respectively; statistically valid estimates, but based on what appear to be less valid assumptions about the nature and distribution of injury.

The purpose of this project is to conduct site-specific restorative actions at injured archeological sites on Federal or State lands within the oil spill pathway. Guidance for the proposed work is drawn from Section 14 of the Archeological Resources Protection Act (ARPA). None of the planned work duplicates previous studies; it is based on a careful review of the results of earlier injury investigations.

WHAT

The goal of this project is to ameliorate injury to archeological sites that were impacted by oiling, oil spill cleanup, or vandalism as a direct result of the *Exxon Valdez* oil spill event. The measures include the following:

1. Full damage examination and analysis of the injured sites.

2. Recovery analysis and curation (and where appropriate, repatriation) of any remaining archeological resources that were exposed or disturbed by oil spill related injury.

3. Data recovery to compensate for the loss of important archeological information at injured sites and/or the stabilization and physical repair of disturbed areas within injured sites.

WHY

Archeological sites constitute a category of finite, non-renewable resources managed by the State and Federal governments for the public benefit. These resources represent a major part of the cultural heritage of the United States and injury to resources of this type results not only in the loss of important scientific data about the human past but in an irrevocable diminution of our nation's historic patrimony. The restorative measures proposed herein are designed to either repair physical injury or reduce the loss of important archeological information caused by injury. Physical repair includes such actions as restoring trampled protective vegetation at a site or filling in a looter's hole. Data recovery is used to recover what bits of information can be salvaged from the area of an illegal excavation--in a sense, restoring to the public what information has been potentially lost by means of scientific investigations. If restorative measures are not taken, current signs of vandalism may provoke further vandalism, disturbed archeological soils will most likely result in accelerated erosion of archeological fabric; and altered artifact patterns and contaminated radiocarbon samples will probably play subtle havoc with future archeological

interpretations in the region--one of Alaska's richest but least known archeological zones. In recognition of the archeological importance of the area, the National Park Service has already committed a majority of its funds under a five-year National Archeological Survey project to conduct a sample survey and evaluation of coastal sites in Kenai Fjords and Katmai. Other participating agencies lack a similar funding source, but they are committed to do what they can to increase survey coverage of the area.

HOW

The first step in this project will be to conduct site-specific restoration assessments at sites with documented injury, but where there is insufficient detail upon which to determine appropriate treatment (19 sites). The second step will be to carry out the indicated restorative action--either physical repair and/or data recovery. In many cases, the anticipated restoration treatments will be limited in scope and difficulty and the necessary restorative actions will be taken immediately upon completion of the assessment. A few may require carefully planned return visits. This portion of the work will be carried out in a two-year split (1993 and 1994) to permit sufficient time for planning larger and more complex restorative measures and to take advantage of corrective feedback from the first year of the project.

A concurrent restoration assessment, coordinated with the first, will address long-term injury resulting from oiling. Ten known sites that have been exposed to moderate to heavy oiling will be monitored for a period of 10 years to determine the effect of oil on radiocarbon samples, archeological soil chemistry, and protective site vegetation. Research assessments of this type are specifically authorized by Section 14(c) of ARPA when the nature and level of injury to archeological sites remain uncertain or problematic. The results will alert future researchers to any skewing effect the oil may have on archeological soil or radiocarbon specimens and make land managers aware of any residual threats to archeological sites (e.g., alterations or reductions in protective vegetative cover). The 10 sites selected for monitoring include 5 from the list of 19 sites with evidence of injury attributable to cleanup or vandalism and 5 additional sites that have been oiled, but presently have no documentation of other injury. These 5 sites bring the total number of known injured sites to 24, the number mentioned at the beginning of this proposal.

After completion of the assessment and treatment of previously known injured sites in 1994 the work could be expanded in 1995 to discover additional injured sites, assess the nature and extent of the injury, and carry out appropriate treatment. The favored approach will be a "find and restore strategy." A problem-oriented research design will be developed to guide this inventory. The search will employ a stratified-random survey methodology to target the effort toward the most likely zones to contain injured archeological sites in need of treatment. Continuation of the oiling assessment and the start of this work will depend on an interim review of the results from the first two years of the project and the express approval from the Trustee Council to proceed.

The results of all project work will be published in both technical and popular formats. As they become available, pertinent findings will be fed into the stewardship, site protection monitoring, and public education projects. The research and restorative actions will follow the Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation. The Division of Polar Research, National Science Foundation, is recommended as the most appropriate source and coordinator for peer review of the project.

ENVIRONMENTAL COMPLIANCE

The proposed project is a categorical exclusion from the National Environmental Policy Act but subject to the provisions of the Historic Preservation Act, the Archeological Resources Protection Act, and the Native American Graves and Repatriation Act. The project will be carried out in conformance with the consultative processes and standards demanded by these legislative mandates.

WHEN

March 1 - June 1, 1993	Consultation under the National Historic Preservation Act and the Native American Graves Protection and Repatriation Act; preparation of work plans and research designs.
July 1, 1993	Start of field work for restoration assessment and oil monitoring projects.
December 30, 1994	Completion of restoration assessment for known injured sites.
June 1, 1995	Start of field work for discovery, assessment, and treatment of additional archeological sites.
December 30, 1997	Completion of restoration assessments and treatment actions for additional injured sites.
December 30, 2002	Completion of oil monitoring project.

BUDGET ($K)

	USNPS	USFWS	USFS	ADNR	TOTAL
Personnel	$ 9.1	$ 14.9	$ 10.6	$ 49.2	$ 83.8
Travel	7.7	10.4	7.2	8.5	33.8
Contractual	84.9	3.5	5.3	14.5	108.2
Commodities	1.1	1.2	1.0	3.9	7.2
Equipment	1.2	1.8	1.2	2.9	7.1
Capital Outlay	0.0	0.0	0.0	0.0	0.0
Sub-total	$ 103.9	$ 31.8	$ 25.3	$ 79.0	$ 240.0
General Administration	7.3	2.6	2.0	8.2	20.1
Project Total	$ 111.2	$ 34.4	$ 27.3	$ 87.2	$ 260.1 4

EXXON VALDEZ OIL SPILL PROJECT DESCRIPTION

Project Number: 93012

Project Title: Genetic Stock Identification of Kenai River Sockeye Salmon

Project Category: Restoration Management Actions

Project Type: Fish and Shellfish

Lead Agency: Alaska Department of Fish and Game

Project Term: January 3, 1992 to September 30, 1995

INTRODUCTION

A. Background

Fishing time in the Upper Cook Inlet area was affected in 1989 due to the presence of oil from the *Exxon Valdez* oil spill (EVOS). As a direct result, sockeye salmon (*Oncorhynchus nerka*) spawning in the Kenai River system exceeded optimal escapement goals by three times. This overescapement resulted in overproduction of sockeye salmon fry. The overabundance of sockeye salmon juveniles depleted invertebrate prey populations to the point that widespread juvenile mortality occurred during the winter-spring rearing period. Consequently, sockeye smolt outmigrations in the Kenai River have been severely reduced, and the number of adult sockeye salmon returning from the overescapement in the Kenai River system is expected to be well below minimum escapement levels. Starting in 1993, a large reduction, or closure of Kenai River sockeye salmon harvests may be necessary in an attempt to reach adequate escapements.

Sockeye salmon harvested from the mixed-stock fishery of Cook Inlet include fish from the Kenai, Kasilof, and Susitna Rivers. In order to effectively manage the harvest of EVOS-damaged stocks, Restoration Science Study R59 - Assessment of Genetic Stock Structure of Salmonids - was implemented. This study uses Genetic Stock Identification (GSI) techniques to identify Kenai River stocks in mixed stock Cook Inlet fisheries. Area managers will use this information to modify fishing areas and openings in order to facilitate the harvest of surplus Kasilof and Susitna River stocks while protecting the EVOS-damaged Kenai River stocks.

Restoration of Kenai River sockeye stocks will benefit subsistence, sport, and commercial fishermen in coastal communities throughout Cook Inlet, from Homer north through Anchorage to Tyonek. In 1992 nearly 10,000 families obtained subsistence permits to harvest salmon in UCI, most targeting Kenai River sockeye salmon. The most recent statistics indicate that nearly 100,000 sport anglers fished the Kenai River for salmon in 1990, spending $38 million in 1986 dollars. Forty percent of those anglers were from out of state. Of the 1,323 permits licensed to commercial fish in UCI, 80% are fished by State residents with the remaining predominantly from Pacific Coast states. Average ex-vessel value (1987-1991) of the UCI commercial salmon harvest was $ 67.8 million.

WHAT

Contingent upon funding, the Alaska Department of Fish and Game (ADF&G) will continue to develop a comprehensive genetic database of sockeye salmon stocks in Cook Inlet. In 1992 ADF&G began collecting baseline genetic data from 28 subpopulations from the Kenai, Kasilof, and Susitna Rivers. Beginning in 1993, samples from the Cook Inlet commercial harvest will be analyzed to estimate the composition of the fisheries. This information will enable area managers to identify Kenai River fish occurring in the mixed-stock commercial fishery and thus harvest surplus stocks of sockeye salmon while providing protection to EVOS-damaged stocks destined for the Kenai River. The specific objectives are the following:

1. Refine and expand the allozyme database to include all significant spawning stocks contributing to mixed-stock harvests of sockeye salmon in Cook Inlet. Initiate the development of DNA marker detection in sockeye salmon to test for expanded resolving power.

2. Obtain genetic data each week from samplings of the various mixed-stock fisheries occurring in 1993 - 1995.

3. Use Genetic Stock Identification (GSI) algorithms to estimate the proportion of Kenai River stocks in mixed stock fisheries so that managers may modify area and time of harvest in order to protect these damaged stocks while targeting surplus Kasilof River and Susitna River stocks. Estimates will be provided within 48 hours post-fishery.

WHY

Attempts to use stock identification to manage harvests of Cook Inlet sockeye salmon in the past have relied on scale growth patterns. However, the accuracy of the scale technique alone has not been reliable, and it is insufficient to permit the in-season protection of the EVOS-damaged Kenai River stocks. GSI techniques rely on genetic variation to discriminate between populations of organisms. This method has recently been applied as an in-season fisheries management tool, and it has proven to be extremely effective for allocating and adjusting the harvest of fish stocks intercepted in mixed-stock fisheries such as those that occur in Cook Inlet. Once a database has been established, GSI techniques should provide a mechanism for in-season management on a stock-specific basis. This will allow managers to control the harvest of Kenai River sockeye salmon and facilitate their recovery.

HOW

A comprehensive baseline genetic database will be developed for all sockeye salmon stocks contributing to Cook Inlet fisheries. Additional sockeye salmon will be collected from approximately 20 baseline subpopulations each year (1993-1995). Sites will be chosen to supplement those being collected during the 1992 field season. Mixed stock fishery samples will be collected from every drift net fishery occurring during the July fisheries (1993-1995). Muscle, liver, heart, and eye tissue will be taken from individual fish and examined by protein electrophoresis (allozyme analysis) for discriminating gene markers. Genotypic and allelic frequency estimates will be calculated from allozyme electrophoretic data for each baseline and

mixed-stock sample at every gene locus examined and will be used to identify discrete spawning populations. Stock components of mixed fishery samples will be estimated using a conditional maximum likelihood algorithm. Fishery composition estimates will be available within 48 hours following the fishery so that management decisions can be based on the actual composition of the fisheries.

ADF&G will also screen representative individuals for DNA-level markers. Total genomic DNA will be extracted and amplified through PCR (polymerase chain reaction) techniques utilizing various mitochondrial and nuclear primers. Restriction analyses as well as sequencing studies will be performed. Maximum likelihood simulation studies will be performed to test the additional resolution that could be provided by the DNA-level data. DNA data will be collected from the fishery samples as scientifically and logistically feasible.

ENVIRONMENTAL COMPLIANCE

Collecting permits will be obtained as required. This project qualifies for a "Categorical Exclusion" under Federal lead requirements.

WHEN

June - Sept. 1992	Baseline & Mixture sample collections/coordination with project R53
July - Dec. 1992	Laboratory analyses of baseline and model mixtures
Jan. - April 1993	Laboratory analyses of baseline populations and annual report
July - Sept. 1993	Laboratory analyses of mixtures; numerical analyses of stock structure; modeling for 1993 mixture analyses
Oct. 1993 - Sept. 1994	Baseline analyses, in-season analyses, annual report
Oct. 1994 - Sept. 1995	Baseline analyses, in-season analyses, final report

BUDGET ($K)

	ADF&G
Personnel	$ 179.5
Travel	12.0
Contractual	18.0
Commodities	34.7
Equipment	31.9
Capital Outlay	0.0
Sub-total	$ 276.1
General Administration	24.5
Project Total	$ 300.6

EXXON VALDEZ OIL SPILL PROJECT DESCRIPTION

Project Number: 93015

Project Title: Kenai River Sockeye Salmon Restoration

Project Category: Restoration Management Action

Project Type: Fish and Shellfish

Lead Agency: Alaska Department of Fish and Game

Cooperating Agencies: None

Project Term: January 3, 1992 to September 30, 1996

INTRODUCTION

Sockeye salmon *Oncorhynchus nerka* which spawn in the Kenai River system were injured by the *Exxon Valdez* oil spill. Reduced fishing time in the Upper Cook Inlet area due to the oil spill caused sockeye spawning escapement levels in the Kenai River system to exceed the desired amount by three times. The biological impact of the oil spill on Kenai River sockeye salmon stocks is expected to be serious. Data collected by NRDA Fish/Shellfish Study 27, *Sockeye Salmon Overescapement*, showed greatly reduced survival estimates of juvenile sockeye salmon during the winter-spring rearing period. The large escapement appears to have produced more rearing juvenile sockeye salmon than could be supported by nursery lake productivity. In general, when rearing salmon abundance greatly exceeds lake carrying capacity, the species and size composition of prey resources are altered, which, in turn, affects all trophic levels. Because of such changes, juvenile sockeye growth is reduced and freshwater mortality is increased. Greater numbers of fry remain in the lake for another year of rearing. Competition for a limited food supply reduces condition of surviving fry. Marine mortality is increased because of poor condition of outmigrating smolts.

Limiting sockeye salmon fry production by closely regulating the number of spawning adults is the best way to restore the productivity of these rearing areas. However, the number of adult sockeye salmon returning from the 1989 overescapement may be so low that a reduction or closure of Kenai River sockeye may be necessary starting in 1993 in an attempt to reach adequate spawning escapements.

This project consists of increased monitoring and management of the sockeye salmon stocks in the Kenai River and Upper Cook Inlet (UCI) north of Anchor Point. The project will benefit subsistence, sport, and commercial fishermen in coastal communities throughout Cook Inlet, from Homer north through Anchorage to Tyonek. In 1992 nearly 10,000 families obtained subsistence permits to harvest salmon in UCI, most targeting Kenai River sockeye salmon. The most recent statistics indicate that nearly 100,000 sport anglers fished the Kenai River for salmon in 1990, spending $38 million in 1986 dollars. Forty percent of those anglers were from out of state. Of the 1,323 permits licensed to commercial fish in UCI, 80% are fished by State residents with the remaining predominantly from Pacific Coast states. Average ex-vessel value (1987-1991) of the

UCI commercial salmon harvest was $ 67.8 million.

WHAT

A. Goal

The goal of this project is to restore Kenai River sockeye salmon stocks injured by the oil spill. This will be accomplished through improved stock assessment capabilities, more accurate regulation of spawning levels, and modification of human use. Restoration of Kenai River sockeye salmon stocks will be achieved when average fry, smolt, and adult production can be maintained at pre-spill levels. Prey resources of rearing lakes must also be restored to normal levels (This will be monitored under another restoration study, which will be based on information obtained from NRDA Fish/Shellfish Study 27).

B. Objectives

Specific objectives of this proposal are as follows:

1. Improve stock identification capabilities by combining parasite and genetic stock identification information with available scale growth data to provide statistically reliable estimates of Kenai River stocks in the mixed stock fishery of Upper Cook Inlet (UCI),

2. Increase the accuracy and precision of escapement monitoring by supplementing hydroacoustic equipment used in the Kenai River, and

3. Provide more accurate estimates of abundance of Kenai River sockeye salmon within UCI through hydroacoustic assessment techniques.

WHY

More intensive management is necessary to restore affected stocks to pre-spill levels and maintain them at those levels until the populations stabilize. This project will help restore those stocks by providing the information needed to properly manage human uses. Intensive fisheries management will temporarily reduce human pressure on these injured stocks to speed their recovery. As a means of minimizing impacts on the fisheries, existing fisheries may need to be restricted or redirected to alternative sites. For Cook Inlet this will relieve pressure on what are anticipated to be small runs to the Kenai River in the next several years without shutting down other UCI fisheries.

HOW

A. Stock Identification

Stock identification studies used to regulate human use of UCI sockeye salmon have, in past years, relied on scale growth patterns. The accuracy and precision of this technique has varied considerably from year to year. Kenai stocks typically dominate the total return and their scale

patterns are generally distinct enough to provide some separation from other stocks. However, when runs to other systems are more abundant (as may occur in 1993-1995) separation of Kenai stocks will be much more difficult. Improvements in stock identification procedures will be necessary to identify the contribution of Kenai River sockeye salmon to the total run accurately in this situation. Recent work by ADF&G, in cooperation with National Marine Fisheries Service staff, has shown that parasite occurrence can be used to improve estimates of stock contribution during the fishing season. The combination of scale patterns, parasites and genetic stock identification techniques (Restoration Science Study Number 59) will greatly increase the accuracy of UCI stock assessment estimates.

Sockeye salmon escapements into major drainages of Upper Cook Inlet were sampled for genetic, parasite, scale and otolith characteristics in 1992. During 1993, 20 additional baseline populations will be sampled and mixed-stock samples will be collected from the commercial drift gillnet fishery. Stock composition of mixed stock fishery samples will be estimated using scale pattern analysis, parasite data, genetic data, or a combination of all three. Stock resolution will be enhanced by using several kinds of biological marker data simultaneously. Typically a maximum-likelihood estimation procedure for a mixture problem with learning samples has been used to combine these data. The principal components of this project are sample collection, transportation to genetic laboratory facilities (for preparation by Restoration Study Number 59), and real time stock composition modeling necessary for inseason resource management decisions.

B. Escapement Monitoring

Bendix Corporation side-scan hydroacoustic equipment has been used since 1976 to count adult sockeye salmon entering the Kenai River to spawn. Lack of Bendix replacement parts and the inability to purchase new Bendix counters will compromise our future ability to provide escapement estimates. Accuracy of estimates would be greatly enhanced through use of newer, more technically advanced equipment. Evaluation of new equipment in 1992 will result in selection of the most appropriate replacement system. Funding for purchase of replacement equipment was authorized in 1992. ADF&G will conduct continuous operations with both the old Bendix equipment and the new equipment on both banks of the Kenai River during a three week period in 1993 to encompass the peak of the sockeye salmon run. This will provide a measure of quality assurance that will allow comparison of data previously collected using only the Bendix device to that collected using new equipment. Use of the Bendix is expected to be unnecessary in subsequent years.

C. Offshore Assessment Program

Sockeye salmon returning to UCI are captured with a drift gill net at a series of stations between Anchor River and Red River delta. Estimates of the total sockeye salmon return are made several times during the season by estimating expected total test fishery catch per unit of effort for the season and catchability of sockeye salmon in the test fishery calibrated by the commercial drift gillnet fishery. Analysis of historical data indicates that existing sampling effort and catch has not been proportional to abundance. Calibration by the commercial fleet is not guaranteed for future reduced run sizes. In 1992 hydroacoustic equipment and techniques were evaluated by a contractor experienced in marine salmon investigations to supplement the existing program.

Anticipated results include: (1) operating parameters of the hydroacoustic system used, (2) real time estimates of fish density, (3) fish distribution across the transects, and (4) definition of run timing models and total return estimates. In 1993 a hydroacoustic survey will be conducted to provide a real-time estimate of adult sockeye salmon in UCI. Placement and duration of transects needed for the 1993 survey will be based on 1992 results to provide an appropriate level of precision and accuracy for an abundance estimate of sockeye salmon. This is to include appropriate species composition estimates of fish targets. Purchase of offshore hydroacoustic equipment will be necessary in order to meet these goals.

ENVIRONMENTAL COMPLIANCE

A Corps of Engineers Section 10 or 404 permit, State of Alaska Title 16 permit, and a finding that this project is consistent with the Alaska Coastal Zone Management Plan may be required. This project qualifies for a "Categorical Exclusion" under Federal lead agency requirements.

WHEN

Four additional years will be required to meet project objectives. Adult returns from the injured 1989 brood year will occur during 1993-1995, but information on the 1990, 1991, and 1992 brood years will also be needed to monitor recovery of the system. Adult returns from the 1992 brood year will not be observed until 1996.

Aug. 1992 Begin to evaluate results of escapement monitoring, purchase new equipment and design escapement monitoring for 1993.

Jan. 1993 Begin to evaluate results from the offshore hydroacoustic investigation and design a survey for 1993.

April 1993 Results of baseline genetic sampling due to evaluate accuracy and precision of stock composition modeling and set sample design and sample size goals for 1993.

May 1993 Award contract for the offshore hydroacoustic survey in UCI to begin in July.

June 1993 Begin field work: fishery sampling and escapement monitoring begin in July, and escapement sampling for stock identification baselines through September.

Sept. 1993 Interim Report to include (1) performance of stock composition modeling with scale, genetic, and parasite data, (2) estimates of adult sockeye escapement in the Kenai River, and (3) offshore hydroacoustic estimates of sockeye salmon.

BUDGET ($K)

	ADF&G
Personnel	$ 203.1
Travel	10.6
Contractual	136.5
Commodities	41.2
Equipment	25.4
Capital Outlay	0.0
Sub-total	$ 416.8
General Administration	40.0
Project Total	$ 456.8

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EXXON VALDEZ OIL SPILL PROJECT DESCRIPTION

Project Number: 93016

Project Title: Chenega Chinook and Coho Salmon Release Program

Project Category: Manipulation and Enhancement

Project Type: Fish and Shellfish

Lead Agency: Alaska Department of Fish and Game

Project Term: January 1, 1993 to December 31, 2003

INTRODUCTION

A. Background

Due to the oil spill, salmon stocks were impacted. Subsistence as well as sport and commercial fisheries were disrupted. Traditional usage of fish stocks and fishing grounds by the Chenega Village residents was lost. This project will help to restore lost subsistence fishing and establish alternate subsistence fishing opportunities. The Trustee Council requires full environmental compliance before funding this project. Therefore, only completion of the Environmental Assessment is planned for the 1993 fiscal year. Implementation of the field work will begin in May of 1994.

B. Injury

As a result of the *Exxon Valdez* oil spill, subsistence harvest of salmon and other resources was disrupted.

C. Location

Fish production at W. Noerenberg (WHN) Hatchery at Esther Island in PWS. (This is the preferred site if production can be accomplished without major modifications). Fish will be released and harvested in the vicinity of Chenega Village in southwestern Prince William Sound, at Deadend Bay.

WHAT

A. Goal

To replace subsistence resources by permitted releases of chinook and coho salmon at designated sites near Chenega Village from stocks of Prince William Sound Aquaculture Corporation (PWSAC) Wally Noerenberg Hatchery near Esther Island.

B. Objectives

1) Produce 50,000 chinook salmon smolts at the W. Noerenberg Hatchery for transport and release at site(s) near Chenega Village.

2) Hold and feed the smolts in net pens at the release site for 2 weeks before they are released.

3) Harvest approximately 1500 adult chinook salmon when they return (Assume 3% survival rate; 4 years before all year classes are represented).

4) Produce 50,000 coho salmon smolts for transport, holding, feeding and release near Chenega Village.

5) Harvest approximately 2500 adult coho salmon annually (Assume 5% survival rate; annual return beginning 1 year after first release).

WHY

A. Benefit to Injured Resource/Service

These projects will restore and improve subsistence salmon harvests that were lost because of the *Exxon Valdez* oil spill.

B. Relationship to Restoration Goals

Results from this project will help to restore lost subsistence fisheries. (Restoration Options: replace lost subsistence use (Management of Human Uses) 18 (Resource Manipulation), 30 (Other) related to hydrocarbon contamination of subsistence foods.

HOW

A. Method

1. Smolts will be utilized from existing production lots and raised to smolt stage at the WHN Hatchery.

2. Smolts will be transported by barge to the designated sites.

3. Smolts will be held and fed in net pens for 2 weeks before release to improve survival and imprinting.

4. Adults will be harvested when they return.
   Chinook Salmon: broodstock - from hatchery stock.
   Coho Salmon: broodstock - from donor stock near the release site.

All plans will be reviewed by the PWS Regional Planning Team (RPT) and by the Fish Transport

Permit (FTP) process and will comply with the ADF&G Fish Genetics Policy.

B. Other Efforts

This project will provide an alternate source of food for subsistence use and reduce the need for reliance on wild stocks that were injured by the oil spill.

ENVIRONMENTAL COMPLIANCE

This project will be reviewed for full compliance with the NEPA Process, the PWS RTP, and the ADF&G FTP review before it is implemented. The lead Federal agency has determined that this project requires an Environmental Assessment under the NEPA process.

WHEN

Jan. 1993	Plans are reviewed by the NEPA process, PWSAC, and the PWSAC RPT.
Aug. 1993	Completion of Environmental Assessment.
Oct. 1993	Review and approval of Environmental Assessment.
June 1994	First chinook smolts transported, penned, fed, and released.
Oct. 1993	Coho salmon broodstock screening and selection.
June 1994	First "adult" (jack) returns of chinook salmon.
Oct. 1994	First coho salmon eggs are taken from the designated location.
June 1995	First coho salmon smolts are released.
Aug. 1996	First coho salmon adults return.
June 1996	First complete complement of all chinook salmon age classes return.

Each year, smolts will be released in June (or late May).

BUDGET ($K)

	ADF&G
Personnel	$ 0.0
Travel	0.0
Contractual	10.0
Commodities	0.0
Equipment	0.0
Capital Outlay	0.0
Sub-total	$ 10.0
General Administration	0.7
Project Total	$ 10.7

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EXXON VALDEZ OIL SPILL PROJECT DESCRIPTION

Project Number: 93017

Project Title: Subsistence Restoration Project

Project Category: Restoration Management Actions

Project Type: Subsistence

Lead Agency: Alaska Department of Fish and Game

Cooperating Agencies: National Oceanic and Atmospheric Administration

Project Term: January 1, 1993 to September 30, 1995

INTRODUCTION

A. Background

Subsistence use of fish and wildlife constitute a vital natural resource service that was injured by the *Exxon Valdez* oil spill. Data collected by the Alaska Department of Fish and Game's Division of Subsistence has demonstrated this injury.

B. Summary of Injury

Annual per capita subsistence harvests declined dramatically (from 12 to 77 percent decline as compared with pre-spill averages) in ten of the communities in the path of the spill during the first year after the event. While some of these communities' harvests demonstrated a limited recovery in the second post-spill year, harvest levels in other affected communities showed no signs of recovery. Concern over the long-term health effects of using resources from the spill area, a loss of confidence on the part of subsistence hunters and fishermen in their own abilities to determine if their traditional foods are safe to eat, and a perceived reduction in available resources, all contribute to the reduced harvest levels.

C. Location

This subsistence restoration project will involve the following communities: Chenega Bay, Tatitlek, Cordova, Valdez, Nanwalek, Port Graham, Seldovia, Kenai, Seward, Larsen Bay, Karluk, Old Harbor, Akhiok, Port Lions, Ouzinkie, Kodiak City, Chignik Lake, Chignik, and Chignik Lagoon.

WHAT

A. Goal

The goal of the project is to restore the subsistence use of fish and wildlife damaged by the *Exxon Valdez* oil spill. Community meetings will be held in order to identify and map the specific areas and resources of continued concern to subsistence users. These meetings will provide a

comprehensive, final opportunity to identify these concerns. Data obtained in these meetings will provide prioritization and locations of sites to the Alaska Department of Environmental Conservation's 1993 spring shoreline survey, Restoration Project 93018, in order to focus treatment efforts if necessary. Samples of subsistence foods will be collected from harvest areas identified during the mapping.

C. Objectives

Community representatives will assist in site selection, as well as the collection of samples. The samples will be analyzed for the presence of hydrocarbon contamination. The results of the tests, along with findings from other damage assessment and restoration studies, will be interpreted by the Oil Spill Health Task Force, and reported to the communities in an informational newsletter and community visits. This information will assist the Trustee Council in making decisions concerning restoration, enhancement or replacement of lost subsistence resources and uses. In addition, funds will be made available to support subsistence food sharing programs between communities.

WHY

The Oil Spill Health Task Force has had some success in conveying the message that most subsistence foods are safe to eat. However, concerns about long-term effects remain. Also, limited public access to the damage assessment studies has created the impression in most communities that the task force did not base its conclusions on a complete assessment of all data. This project provides the opportunity to put information from the damage assessment into context. This will help to empower the people in the impacted communities to make informed decisions and encourage those who are so inclined to return to using more subsistence resources. It would also restore the communities' abilities to pass on skills and knowledge associated with using subsistence foods.

Making information from subsistence users part of the restoration process will facilitate the recovery of subsistence use areas, the importance of which might otherwise be missed. There is a need in these communities to actively participate in restoration of the environment. This project would provide for this involvement.

The project answers the need to continue to monitor the risks to human health from the oil spill. This is consistent with the goal of restoring human services of the natural resources damaged in the oil spill. It also addresses the need to restore the natural resources and the services these resources previously provided to subsistence users.

HOW

By involving subsistence users in decisions affecting mitigation, and the monitoring, enhancement and replacement of the natural resources, we can accelerate the recovery of the resources subsistence users rely upon. This involvement, combined with effective communication of information concerning the safety of the resources should cause subsistence harvests to begin to approach pre-spill levels, and reduce anxiety about their use.

The Division of Subsistence will use the results of a joint study currently being conducted with the U.S. Minerals Management Service in 15 communities impacted by the *Exxon Valdez* oil spill to determine the communities where concern continues to exist, as well as the nature of that concern. Similar activities were suggested by the Bureau of Indian Affairs
The details of the subsistence research being undertaken by the Department of the Interior as part of the Chenega Bay settlement are not available due to the litigation sensitive nature of the work. Nevertheless, the Department of Fish and Game has been assured by Regina Sleater, an attorney of the U.S. Department of the Interior, that there is minimal overlap between the ADF&G study and the DOI study. In addition, the results of the Interior study will be available in December 1992 and 93017 will be able to build upon--rather than overlap with--the Interior project.

ENVIRONMENTAL COMPLIANCE

This project is categorically excluded under NEPA guidelines.

WHEN

Jan. 1-May 31, 1993	Community meetings to map areas and species of concern
June - July 1993	Coordinate with DEC shoreline assessment to verify oiling information
June 1993	Collect subsistence food samples for testing (two months for analysis)
August 1993	Informational newsletter issued
September 1993	Collect subsistence food samples for testing
November 1993	Informational newsletter issued
December 1993	Collect subsistence food samples for testing
February 1993	Informational newsletter issued
March 1994	Collect subsistence food samples for testing
May 1994	Informational newsletter issued
June - July 1994	Coordinate with DEC shoreline assessment to verify oiling information
June 1994	Develop plan for additional cleanup/mitigation of oil
September 1994	Develop plan for enhancement/replacement of resources
May 1995	Coordinate with DEC shoreline assessment to verify oiling information

Note: There will be ongoing communication with subject communities throughout the duration of the project, with visits to communities as needed.

BUDGET ($K)

	ADF&G	NOAA	TOTAL
Personnel	$ 78.5	$ 65.2	$ 143.7
Travel	30.0	0.0	30.0
Contractual	85.5	0.0	135.5
Commodities	0.8	17.3	35.4
Equipment	0.0	0.0	18.1
Capital Outlay	0.0	0.0	0.0
Sub-total	$ 194.8	$ 82.5	$ 327.3
General Administration	17.8	12.0	33.3
Project Total	$ 212.6	$ 94.5	$ 360.6

EXXON VALDEZ OIL SPILL PROJECT DESCRIPTION

Project Number: 93022

Project Title: Monitoring the Recovery of Murres in the Barren Islands

Project Category: Restoration Monitoring

Project Type: Birds

Lead Agency: Department of the Interior - Fish and Wildlife Service

Cooperating Agencies: None

Project Term: January 1, 1993 to December 31, 1993

INTRODUCTION

A. Background

Murres were the species of higher vertebrates most heavily affected by the oil from the *Exxon Valdez* spill. These diving seabirds have continued to demonstrate abnormal breeding behavior and low reproductive output at several sites since the spill. Factors that normally result in increased breeding success of common murres are breeding in high-density concentrations and laying eggs in synchrony with neighbors. Being one of a crowd apparently reduces vulnerability to avian predators. Within a colony, birds in groups that breed early tend to be more productive than birds breeding later, and older birds tend to breed earlier and be more successful than young birds. Prior to laying, murres tend to be flighty. In cases where a small percentage of murres in a cluster have begun to incubate before others have laid, incubators tend to leave their eggs exposed to predators, joining the flock when panic flights occur. Nevertheless, as more birds lay there is a tendency for incubators, now apparently feeling safer with company, to remain with eggs when non-breeders flush.

For reasons not yet fully understood, murres at colonies affected by the oil have not yet resumed normal breeding schedules. Apparently a relatively small proportion of birds have laid their eggs earlier than others, and egg predation by gulls has been high. Perhaps a substantial proportion of experienced breeders were killed in the spill so that the population now is composed of mostly young, inexperienced breeders. It is not well understood how crucial the presence of older birds is to the social facilitation of normal breeding, and it is possible that a shortage of experienced breeders is causing the abnormal timing and poor reproductive success. Another contributing factor could be reduced breeding densities, since populations were reduced by mortality of adults.

B. Summary of Injury

Over 100,000 murres were killed by the oil, and counts of birds at colonies within the trajectory of the oil indicated reduced populations after the spill. In the 3 years following the spill, remaining murres at colonies affected by the oil have initiated laying up to 1 month late, if they laid at all, and reproductive output has remained much lower than would be expected. Three

consecutive years of poor reproductive success is very unusual based upon other studies.

C. Location

Experiments would be conducted at murre colonies in the Barren Islands, located between the Kenai Peninsula and the Kodiak Archipelago.

WHAT

A. Goal

The purpose of this project is to count murres at breeding colonies and determine the timing of nesting events and reproductive success to evaluate recovery.

B. Objectives

1. Monitor the recovery of murres in the Barren Islands.

WHY

A. Benefit to Injured Resources/Services

Monitoring is essential to assess the recovery of the colony as a whole following the oil spill. The underlying causes of the abnormal nesting behavior (e.g., delayed laying) are not yet understood, and monitoring data will provide the basis for testing various hypotheses. Understanding the impact of the oil spill may make it possible to minimize damage in future spills by directing clean-up efforts appropriately. Moreover, documentation of the response of murres in the aftermath of the oil spill will provide a basis for predicting the extent of the injury from future spills.

B. Relationship to Restoration Goals

This project meets the Trustee Council goal of restoring the spill area to its pre-spill condition by providing information that could be used to develop a management action.

HOW

A. Methodology

Murres will be counted on established plots. Counts will be made from boats following standard seabird census protocols. Information on timing of nesting events and reproductive success will be obtained through observation and use of the time-lapse photography.

B. Coordination with Other Efforts

Data from the monitoring program will be used to assess the effectiveness of this project.

ENVIRONMENTAL COMPLIANCE

This is a non-intrusive project which appears to qualify for categorical exemption under NEPA.

WHEN

Jan. - April 1993	Plan and arrange logistics (e.g., boat charters), recruit seasonal employees, develop detailed study protocols, assemble field gear, purchase equipment
May 1993	Train personnel; organize equipment
June - August 1993	Conduct field studies
Sept. - Oct. 1993	Analyze data; store equipment
Nov. - Dec. 1993	Write report; draft report submitted for internal review Nov. 15
Dec. 15, 1993	Draft report submitted for peer review
Dec. 30, 1993	Final report completed

BUDGET ($K)

	USFWS
Personnel	$ 80.0
Travel	13.6
Contractual	55.5
Commodities	8.2
Equipment	4.0
Capital Outlay	0.0
Sub-total	$ 161.3
General Administration	15.9
Project Total	$ 177.2

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EXXON VALDEZ OIL SPILL PROJECT DESCRIPTION

Project Number: 93024

Project Title: Restoration of the Coghill Lake Sockeye Salmon Stock

Project Category: Restoration Manipulation and Enhancement

Lead Agency: Alaska Department of Fish and Game (ADF&G)

Cooperating Agencies: U.S. Forest Service (USFS)

Project Term: January 1, 1993 to December 31, 1997

INTRODUCTION

This project will attempt to restore the natural productivity of Coghill Lake through use of established lake fertilization techniques. Coghill Lake is located on the eastern side of Port Wells in the northwest region of Prince William Sound (PWS). The Coghill Lake sockeye salmon stock historically supported important sport and commercial fisheries. Returns have declined in recent years from a historical average of 250,000 to only 25,000 in 1991. Damage assessment studies on juvenile salmon suggest that the *Exxon Valdez* oil spill contributed to the decline of the Coghill sockeye stock. Salmon migration patterns indicate that juvenile sockeye smolt from Coghill Lake likely migrated through oil-contaminated areas in western PWS. Juvenile salmon similar in size to Coghill smolts utilized oiled nearshore nursery habitats. The growth and survival of juvenile salmon utilizing these habitats was reduced by oil contamination from the *Exxon Valdez* spill. The Coghill Lake stock is presently at extremely low levels. Action must be taken to restore the stock before any further decline occurs. The communities of Anchorage, Whittier, Valdez, and Cordova will benefit from this project. Coghill Lake sockeye have been heavily utilized by sport fishermen traveling from Whittier by boat and from Anchorage by air. Commercial fishermen from all of these communities have historically fished the Coghill Lake sockeye salmon stock. Restoration of Coghill Lake sockeye salmon will further improve management of important sockeye and chum salmon stocks returning to hatcheries in western PWS.

WHAT

The goal of this project is to restore the natural productivity of Coghill Lake and the resident sockeye salmon population through use of established lake fertilization techniques. The USFS will apply fertilizer to the lake each summer for five years (the USFS has already purchased the fertilizer from another funding source). The ADF&G will conduct limnological and fisheries studies needed to monitor and refine the fertilization program. These studies will focus on the effects of fertilization on primary and secondary production and the growth and survival of juvenile sockeye salmon in the lake. The ADF&G component of the project will achieve the following objectives each year:

1. Determine the response of lake nutrient levels, primary and secondary production, and plankton species composition to lake fertilization,

2. Monitor changes in water temperature, light penetration, and water level in the lake,

3. Determine the habitats utilized by sockeye salmon fry at various lifestages,

4. Determine if fry prey composition, growth, and overwinter survival changes in response to lake fertilization,

5. Estimate the effect of fertilization on lake carrying capacity and smolt-to-adult survival, and,

6. Develop recommendations for refinement of the lake restoration program.

WHY

This project will restore an important natural resource and resource service in the *Exxon Valdez* oil-spill area. Restoration of the Coghill sockeye stock will further provide natural resource services to replace those once provided by other injured stocks. Damage assessment studies on juvenile salmon suggest that the *Exxon Valdez* oil spill may have contributed to the decline of the Coghill sockeye stock. Lake fertilization techniques have been successfully applied in Alaska and elsewhere to restore the productivity of sockeye salmon rearing lakes. The production of sockeye salmon populations is closely linked to the productivity of lakes where the fish rear for one to three years. The availability of food in rearing lakes determines the growth and size of smolts that emigrate to sea. Smolt size in turn determines ocean survival and subsequent adult returns. The fry food resources in Coghill Lake are currently very low. As a result, the lake cannot support large numbers of fry, and the smolts are very small. Fertilization is needed to increase lake productivity and boost fry food abundance until natural nutrient input from salmon carcasses is restored.

HOW

Limnological sampling will be conducted twice each month at two stations. Dissolved oxygen concentrations will be measured from the surface to a depth of 40 M. Eight liter water samples will be collected from the 1m stratum, chemocline, and monimolimnion. Replicate vertical zooplankton tows will be taken using a 153-μm mesh conical net. Water samples will be analyzed for the following parameters: conductivity, alkalinity, calcium, magnesium, turbidity, total iron, filterable reactive phosphorus, total phosphorus, nitrate and nitrite, total Kjeldahl nitrogen, total nitrogen, and reactive silicon. Yearly phosphorus loading will be estimated. Euphotic zone depth and algal standing crop will be estimated. Zooplankton abundance will be estimated from triplicate counts of organisms in 1 ml subsamples. Zooplankton dry weight and biomass will be estimated by regression analysis using body length measurements on 10 individuals from each taxa. Light penetration will be measured at 1 m increments from the surface to a depth equivalent to 1% of the subsurface light. Water temperature in the epilimnion and water level will be continuously monitored by electronic recorders moored at 5, 15, and 25m depth. The habitats used by sockeye salmon fry in the lake will be determined from visual surveys, beach seine and tow net catches, and hydroacoustic surveys conducted in June, August, and October. A 70-Khz echosounder will be used to determine the vertical distribution of fry in the lake during the day

and at night. Twenty samples (n = 10) of 10 sockeye salmon fry will be collected from various habitats during each survey for later analysis of stomach contents and otolith growth.

Stomach analysis will be conducted on sockeye fry (n = 200) collected during each survey. Prey items in the stomach will be identified to the lowest possible taxonomic level. Prey body weight will be estimated by regression analysis using body length measurements on 10 individuals from each taxa. Stomach contents' weight will be estimated by the product of abundance and mean body weight for each taxa. Chi-square analysis will be used to test for differences (P = .05) in the proportion of stomach contents weight in each taxonomic group between three time periods. Analysis of covariance will be used to test for differences (P = .05) in stomach contents weight between three time periods.

Otolith microstructure analysis will be conducted on sockeye fry (n = 200) collected during each survey. Thin sections of the otoliths will be prepared using established methods. A computer image analysis system will be used to collect data from the otoliths. A modified Fraser-Lee back calculation procedure will be used to reconstruct fish growth histories during weekly time periods. Weekly growth estimates obtained from otoliths will be regressed against weekly mean water temperatures obtained from electronic temperature recorders. Analysis of covariance will be used to test for differences (P = .05) in temperature-specific growth between Coghill Lake sockeye and fish fed an excess ration. Comparison of regression slopes will be used to determine if fry growth in Coghill Lake is limited by food abundance. This information will be used to monitor the growth response of the fish to fertilization and determine the carrying capacity of the lake.

The overwinter survival of juvenile sockeye will be estimated from fall fry and spring smolt population estimates. Fall fry population size will be estimated with a 120-Khz echosounder towed along 10 randomly selected transects. A mid-water trawl will be used in conjunction with the hydroacoustic surveys to determine species composition, age, and size of fish targets. Sockeye salmon smolts emigrating from Coghill Lake will be enumerated using incline-plane traps. The traps will be operated continuously from early May through June. The catch efficiency of the traps will be determined by mark/recapture analysis. Age composition and size will be estimated from a sample of 40 smolts collected each day. Chi-square analysis and analysis of variance will be used to test for differences (P = 0.05) in age composition and smolt size between years, respectively. A representative sample of smolts will be coded-wire tagged to enable later estimation of smolt-to-adult survival in the commercial fishery. The combined results from these investigations will be compiled in an annual report describing the success of the fertilization program and recommending refinements to the methodology.

ENVIRONMENTAL COMPLIANCE

An Environmental Assessment has been conducted to evaluate the various options for rehabilitating Coghill Lake and the resident sockeye salmon population. The assessment has concluded that a program of lake fertilization is the most appropriate method for rehabilitation in this case. Final approval of the Environmental Assessment is expected before the end of 1992.

WHEN

This project will be conducted over a five-year period which corresponds to the generation time for Coghill Lake sockeye salmon. Lake fertilization is expected to elevate lake productivity until carcasses from adult spawners can once again contribute significantly to the nutrient load in the lake. Project activities will take place throughout each year.

May - June 1993	Enumerate outmigrant smolts and estimate smolt age and size
June - October 1993	Apply fertilizer each week and conduct limnological sampling
June, Aug., Oct. 1993	Determine fish habitat use and sample for otolith and stomach analysis
October 1993	Estimate fall fry population size using hydroacoustic techniques
June - October 1993	Conduct laboratory analyses of limnological, otolith, and stomach samples
October - Dec. 1993	Analyze data and prepare annual report

BUDGET ($K)

	ADF&G	USFS	TOTAL
Personnel	$ 84.8	$ 10.2	$ 114.9
Travel	1.2	5.4	6.7
Contractual	17.1	7.0	15.8
Commodities	7.6	0.7	14.7
Equipment	39.6	0.0	21.5
Capital Outlay	0.0	0.0	0.0
Sub-total	$ 150.3	$ 23.3	$ 173.6
General	16.3	2.0	18.3
Project Total	$ 166.6	$ 25.3	$ 191.9

EXXON VALDEZ OIL SPILL PROJECT DESCRIPTION

Project Number: 93030

Project Title: Red Lake Restoration

Project Category: Restoration, Manipulation and/or Enhancement

Project Type: Fish

Lead Agency: Alaska Department of Fish and Game

Cooperating Agencies: None

Project Term: January 7, 1993 to September 30, 1997

INTRODUCTION

Red Lake, located on the southwest side of Kodiak Island, has historically been one of the most consistent producers of sockeye salmon for Kodiak's commercial purse seine fishermen. The Department of Fish and Game's annual escapement goal for the system ranges from 200 to 300 thousand. Since 1980, the catch has ranged from 25,000 to 1.5 million with an average of 450,000. This fishery has had an average annual value to fishermen of about $2.2 million.

Careful management of the number of spawning fish is required to maintain this fishery at a high level. Young sockeye salmon spend at least their first year of life (up to 3 years) living and growing in lakes where they rely on microscopic-sized animals (plankton) for food. These animals, in turn, graze on tiny plants. If too many adult salmon spawn in the lake system, an overabundance of the young sockeyes will deplete their limited food source before they migrate to sea. When this happens, large numbers of young salmon die, survivors grow more slowly and smaller numbers migrate to the ocean to mature. So, large numbers of spawners in one year may result in an unusually small run in the next cycle.

In 1989, as a result of the *Exxon Valdez* oil spill, commercial salmon fishing was closed over most of Kodiak Island waters. The closure resulted in an escapement of 768,000 sockeye salmon into Red Lake, a 2.5 fold increase over the maximum desired. Data gathered showed low survival for the 1989 escapement year. Surveys showed low numbers of juveniles in the lake in the fall of 1990; and, in the spring of 1991, reduced number of migrant smolts were observed. This means that very low numbers of sockeye will return as four-, five-, and six-year olds in 1993, 1994, and 1995. It is anticipated that adult salmon return may be depressed to the extent that the escapement may fall below 150,000. If this happens during one or more of these years, supplemental production would be implemented immediately to restore the population.

If immediate actions are taken, we will have the capability to restore Red Lake sockeye salmon production. As a result of the oil spill, sockeye salmon returns are expected to be so low in 1993 and 1994 that minimum spawning population goals will not be achieved. If this were to happen, the productivity of this lake would be underutilized, and the fisheries would be seriously impacted in future years.

Restoration will involve taking a total of six million early run sockeye salmon eggs at Red Lake by August 30th each year. The eggs will be transported and incubated in a module at the Pillar Creek Hatchery in Kodiak. Fry will be reared until emergence and then released into Red Lake in May of each year.

The commercial purse seine fleet will benefit from this project as well as all associated fishing communities on Kodiak Island. The Red Lake sockeye fishery has historically provided a stable, significant source of income for Kodiak fishermen; consequently, restoration of this system is extremely important.

WHAT

Contingent upon the finding of a sockeye salmon synthesis meeting, this project is intended to supplement natural sockeye fry production in Red Lake with fry plants if escapement levels fall below minimum levels. However, early observations indicate that 1993 escapement levels will be adequate for this year. Therefore, no field work is needed this season.

Since the Trustee Council requires full environmental compliance before funding further work on this project, only completion of the Environmental Assessment is planned for the remainder of the 1993 fiscal year.

Project objectives are as follows:

1. Increasing the incubation and rearing capacity of Pillar Creek Hatchery to support additional Red Lake eggs and fry.

2. Collecting six million early run Red Lake sockeye eggs, beginning in 1993 and continuing through 1995, contingent upon Red Lake escapement falling below the minimum escapement goal of 150,000 by August 1.

3. Incubation of six million Red Lake sockeye eggs at Pillar Creek Hatchery with 90% survival from green to eyed eggs.

4. Rearing of approximately 5.4 million Red Lake sockeye fry at Pillar Creek Hatchery to the size of .25 grams with 90% survival.

5. Evaluating freshwater survival and the success of hatchery fry plants, by thermally marking otoliths of fry prior to stocking into Red Lake.

6. Stocking of approximately 4.9 million fed fry (.25 gram) into Red Lake with timing parallel to the period of wild stock recruitment.

7. Producing approximately 146,000 adult red salmon from annual fry plants (3% fry to adult survival).

WHY

The project restoration activity will result in restoration by allowing wild and cultured fry to enter the lake at the same period. A forecasted survival rate of 3% from fry to adult could result in 146,000 adults returning each year to the Red Lake system.
This project should be funded because immediate actions are needed to restore Red Lake sockeye salmon production if expected damage from the oil spill is realized. This damage is expected to result in weak return in 1993 and 1994, when minimum escapement goals may not be achieved. If this happens, the productivity of the lake would be underutilized and the fishery and economy would be seriously impacted in future years.

HOW

Pillar Creek Hatchery will be modified by the addition of an incubation module and 24 Kitoi box incubators to allow receipt of Red Lake eggs. Additional raceways will be installed to short-term rear emergent fry. Net pens, frames, seines and other egg take gear will be purchased and staged in Kodiak in July each year, after the initial purchase in 1992. If escapement into Red Lake is below 150,000 by August 1st (beginning in 1993), an egg take will proceed. Eggs will be collected, with a goal of 6,000,000, in August and transported to Pillar Creek Hatchery for incubation. During incubation, between the eyed and hatched stages, eggs will be marked by thermally induce otolith banding. Fry will be reared in aluminum raceways until reaching a weight of .25 grams and then will be transported by float plane for release into Red Lake. Smolt samples will be collected via NRDA #27 smolt enumeration project and checked for marks to determine hatchery fry contribution and project success.

This project will be operated in close association with NRDA Study #27 which monitors the effects of the 1989 overescapement on the productivity of Red Lake. This monitoring will assist with forecasting returns and, in association with the ADF&G weir, will help coordinate this project's restoration activities. Also, Pillar Creek Hatchery enhancement and rehabilitation activities in other areas of Kodiak Island will provide technical assistance to this project.

Red Lake lies within the boundaries of the Kodiak National Wildlife Refuge. Other projects of this type on refuge lands have required an environmental analysis (EA) and a "finding of no significant impact." The EA will be completed prior to implementation of this project.

WHEN

July 1992-Jan. 1993	Purchasing incubators, raceways, pipeline, and plumbing
Jan. 1993-Feb. 1993	Purchasing egg take supplies
Nov. 1992-Dec.1992	Annual project status report
Mar. 1993-June 1993	Preparation of PCH for receiving of eggs; incubator, raceways, and pipeline installation, egg take camp set up, supply ordering
July 1993- Sep.1993	Completion of Environmental Assessment

BUDGET ($K)

	ADF&G
Personnel	$ 7.5
Travel	0.0
Contractual	0.0
Commodities	0.0
Equipment	0.0
Capital Outlay	0.0
Sub-total	$ 7.5
General Administration	0.0
Project Total	$ 7.5

EXXON VALDEZ OIL SPILL PROJECT DESCRIPTION

Project Number: 93033

Project Title: Restoration Monitoring of Harlequin Ducks (*Histrionicus histrionicus*) in Prince William Sound and Afognak Island Areas

Project Category: Restoration Monitoring

Project Type: Birds

Lead Agency: Alaska Department of Fish and Game

Cooperating Agencies: Alaska Department of Natural Resources; National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Auke Bay Laboratory; U.S. Fish and Wildlife Service

Project Term: January 10, 1992 to September 30, 1995

INTRODUCTION

The *Exxon Valdez* oil spill (EVOS) significantly affected Harlequin ducks (*Histrionicus histrionicus*). Not only was there direct mortality of at least 200 Harlequins in Prince William Sound (PWS), but there has been a nearly complete reproductive failure of residents of the western PWS oil spill area from 1990 to 1992. (No study was conducted in 1989). This is a significant and unexpected long-term effect. Because some Harlequins spend their entire lives in the oil spill area, where they breed, feed, and overwinter, it is possible to detect and study this impact of EVOS. (Non-resident Harlequins and other seaducks that over-winter in oiled areas may be similarly affected, but because they breed in areas remote from the spill, it is impractical to study them.)

Harlequins are intertidal feeding diving ducks. The Harlequin duck population in the Prince William Sound and Afognak areas contains both resident and non-resident migrants. The residents breed along forested streams within a few kilometers of saltwater, molt in secluded bays and lagoons, and roost on offshore rocks. Broods are found with hens on saltwater in summer. Non-resident Harlequin ducks which winter on the south coast of Alaska breed elsewhere on mountain streams. They arrive in the south coastal area in October and depart in May. Harlequin ducks return to the same breeding and wintering areas year after year.

Breeding Harlequin ducks were formerly distributed throughout PWS, including the oil spill area, with broods commonly observed in shoreline habitats (Isleib and Kessel, 1973; Isleib, pers. comm.). Subsequent to the oil spill, Harlequin ducks have failed to breed in western Prince William Sound, and their population has declined in the oil spill area.

In contrast, these ducks reproduced normally in unoiled areas of Prince William Sound, and their population has remained stable. A few broods were found on the periphery of the EVOS area in 1991-92.

The reproductive failure of Harlequin ducks in the oil spill area is postulated to be a chronic effect of petroleum exposure through contaminated intertidal food. Blue mussels (*Mytilus*) appear to be the most likely source of contamination. They are well known to concentrate and hold pollutants in their tissues. Restoration Study #103 has documented high concentrations of polynuclear aromatic hydrocarbons (PAHs) in mussel flesh, byssal thread mats, and underlying substrates in western PWS in 1992. Because Harlequin ducks consume entire mussels, ingesting petroleum hydrocarbons in mussel tissue, on the shell surface, and in attached byssal threads and sediment, Harlequin ducks collected in 1989-90 in western PWS and SW Kodiak contained oiled food items in their gullets and petroleum residues in liver tissue and bile. Experimental studies have demonstrated that single small doses of petroleum can cause reproductive failure in some seabirds. A search of the files of U.S. Coast Guard Federal On-Scene Coordinator indicated that approximately 130 blue mussel beds may retain EVOS oil in western PWS. However, field evidence collected in 1992 has shown additional previously unreported oiled mussel beds in PWS and along the Kenai coast. EVOS oil also remains associated with dispersed blue mussels in a number of sheltered locations currently under investigation. Damage Assessment studies of Harlequin ducks through 1992 have been limited to Prince William Sound. Additional work is needed on Afognak Island.

WHAT

A. Goals

1. Test the hypothesis that continuing exposure to oil is responsible for the observed reproductive failure by examining Harlequin duck reproductive anatomy, histology, and blood parameters in oil spill and control areas;
2. Determine from chemical samples whether hydrocarbon residues are currently present in Harlequins;
3. Monitor Harlequin reproduction in western Prince William Sound;
4. Characterize Harlequin duck nesting habitat using existing information, remotely sensed data, and GIS modelling techniques;
5. Apply and evaluate Harlequin duck habitat models to provide a broad general perspective on Harlequin duck habitat within the EVOS area.

B. Objectives

1. Collect and analyze tissue and blood samples from Harlequin ducks in oiled and unoiled areas of PWS for evidence of oil-induced pathology;
2. Investigate food habits and to examine food items from proventriculus samples for petroleum contamination;
3. Determine breeding condition of Harlequin ducks by examining reproductive tracts of both males and females for physiological changes;
4. Continue monitoring productivity of Harlequin ducks in oiled and unoiled areas of PWS by means of shoreline boat surveys for young in August;
5. Describe and characterize potential Harlequin duck nesting habitat on Afognak Island.

WHY

The ultimate goal of this project is the restoration of breeding Harlequin ducks to the oil spill area. To achieve restoration requires the following:

1. Determine the nature and extent of the reproductive failure

2. Define habitat requirements to guide restorations, and

3. Determine whether hydrocarbon residues are currently present in Harlequins in order to clarify the link to persistent oil contamination. If the observed failure of reproduction is related to the contaminated food chain, remaining oil may need to be treated to make other restoration efforts more effective. In some cases these mussel beds remain grossly contaminated. Technical knowledge of habitat requirements of breeding Harlequin ducks may prove valuable for habitat acquisition and mitigation measures, protection of non-Federal lands in National Park Service areas, development of marine sanctuaries, or other restoration actions.

HOW

ADF&G will use methodology developed during previous Harlequin duck studies. The 1993 project will collect Harlequin ducks to test for anatomical, histological, and chemical differences between ducks from oiled and unoiled areas of PWS. Two collection periods are planned; one in April, when the ducks would be responding physiologically to changes in photoperiod, and on in late May, when the birds are actually in breeding condition. Aspects of reproductive tract anatomy, including ovary, oviduct, and testis weight, follicle number and size, will be recorded and samples taken for histological examination. Blood and tissue samples will be taken from the 40 collected Harlequin ducks. Blood samples will be analyzed for normal blood parameters and for the presence of elevated levels of haptaglobins and interleukins. Tissues will be examined histologically, and samples from adipose tissue, liver, and bile will be analyzed for the presence of petroleum hydrocarbons. Proventriculus and other gut contents will be removed for hydrocarbon analysis and food habits documentation.

The status of Harlequin reproduction in PWS will be monitored by brood surveys in shoreline habitats during August. All major stream mouths in the western PWS oil spill area will be visited. Equivalent surveys will be conducted in eastern PWS.

The 1993 Harlequin duck project will assist the Habitat Protection Work Group (HPWG) in the mapping of potential Harlequin duck habitat on Afognak Island. Potential Harlequin duck nesting habitat, brood rearing habitat, and feeding areas will be characterized using habitat parameters documented in Restoration Study 71, new data from field work on Afognak, and databases from remote sensing and other sources. Field reconnaissance of potential Harlequin habitat on Afognak Island will be conducted in early June to determine the feasibility of remotely classifying Harlequin duck habitat. Site-specific information on Harlequins will also be obtained.
This project will coordinate with Restoration Study #051 (Stream Habitat Assessment) to ground-truth aerial photographs and satellite imagery in the Afognak area. There is no financial or operational overlap with project #93051.

ENVIRONMENTAL COMPLIANCE

This project will comply with requirements of the National Environmental Policy Act. No environmental analysis is required to conduct this study, because it is a research project. State and Federal collecting permits will be obtained through regular procedures.

WHEN

This project will be conducted during 1993-1995. Field work will be completed each year by August 30. Report preparation will begin in September, and the annual progress report will be completed before January 30. Literature review and study plan revisions will be conducted during February. Preparation for field work will continue during March-April. Field work will begin in mid-April. Collection periods will occur in April and late May. Field reconnaissance of Afognak Island will be carried out during June. Brood counts will take place between August 15-September 1. Final report preparation will be between September 1, 1994-January 29, 1995.

BUDGET ($K)

	ADF&G
Personnel	$ 89.9
Travel	25.0
Contractual	133.3
Commodities	19.0
Equipment	10.0
Capital Outlay	0.0
Sub-total	$ 277.2
General Administration	22.8
Project Total	$ 300.0

EXXON VALDEZ OIL SPILL PROJECT DESCRIPTION

Project Number: 93034

Project Title: Pigeon Guillemot Colony Survey

Project Category: Habitat Protection and Acquisition

Project Type: Birds

Lead Agency: Department of the Interior, Fish and Wildlife Service

Cooperating Agencies: None

Project Term: January 1, 1993 to December 31, 1993

INTRODUCTION

A. Background

The pigeon guillemot (*Cepphus columba*), a diving seabird, feeds in nearshore waters and nests in numerous small colonies on rocky shores throughout the eastern North Pacific. The U.S. Fish and Wildlife Service began studies of pigeon guillemots at Naked Island in the center of Prince William Sound (PWS) during the late 1970s when oil tanker traffic began through the Sound. These studies have provided baseline data for evaluating the effects of the spill on guillemots.

An estimated 2,000 to 3,000 guillemots were killed as a direct result of the *Exxon Valdez* oil spill. These birds may have represented as much as 10% of the cataloged pigeon guillemot population in the Gulf of Alaska, and 33% of the 1991 estimated PWS population. Pigeon guillemots are one of six seabird species that showed significantly greater declines in the oiled area of PWS. The PWS summer population has declined from over 15,000 in 1972 to 6,585 in 1991. At Naked Island, guillemot numbers declined more in oiled areas, and a complete colony census in 1992 showed continuing decline. Adults were contaminated internally, and unhatched eggs showed internal and external contamination in 1989 and 1990. On a daily basis throughout the summer, guillemots perch on intertidal and supratidal rocks at nesting colonies, and researchers have hypothesized that guillemots were, and continue to be, contaminated by shoreline oiling.

Knowledge of the distribution of guillemot colonies and of the number of birds breeding at these colonies is very limited. Because guillemots often represent only a small number of the birds nesting at large multispecies colonies, researchers typically only list guillemots as present, and good estimates of their numbers are not often made. In addition, guillemots nest at many locations where the other more abundant seabirds do not breed, thus the majority of guillemot colonies are missed completely.

Within the spill area, censuses specific for pigeon guillemots have been conducted only in very limited areas around Naked Island and Afognak Island (1992 only). Although Bird Study 2 provided a population estimate for PWS guillemots, these surveys were not designed to identify breeding colonies. Information on the location and degree of oiling at guillemot colonies would

identify areas where protection management actions might be appropriate or where additional cleanup could benefit guillemots.

B. Location

This project will be conducted in PWS with efforts focused primarily in the western sound.

WHAT

A. Goal

The goal of this project is to enhance recovery of pigeon guillemot populations injured by the *Exxon Valdez* oil spill. This goal will be accomplished by identifying important breeding areas for possible protection or additional cleanup.

B. Objectives

1. Locate all pigeon guillemot nesting colonies within the EVOS area of PWS, and estimate numbers of birds at each.

2. Survey Naked Island colonies during the first week in June.

3. Locate pigeon guillemot colonies within selected areas outside the spill area as non-oiled controls, and estimate numbers of birds.

4. Secondary objectives
   a) Determine which colonies or areas are best suited for comparative monitoring of future population productivity.
   b) Determine which colonies or areas may benefit from restoration efforts, and suggest possible restoration strategies.

WHY

A. Benefit to Injured Resources/Services

This project will benefit injured pigeon guillemot populations by identifying and censusing guillemot colonies throughout the spill area. Important breeding areas must be identified to enable protective measures or land acquisition which will benefit guillemot restoration. Guillemots nest in crevices among supratidal talus, on cliffs, or in the cavities formed by the roots of trees at the forest/cliff edge. Guillemot nest sites are sensitive to logging operations or other shoreline developments, since they utilize forest edges and beach talus. Because guillemots tend to feed near their nest sites, adjacent foraging areas could also be impacted by such activities as logging, tailings from mining operations, intensive commercial fishing, barge or dredging operations, and recreation activities. Thus, foraging areas near large guillemot colonies might be included in a marine sanctuary system or be protected by an extended buffer strip.

B. Relationship to Restoration Goals

This project meets the Trustee Council goal of restoring the environment to its pre-spill condition by identifying management actions that will help restore an injured marine bird species.

HOW

A. Methodology

Pigeon guillemot colonies will be located and censused by cruising the shoreline when birds are at their colonies. The optimum time for locating colonies is prior to incubation, in May and early June, at 0400-0800 h or at high-tide. In PWS, three teams of two observers operating from 25-foot boats will find colonies by cruising close to shore during the appropriate hours. About 60 km of shoreline can be covered per boat per day during appropriate hours, so that much of the west side of PWS can be covered in May and early June. Colony locations will be marked on topographic maps and lat/long recorded using the Global Positioning System. Colonies will also be censused. Habitat, nest accessibility and onshore oiling at each colony will be recorded.

B. Coordination with Other Efforts

This project will use existing distribution and abundance data collected by the PWS boat survey project (former Bird Study 2) to determine likely guillemot colony locations. This project will also share personnel and equipment with the proposed 1993 boat survey project (Project 93045), assuming both projects are approved. Data on colony locations will be added to the Catalog of Alaskan Seabird Colonies. The catalog, including updated information such as will be collected by this proposed project, will be used as a data layer for the oil spill area geographic information system being developed under proposed project 93060 (Accelerated Data Acquisition for Habitat Protection/Acquisition).

ENVIRONMENTAL COMPLIANCE

This project relies on non-intrusive methods and appears to qualify for a categorical exemption from the requirements of the National Environmental Policy Act.

WHEN

March - April 1993	Study design and logistical planning
May - June 1993	Colony census
Sept. - Dec. 1993	Data analysis, report

BUDGET ($K)

	USFWS
Personnel	$ 88.0
Travel	4.4
Contractual	49.5
Commodities	6.2
Equipment	1.0
Capital Outlay	0.0
Sub-total	$ 149.1
General Administration	16.7
Project Total	$ 165.8

EXXON VALDEZ OIL SPILL PROJECT DESCRIPTION

Project Number: 93035

Project Title: Potential Impacts of Oiled Mussel Beds on Higher Organisms: Contamination of Black Oystercatchers Breeding on Persistently Oiled Sites in Prince William Sound

Project Category: Restoration Monitoring/Restoration Manipulation

Project Type: Birds

Lead Agency: Department of the Interior, Fish and Wildlife Service

Cooperating Agencies: None

Project Term: January 1, 1993 to March 15, 1994

INTRODUCTION

A. Background

The Shoreline Assessment Program which has monitored the recovery of beaches impacted by oil from the *Exxon Valdez* spill has documented the existence of persistent oil contamination in dense blue mussel (*Mytilus edulis*) beds at more than 100 sites throughout western Prince William Sound (PWS). The oil has been trapped under the mussels in the byssal mats that anchor the mussels to each other and to the substrate. In this anaerobic environment, the oil has not degraded. Sheening from these beds has been observed, and aromatic compounds are still present.

The black oystercatcher (*Haematopus bachmani*) is a large shorebird that lives on rocky intertidal shores throughout the North Pacific. They nest in the open on rocky points and islets and rely on cryptic egg coloration and distractive behaviors to avoid predation of eggs and chicks. After hatching, adults feed their chicks until the chicks are capable of feeding themselves; the total length of this rearing period is unknown, but may last two or more months. During the early rearing period, the adults and chicks occupy a feeding territory in the vicinity of the nesting site. Black oystercatchers feed on a variety of intertidal mollusks, including mussels which form a significant portion of the diet of both adults and chicks. In PWS, oystercatchers favor gravel shorelines, and mussel beds embedded in sand/gravel beaches are an important foraging habitat. The mussel beds used by oystercatchers in PWS occur in low energy environments where oil persists. Because oystercatcher chicks are fed food items from a restricted area near their natal site, oystercatcher chicks are excellent subjects for monitoring how oil from the *Exxon Valdez* spill is affecting the physiology and reproduction of a higher vertebrate species. Because of their complete dependence on rocky intertidal areas and the importance of mussels in their diet, black oystercatchers can serve as an indicator species for assessing the condition of rocky intertidal habitats and the continuing presence of oil in such habitats.

B. Summary of Injury

Oil from the *Exxon Valdez* contaminated rocky shorelines used by black oystercatchers for feeding and nesting. Based on initial studies in PWS at Green Island, the oiling affected black oystercatchers by reducing the number of breeding pairs and by reducing egg volume. Subsequent studies demonstrated that oystercatcher chicks raised on oiled beaches, despite being delivered a larger biomass of food, grew slower than chicks raised on unoiled beaches. Based on studies with captive birds, ingestion of oil can decrease growth because energy that would otherwise be used for growth is used to fuel the metabolic processes that detoxify oil. The reduced growth rates of chicks raised at sites with persistent oil contamination is still occurring, suggesting continuing injury due to the presence of *Exxon Valdez* oil in rocky intertidal habitats.

C. Location

This study will be conducted in Prince William Sound. Study sites will include Montague Island (unoiled), Green Island (oiled) and Knight Island (oiled).

WHAT

A. Goal

The goal of this study is to determine whether black oystercatchers breeding on shorelines with persistent oil contamination in Prince William Sound are affected by their use of these habitats. This study will determine if there is a link between use of oiled mussel beds by oystercatchers and their reproductive success, as evidenced by chick growth rates and recruitment.

B. Objectives

1. To determine if the continued persistence of hydrocarbons in mussel beds is being transferred to chicks via the food chain and is responsible for depressed growth rates.

2. To assess the recruitment of oystercatchers into the breeding population and the survival of sub-adult birds that were raised in oiled territories.

WHY

A. Benefit to Injured Resources

This study will be beneficial to the restoration of black oystercatchers because the study will determine whether continuing injury or recovery is occurring at oiled sites. If recovery is not occurring, the study is designed to reveal whether a cause of the continuing injury to oystercatchers is use of oiled mussel beds for feeding. This study will identify specific mussel beds and their characteristics which result in the continuing injury to oystercatchers. These data could be used to identify sites needing additional treatment. Treatment of such sites will eventually benefit oystercatchers by returning their foraging areas to a normal condition.

B. Relationship to Restoration Goals

This study meets two Trustee Council restoration goals: restoration monitoring and restoration manipulation. This study will determine whether black oystercatchers are continuing to be adversely affected by persistent oil contamination. This information is necessary to plan meaningful restoration actions. This study will also identify areas with persistent contamination and document the effects of that contamination on a higher trophic level organism. These data could be used by the Trustee Council to identify specific areas needing additional treatment so that the contamination can be eliminated.

HOW

A. Methodology

Study methodology will follow previous study plans. From June to late August, study personnel will operate from field camps at Herring Bay, Knight Island, Montague Island, and Green Island. Chicks raised on Montague Island will serve as unoiled controls.

Chicks will be banded with individually-recognizable color bands when $\geq$7 days old and will be reweighed twice before fledging. At $\geq$25 days, blood samples will be collected from chicks. Fecal samples from chicks will be collected and analyzed to determine the presence of hydrocarbons (n=50).

Recruitment of young into the breeding population and overwinter survivorship will be determined by relocation of color-banded birds marked in previous years by this study (n=140+).

Samples of mussels from mussel beds used by black oystercatchers for feeding will be collected for hydrocarbon analysis by the NOAA oiled mussel bed project.

B. Coordination with Other Efforts

This study continues damage assessment and restoration projects on black oystercatchers in 1989, 1991 and 1992. As in 1992, the study will coordinate with the proposed NOAA oiled mussel bed study to ensure that oiled mussel beds used by oystercatchers are included in the NOAA sampling program. This study will also coordinate with the proposed harlequin duck study.

ENVIRONMENTAL COMPLIANCE

This study is a non-intrusive study primarily involving observations and infrequent handling of live birds. No birds will be collected. Samples of oystercatcher fecal material and food items will be collected for analysis of hydrocarbon content. This study appears to qualify for a categorical exemption from the requirements of the National Environmental Policy Act.

WHEN

March - May 1993	Logistical planning
May 20 - Aug. 10, 1993	Field data collection
Aug 11 - Oct. 31, 1993	Data entry, analysis; fecal sample analysis
Nov 1 - Dec. 31, 1993	Draft report written and internal review
January 1994	Draft report submitted for peer review
April 1, 1994	Final report

BUDGET ($K)

	USFWS
Personnel	$ 38.0
Travel	4.0
Contractual	48.0
Commodities	6.0
Equipment	3.0
Capital Outlay	0.0
Sub-total	$ 99.0
General Administration	8.9
Project Total	$ 107.9

EXXON VALDEZ OIL SPILL PROJECT DESCRIPTION

Project Number: 93036

Project Title: Recovery Monitoring and Restoration of Intertidal Oiled Mussel Beds in Prince William Sound and the Gulf of Alaska Impacted by the *Exxon Valdez* oil spill

Project Category: Restoration Monitoring and Restoration Manipulation

Project Type: Coastal Habitat

Lead Agency: National Oceanic and Atmospheric Administration

Cooperating Agencies: National Park Service; U. S. Fish & Wildlife Service; Alaska Department of Fish and Game; and Alaska Department of Environmental Conservation

Project Term: January 1, 1993 to December 31, 1997

INTRODUCTION

A. Background

The persistence of *Exxon Valdez* crude oil underlying some densely packed mussel (*Mytilus trossulus*) beds in Prince William Sound, Alaska, began to cause concern, 1991, among scientists from State and Federal agencies. With the encouragement of the Restoration Team and the Trustee Council, staff from several agencies conducted a field survey and sampled mussels and underlying sediments from several sites in June of 1991. Subsequent sampling trips were conducted by NOAA in August and September of that year and several times to date in 1992.

Preliminary analytical data indicate total aromatic hydrocarbon concentrations as high as 470 ppm dry weight in sediments and 5.5 ppm dry weight in mussels. Natural recovery of oiled mussel beds appears to be minimal.

B. Summary of Injury

High concentrations of oil in mussels from oiled mussel beds may provide a source of continued exposure to petroleum hydrocarbons through ingestion by higher consumers. There may be possible linkage to 2 species of birds - harlequin ducks and black oystercatchers; and possibly river and sea otters. The presence of these contaminated beds is also of concern for human subsistence.

C. Location

Identified and verified oiled, densely packed mussel beds are located throughout the western and southwestern part of Prince William Sound. The National Park Service has also surveyed and sampled mussels and sediments from oiled sites along the Kenai Peninsula and proposes to continue the monitoring in 1993. NPS expects to extend the geographic area of site survey to

the Kodiak area.

WHAT

A. Goal

The overall purpose of this project is to document continued bioavailability of petroleum hydrocarbons to consumers of contaminated mussels, and determine the rate of recovery of oiled mussel beds with and without manipulation. Restoration/recovery methodology will be tested to accelerate cleansing of oiled mussel beds.

B. Objectives

1.a. To measure recovery of petroleum hydrocarbon concentrations to background levels in mussel bed sites manipulated in 1992. This involves three sites treated by NOAA and two sites manipulated by ADEC in 1992; and additional sites if cleaning mussel beds is initiated by ADEC in 1993 under Project 93038. [NOAA]

b. To test the feasibility of new, minimally intrusive manipulative techniques at 3 oiled mussel bed sites within Prince William Sound; and to conduct restorative manipulations at selected sites in the Gulf of Alaska. [NOAA, NPS]

2. To measure natural recovery in levels of petroleum hydrocarbons in mussels and underlying sediments and oiled mussel beds identified and sampled in 1991 and 1992 and to sample mussel beds in areas newly identified by other agency field investigators. [NOAA, NPS]

3. To measure the physiological and reproductive injury of mussels, with and without treatment. [NOAA]

WHY

A. Benefit to Injured Resources/Services

This project will provide data on the efficacy of natural recovery processes and the efficacy of on-site cleaning or manipulation to hasten return to background levels.

Documentation of the level of hydrocarbons in oiled mussel beds or recovery of oiled mussel beds is necessary to evaluate continued linkage to injury seen in consuming species - harlequin ducks, black oystercatchers, river and sea otters; and, will provide necessary information for human subsistence purposes.

B. Relationship to Restoration Goals

If petroleum hydrocarbon concentrations remain high in these beds in 1993; further action may be necessary to minimize or eliminate these mussels as a pathway of oil being incorporated into the food chain of consuming mammals and birds. Recovery monitoring is necessary to insure that

petroleum hydrocarbon levels in sediments and mussels have returned to background levels and are no longer a source of contaminated prey.

HOW

A. Methodology

Sampling of mussels and sediments for petroleum hydrocarbons will follow protocol established by NOAA and the NRDA process. NOAA's Auke Bay Lab has successfully established a fast screening method (UV Fluorescence) for sediment hydrocarbons. Using this technique, we have documented that hydrocarbon distribution within a heavily oiled mussel bed appears to be patchy and probably related to grain size of the sediment. Rapid turn around of hydrocarbon data allows targeting manipulative areas in a timely manner. Most sediment samples will be analyzed using this method and only selected sediment samples (mostly for method verification) and mussel samples (based on UV levels found at particular sites) will be analyzed by gas chromatography/mass spectroscopy.

Samples for histopathological analyses have been collected several times at manipulated and control sites in 1992 and we propose to process them and have them examined for anomalies, particularly precancerous conditions associated with long-term exposure to petroleum hydrocarbons. Data for condition and reproductive indices for mussels from selected sites will be calculated using accepted standard methods.

Byssal thread extrusion rates were measured in May 1992 and again in June 1992 in mussels from selected sites and data from these trials are currently being analyzed. Depending on results, we may again repeat this test in May 1993. Thread extrusion rates can be a sensitive indication of overall physiological health. These tests incorporate hydrocarbon depuration while mussels are exposed to clean seawater.

Maps will be produced showing within site variation of petroleum hydrocarbon concentrations at manipulated sites. These will show a time series to illustrate changes in concentrations at 30 days, 90 days and 1 year. Standard statistical analytical methods will be used on data and will be tested at the $P = .05$ level. Guidance here will come from that given by the NRDA peer reviewers.

B. Coordination with Other Efforts

Close coordination with principal investigators of species affected by ingestion of oiled mussels will be maintained to identify new areas of continued contamination.

ENVIRONMENTAL COMPLIANCE

This is a field research project in which routine data collection will take place which is limited in context and intensity. Consequently, this project is categorically excluded from being required to provide an Environmental Impact Statement or Environmental Assessment.

WHEN

Analytical Analyses: GC/MS analyses will be conducted at the completion of all NRDA samples still in the analytical queue. Selected mussel and sediment analysis are scheduled to begin in December 1992 and expected to continue on an as needed basis through 1993. UV fluorescence screening will be done on an as needed basis. This technique produces data within 10 days. We estimate processing around 500 samples by this method in 1993.

Biological and physiological measurements and data from 1992 will be analyzed during Jan-Mar 1993.

Field work on manipulated sites is scheduled to occur during May with follow up evaluation at 30 days and at the end of the field season. Resampling of oiled mussel sites already identified and any new sites proposed by other agency field personnel will be sampled at a suitable low tide series - probably in late June. Some of this site sampling may be coordinated with the other trips.

BUDGET ($K)

	NOAA	USNPS	ADEC	TOTAL
Personnel	$ 126.0	$ 31.5	$ 0.0	$ 157.5
Travel	23.0	6.0	0.0	29.0
Contractual	70.0	45.0	0.0	115.0
Commodities	26.0	7.6	0.0	33.6
Equipment	34.0	4.0	0.0	38.0
Capital Outlay	0.0	0.0	0.0	4.0
Sub-total	$ 279.0	$ 94.1	$ 0.0	$ 373.1
General Administration	23.8	7.9	0.0	31.7
Project Total	$ 302.8	$ 102.0	$ 0.0	$ 404.8

EXXON VALDEZ OIL SPILL PROJECT DESCRIPTION

Project Number: 93038

Project Title: Shoreline Assessment

Project Category: Restoration Monitoring

Project Type: Coastal Habitat

Lead Agency: Alaska Department of Environmental Conservation

Cooperating Agencies: Trustee Agencies

Project Term: January 1, 1993 to September 30, 1993

INTRODUCTION

Shorelines treated during spill response activities need to be monitored to ensure recovery is proceeding at an acceptable rate and that winter storms have not brought subsurface oil to the surface. Shorelines treated in 1992 and other potentially oiled sites need to be evaluated to determine if the shorelines responded to treatment, or if additional treatment is required to restore resources and services. Technical experts with *Exxon Valdez* spill experience from the State and Federal agencies along with the local communities will evaluate impacted shorelines for the presence of *Exxon Valdez* hydrocarbons. The evaluation will document the amount of remaining hydrocarbons and determine if the remaining oil impacts shoreline activities.

This project is divided into two phases. Phase 1 is the physical survey of selected shorelines. This project will use the assessment procedures developed and refined during the *Exxon Valdez* spill clean up. Agency surveyors and upland landowners will evaluate shorelines and determine if additional activities would be of net benefit to restore resources and services. Phase 2 is the restoration of land and resource uses, if necessary. Light duty restoration activities would be performed during and after the survey by the surveyors where feasible. Larger scale treatment work, if necessary, would be identified on work orders and restoration crews from Chenega, Port Graham or other areas would be hired to perform the identified work.

This project will assess *Exxon Valdez* impacted shorelines in Prince William Sound and the Gulf of Alaska. The principal areas are Knight, Latouche, Evans, Elrington, Green, and Disk Islands in Prince William Sound and Tonsina Bay, Windy Bay, and Chugach Bay in the Gulf of Alaska. These areas are in proximity to Chenega Village, Whittier, Port Graham, Seward and Homer.

WHAT

The overall purpose of the project is to ensure that shorelines have recovered sufficiently to facilitate normal shoreline activities. The project objectives are to assess the shoreline hydrocarbon concentrations and, where appropriate, to carry out necessary treatment either during the survey or following the survey using local work crews to perform the identified work.

The shoreline assessment will utilize the process developed and refined since the 1989 spill:

1. Survey shorelines for the presence of *Exxon Valdez* hydrocarbons.
2. Determine if resource uses are affected by hydrocarbons.
3. Perform light duty manual treatment to restore resource use if necessary and feasible.
4. Write work orders for local crews to treat the shoreline if necessary.
5. Document field activities.

WHY

This project will assess shorelines and determine if resources and services are still impacted and the need for additional treatment, if any. The public, land owners, and resource managers need to have current and accurate field information for operation and management. If resources are impacted and need to be restored, technical experts need to survey the sites and determine the best course of action to correct the problem and not cause further damage. Impacts on resources will be corrected and resource use will be restored. Public complaints about the presence of hydrocarbons can be assessed and addressed through the framework of this project.

Information collected by this project will assist Trustee Council review of other projects submitted for funding. This project will provide current, accurate information about shoreline conditions that will help with funding decisions for other activities. Accurate field information will be used by Restoration Team members to identify areas with persistent hydrocarbon concentrations that may slow restoration activities.

HOW

The Alaska Department of Environmental Conservation, in conjunction with the other Trustee Agencies and in consultation with the U. S. Coast Guard, will review the 1992 shoreline survey information and produce a list of subdivisions to be surveyed in 1993. This list will then be circulated to subsistence users by Project 93017 (Subsistence) and to land owners and resource managers to identify additional sites to be included on the 1993 survey. Agency personnel will review the proposed survey list and ensure that oiling conditions at each segment warrant an assessment. The survey list will be prioritized based on resources affected and projected oil concentrations. For planning purposes, we have assumed that 80 sites or less will be recommended for survey. After a final list is developed, the survey list will be sent to land and resource agencies for their approval and clearance to assess the sites.

Phase 1 is the physical survey of the shorelines. Agency technical experts and the upland owners will assess the shoreline segments and document oiling conditions. The survey team will be berthed on a vessel and use skiffs to access the shoreline. Float planes will provide logistics support. Previous *Exxon Valdez* surveys have used these logistics as the most cost effective and time efficient support structure. Agency representatives will be chosen for their environmental and habitat experience. Each person will have extensive *Exxon Valdez* spill experience. Surveys

will be conducted daily during both low tide windows with appropriate weather and light conditions. Field information will be recorded on forms previously generated during *Exxon Valdez* surveys to facilitate comparison and familiarity of the existing databases.

Phase 2 is the restoration of resources and services, if necessary. Agency personnel with input from the landowner will determine if treatment is necessary based on established State and Federal standards. Such a determination would include consideration of the resources impacted by the oil, the area and concentration of remaining oil, the cost effectiveness and technical feasibility to treat the oil, the services such as subsistence provided by the shoreline segment, and a reasonable expectation that the treatment will not cause more damage than allowing the oil to remain in place. Such a determination would be made by the Agencies in consultation with the Chief Scientist. The State On-Scene Coordinator will resolve disagreements between Agencies. Any light duty restoration work that is determined to be necessary would be completed during and after the survey by the surveyors which have proven to be the most cost effective method of treatment. Additional restoration treatment would be identified with work orders and the treatment will be performed using local work crews. Necessary treatment would usually consist of hand labor using shovels, rakes, and bags. A determination of appropriate restoration activities, if any, to be done in oiled mussel beds would be based upon results from the 1992 mussel bed study (R-103), the 1993 spring survey of project 93036 (Monitoring of Oiled Mussel Beds), and other completed and ongoing damage assessment and restoration studies. Any treatment work done in oiled mussel beds will be conducted in conjunction with Project 93036 to ensure appropriate treatment methods are used and to monitor the effectiveness of treatment.

The need for shoreline treatment work, if any, in 1993 cannot be determined until the 1993 shoreline assessment is completed and the results of several damage assessment and restoration studies become available this winter and next spring. Because of the necessity of preplanning logistics support, we will assume limited treatment work will be necessary. If treatment is found not to be necessary, the logistics support will not be used, and the money will be returned to the Trustee Council for use in other restoration activities. If treatment is found to be necessary at a level greater than initially authorized, we will request additional funds from the Trustee Council to expand the effort.

Surveyors and work crews will be required to attend Hazwoper training.

Wastes generated during restoration activities will require treatment at approved facilities.

ENVIRONMENTAL COMPLIANCE

As in prior years, permits and notifications will be required by several permitting agencies. All permits will be obtained prior to commencement of field work.

WHEN

The duration of this project will be determined by yearly surveys of contaminated sites. The project will be recommended for termination as soon as conditions warrant. Funds expended in 1993 will be proportional to the amount of restoration work necessary. Unexpended funds will be returned for use on other projects in later years. If work is necessary in future years,

milestones would be similar for each year. Costs would vary in future years due to the size of the survey and type of restoration activities.

Dates	Project Activity
Jan. 15 - Feb. 15, 1993	Solicit input from landowners and resource agencies on sites to be surveyed.
March 1, 1993	Produce final list of survey sites for Trustees.
March 7, 1993	Submit request for bids for vessel and float plane.
March 30, 1993	Receive approvals from land and resource agencies to access shoreline for survey and restoration activities.
April 15, 1993	Secure contracts for vessel and float plane.
May 15, 1993	Surveyors, landowner representatives, and work crews receive Hazwoper training.
Jun. 1 - Jul. 15, 1993	Perform survey.
August 15, 1993	Complete restoration activities, if any.
September 30, 1993	Complete report and documentation.

BUDGET ($K)

	ADEC	ADF&G	ADNR	USFS	USDOI	NOAA	TOTAL
Personnel	$ 147.1	$ 10.0	$ 10.0	$ 10.0	$ 10.0	$ 10.0	$ 197.1
Travel	6.0	0.0	0.0	0.0	0.0	15.0*	21.0
Contractual	252.1	0.0	0.0	0.0	0.0	0.0	252.1
Commodities	16.5	0.0	0.0	0.0	0.0	0.0	16.5
Equipment	5.0	0.0	0.0	0.0	0.0	0.0	5.0
Capital Outlay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sub-total	$ 426.7	$ 10.0	$ 10.0	$ 10.0	$ 10.0	25.0	$ 491.7
General Administration	36.5	1.5	1.5	1.5	1.5	1.5	44.0
Project Total	$ 463.2	$ 11.5	$ 11.5	$ 11.5	$ 11.5	$ 26.5	$ 535.7

* For U.S. Coast Guard participation.

EXXON VALDEZ OIL SPILL PROJECT DESCRIPTION

Project Number: 93039

Project Title: Herring Bay Experimental and Monitoring Studies

Project Category: Restoration Manipulation and Enhancement, and Restoration Monitoring

Project Type: Fish and Shellfish

Lead Agency: Alaska Department of Fish and Game

Cooperating Agencies: None

Project Term: January 1, 1993 to September 30, 1996

INTRODUCTION

Marine intertidal communities were the largest single category of habitat affected by the *Exxon Valdez* oil spill. Experiments conducted at Herring Bay, Knight Island, and throughout the EVOS impact area since 1990 clearly indicate that one of the consequences of the oil spill and resultant clean-up activities was injury to intertidal algal and invertebrate populations, especially in the mid- to upper-intertidal zones. The dominant organism in this community is the seaweed *Fucus gardneri* which provides habitat and food for a variety of invertebrates. These invertebrates in turn serve as an important food source for marine mammals, birds, and fishes. This project is designed to examine the impact of oil on relationships between and among intertidal invertebrates and plants, to investigate means of restoring *Fucus* populations and to provide detailed monitoring of the recovery of intertidal communities over the long term.

A. Summary of Injury

Studies to date indicate that plants and animals living in the upper portion of the intertidal zone suffered extensive injury. In fact, data from 1991 show that some species were still declining in abundance. The upper intertidal is where oil was deposited on rocks and sediments during ebbing tides and where clean-up activities were focused. The dominant alga, *Fucus gardneri*, was greatly reduced in many of these areas, and experiments indicate that several years will be required for its recovery in the lower- and mid-intertidal zones. Recovery of this species in the upper intertidal will require an even longer period. Oil inhibits recruitment of *Fucus* and other algae, and *Fucus* does not recruit successfully onto the cleaned, bare rock surfaces. Grazers such as limpets were also reduced by the spill/cleanup and have been unable to recover, due to lack of food and shelter normally provided by the algae. Barnacles have recruited on oiled surfaces, even tar, but our studies show poor subsequent survival. Our data show some recovery in the mid- to lower-intertidal zone, but recruitment is not consistent between locations and years. Recruitment variability appears to have a greater impact on intertidal community structure in Alaska than at lower latitudes.

B. Location

The proposed restoration, monitoring, and experimental studies will be conducted in Herring Bay, Knight Island. Intertidal studies were initiated in Herring Bay in May 1990 and have continued through the 1992 season. Herring Bay was heavily oiled in 1989, and was a central area for clean-up efforts. The Bay was chosen for experimental studies because of its oiling history and proximity to non-oiled sites used as controls.

WHAT

A. Goals

1. To understand what factors limit and/or facilitate recolonization of the intertidal by algae, especially *Fucus*, and invertebrates such as barnacles, mussels, and limpets.

2. To provide controlled, long-term natural recovery monitoring of inter-tidal communities such that natural variability can be differentiated from oil/clean-up effects.

B. Objectives

1. Quantify recruitment rates, survivorship, and population dynamics of barnacles and other sessile invertebrate species on oiled, oiled and cleaned, and non-oiled substrates and at matched oiled and non-oiled sites.

2. Determine the recovery rate of important community members dependent upon other species reduced or eliminated by the spill, i.e., second-order impacts. And determine the recovery rates of species with poor dispersal capabilities, e.g., the predators *Nucella* and *Leptasterias*.

3. Quantify the population structure and population dynamics of *Fucus* in oiled, oiled-cleaned, and control sites to monitor and to project recovery rates, especially in the upper intertidal zone areas denuded by the oil spill/clean-up activities.

4. Develop techniques for restoring *Fucus* by reducing heat and desiccation stress with a biodegradable substratum.

WHY

A major goal of restoration is to ensure that "injured resources have been restored to their pre-spill baseline conditions." Many plant and animal species were damaged directly by the fresh crude oil of the EVOS and/or the subsequent clean-up activities. Previous work in Herring Bay has shown that some populations continued to decrease in 1991 (1992 data not in yet), suggesting continuing expression of the original impact or additional damage due to residual oil. Experimental studies on the impact of the oil spill on intertidal community structure and recovery dynamics have been conducted in Herring Bay since 1990 and should be continued. A long-term monitoring commitment within Prince William Sound will provide several benefits, including (a) an

understanding of the year-to-year variables that affect intertidal community structure, (b) an understanding of long-term consequences of an oil spill, and (c) establishing baseline data and an understanding of complex community structuring mechanisms at monitoring locations strategically located within Prince William Sound, should there be a future perturbation.

HOW

Population dynamics of *Fucus*, sessile invertebrates, and grazers (limpets) will continue to be quantified in established quadrats at oiled and unoiled sites. Recruitment of algae and invertebrates on tarred, cleaned, and control substrata will be determined, with and without grazing. The impact of grazing on algal recruitment and the role of algae in providing food or shelter on survival or recruitment of other species will be examined in enclosures and exclosures.

Growth rates of tagged *Fucus* plants will be determined. Studies will be continued on *Fucus* egg dispersal, survival, and recruitment at oiled and unoiled sites. Experiments will be conducted on the effects of substrata heterogeneity, herbivory, shading by *Fucus* canopy, and tide level on settlement and recruitment of *Fucus* embryos.

Data from the Damage Assessment studies in Herring Bay have shown that the recovery of damaged *Fucus* populations in rocky habitats on steep south-facing beaches has been very slow. The extent of this type of damage throughout PWS will be estimated using data contained in the Department of Natural Resources Oil Spill GIS database. New data on beach aspect and beach slope in PWS will be generated under a technical services contract to DNR. The GIS model to estimate the areal extent of damage will be developed by Coastal Resources Associates. Field verification of the model and data quality assurance will be conducted in Herring Bay and in nearby sheltered rocky intertidal habitats.

For the *Fucus* restoration study, we will use biodegradable erosion-control fabric that has been seeded with *Fucus* embryos. A series of tests will be conducted to determine the optimum fabric type, of the several varieties available, to maintain sufficient moisture for embryo survival, yet provide enough open space for light for the growth of juvenile plants. We will eliminate the potential problem of lack of natural settlement by seeding the fabric with *Fucus* embryos for adding fertile adult plants. Unseeded strips will be used to test whether embryo seeding is necessary. The cost effectiveness of this procedure for large-scale restoration will be assessed.

ENVIRONMENTAL COMPLIANCE

We anticipate that this project will be categorically excluded.

WHEN

Each year of the study, the field season will commence on a low-tide series in late April. Approximately two weeks will be required to record winter results and initialize experiments for the season. Three subsequent 10-day visits will be made to Herring Bay during the summer low tides. Our objectives will be to collect quantitative data from the experiments and to monitor our restoration efforts. Reports will be prepared by March 1 of each year.

BUDGET ($K)

	ADF&G
Personnel	$ 7.5
Travel	0.0
Contractual	441.7
Commodities	0.0
Equipment	0.0
Capital Outlay	0.0
Sub-total	$ 449.2
General Administration	21.3
Project Total	$ 470.5

EXXON VALDEZ OIL SPILL PROJECT DESCRIPTION

Project Number: 93041

Project Title: Comprehensive Restoration Monitoring Program Phase 2: Monitoring Plan Development

Project Category: Restoration Monitoring

Project Type: Monitoring

Lead Agency: National Oceanic and Atmospheric Administration

Cooperating Agencies: Alaska Department of Fish and Game; Alaska Department of Environmental Conservation; Alaska Department of Natural Resources; U.S. Department of Agriculture, Forest Service; U.S. Department of Interior, Fish and Wildlife Service; U.S. Department of Interior, National Park Service

Project Term: January 1, 1993 to September 30, 1993

INTRODUCTION

A. Background

Resources to be monitored include affected floral and faunal assemblages as well as impacted substrates upon which they depend. Services arising from injured natural resources will also be monitored inclusive of, but not limited to, recreation, subsistence, and wilderness and intrinsic values. Finally, injured archaeological resources will be monitored.

B. Summary of Injury

The *Exxon Valdez* oil spill occurred just prior to the most biologically active season of the year. During the four-month period following the spill, critical life stages of algae, invertebrates, fish, birds, and mammals encountered the most concentrated, volatile, and potentially toxic forms of the spilled oil. While different species demonstrated varying levels of injury, sea otters and marine birds (common and thick-billed murres, sea ducks) were particularly hard-hit. Portions of 1200 miles of coastline were oiled resulting in impacts to intertidal and shallow subtidal resources. Oil reached shorelines nearly 800 miles from Bligh Reef, the site of the spill. Of continuing concern, resources are exposed to oil remaining in the intertidal zone or transported to the subtidal zone. Following the spill, recreational use of public lands and waters declined and archaeological resources along the shoreline also were injured. For a more detailed account of injuries to individual species, habitats and services, see Chapter IV of the *Exxon Valdez* Oil Spill Restoration Volume 1: Restoration Framework.

C. Location

Monitoring will be conducted on and in surface waters, on tidelands, and on adjacent uplands

including their watersheds in Prince William Sound and the Gulf of Alaska.

WHAT

A. Goal

This project will establish the design of the monitoring component of the Restoration Plan. The goal is to develop a comprehensive and integrated restoration monitoring program that will follow the progress of natural recovery, evaluate the effectiveness of restoration activities, and establish an ecological baseline from which future disturbances can be evaluated.

Implementation of this multifaceted program requires central coordination and management. To successfully implement an ambitious and wide-ranging program as contemplated, a high degree of organization is needed to create the design, to analyze, interpret and disseminate the data generated, and to assure that all aspects of the program are carried out as designed.

B. Objectives

This program will assist the Trustees in various organizational and coordination activities in support of developing a comprehensive, interdisciplinary and integrated program of restoration monitoring aimed at:

1. assessing the rate of natural (unassisted) recovery of injured resources and services;

2. evaluating the effectiveness of restoration activities, identifying where additional restoration activities may be appropriate, and determining when injury is delayed, and;

3. following the dynamics of other ecological components (those important in the food webs of injured species) to document long-term trends in the environmental health of the affected ecosystem.

To fulfill these objectives, a three-phase program is planned. Phase 1 is being conducted in early FY93 and focuses on the development of a "conceptual" plan for monitoring[1]. Phase 2, which is the focus of this proposal, will be conducted over essentially the second-half of FY93 and deals with developing the technical plans for monitoring. Phase 3 provides for management of the monitoring program following full implementation (FY94 thru FY2203).

WHY

Monitoring is necessary to assess the adequacy of natural recovery. Resources and associated services that are found to be recovering at an unacceptable rate may have to be reconsidered as candidates for restoration action. Likewise, resources and services that are found to be

[1] Environmental Protection Agency pass-through money in 1991.

recovering faster than anticipated may allow for an earlier completion of a restoration endpoint. Monitoring of important physical, chemical and biological properties will establish an environmental baseline for the affected ecosystem. This baseline then can be used to assess the anticipated effects of human activities and to improve our ability to manage affected resources and services over the long-term.

HOW

Phase 1:

In Phase 1, which is being conducted this year (1 September 1992 thru 31 January 1993), a consultant will be asked to assist the Trustees in developing a "conceptual" design for the required monitoring plan. This will provide for more technical planning in Phase 2, which is the focus of this proposal. The conceptual planning in Phase 1 will address but will not be limited to such issues as goals and objectives, what resources and services to monitor, what process is required for management, what relationships need be established with other monitoring programs in the spill zone, and how can monitoring be funded over the long-term. Phase 1 planning also addresses the need to identify which current cleanup, damage assessment and restoration science studies would best serve the purpose of the intended restoration monitoring program.

Phase 2:

In Phase 2 (1 January 93 thru 30 September 93), a consultant will again be asked to assist the Trustees. With an approved "conceptual" plan, the consultant will develop a "detailed" monitoring plan that will be presented as a "strawman" plan for review by technical experts at a workshop. This phase focuses on the technical requirements of an integrated monitoring plan and assumes a close working relationship with the Trustee agencies and contracted peer reviewers. It is further assumed that the Trustee agencies will implement monitoring once this phase of planning is completed and a Final Restoration Monitoring Plan is approved. Phase 2 will establish:

1. what the bounds (magnitude) of the monitoring effort will be;

2. the locations (fixed and rotating) where monitoring should be conducted;

3. a technical design for each monitoring component (e.g., sediments, invertebrates, fish, birds, mammals, and services [recreation, subsistence, aesthetics, etc.]) that specifies how and when data will be collected, analyzed, interpreted, and reported;

4. a data management system to support the needs of the Trustees and other decision makers, planners, researchers and the public. This assumes a system that facilitates a variety of retrieval and analysis functions and is flexible and expandable to meet new and changing needs;

5. a rigorous quality assurance program to ensure that monitoring data produces defensible answers to management questions and will be accepted by scientific researchers and the public;

6. cost estimates for each monitoring component;

7. coordination of this monitoring plan with other monitoring programs that may exist or be proposed; and

8. a strategy for review and update to ensure that the most appropriate and cost-effective monitoring methods are applied.

A workshop approach will be used to establish a model for specific technical requirements. The consultant will then work directly with representatives of the Trustee agencies and peer reviewers to produce definitive monitoring protocols. After completion of a Draft Restoration Monitoring Plan, a program of peer review will be organized and implemented. Subsequently, the draft plan will be issued for public review and comment.

It is proposed in Phase 2 that NOAA/NMFS will assist the Trustees in various organizational and coordination activities pursuant to developing the Draft Final Restoration Monitoring Plan. NOAA/NMFS will design and prepare the RFP to solicit services of a consultant to provide technical expertise. NOAA/NMFS also will design procedures for evaluating the resulting technical proposals and chair a proposal review committee to select a consultant. NOAA/NMFS with the assistance of the consultant also will design and implement a workshop to develop a framework for detailed monitoring protocols, a data management system, a QA/QC program, costs, and a review strategy, etc.

The Trustee agencies will be expected to attend the workshop and to work with NOAA/NMFS and the consultant to provide detailed input to the comprehensive monitoring plan.

Phase 3:

Following development of the Restoration Monitoring Plan, 1994 and beyond will be devoted to Phase 3 - monitoring and management, including audits, annual reviews, data management, and reports.

ENVIRONMENTAL COMPLIANCE

This activity should fall under a categorical exclusion within NEPA because this proposed project is essentially a planning exercise. This does not, however, obviate the responsibility for each Trustee agency to conduct additional NEPA reviews as various components of the comprehensive and integrated monitoring plan are implemented in Phase 3.

WHEN

Phase 1 planning begins 1 September 1992 and will essentially be complete 1 February 1993. Phase 2 planning which is the focus of this proposal will begin 1 February 1993 and essentially be complete 30 September 1993. Phase 3, a fully expanded and integrated monitoring program, will be implemented in the 1994 field season and will continue for the life of the Restoration Monitoring Program (FY95 thru FY2004).

BUDGET ($K)

	NOAA
Personnel	$ 79.0
Travel	15.0
Contractual	100.0
Commodities	15.0
Equipment	10.0
Capital Outlay	0.0
Sub-total	$ 219.0
General Administration	18.9
Project Total	$ 237.9

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EXXON VALDEZ OIL SPILL PROJECT DESCRIPTION

Project Number: 93042

Project Title: Recovery Monitoring of Prince William Sound Killer Whales Injured by the *Exxon Valdez* Oil Spill Using Photo-Identification Techniques

Project Category: Restoration Monitoring

Project Type: Marine Mammals

Lead Agency: National Oceanic and Atmospheric Administration

Cooperating Agencies: None

Project Term: July 1, 1993 to September 30, 2002

INTRODUCTION

A. Background

The killer whale, *Orcinus orca,* occurs in all oceans of the world. Population estimates, based on photo-identification studies, are available for 4 North Pacific regions (inland waterways of Washington, British Columbia, southeast Alaska, and Prince William Sound). Current killer whale population estimates for Prince William Sound are 11 resident pods (representing 245 whales) and eight transient pods (representing 52 whales). Of these killer whale pods, AB pod is the most often encountered pod in Prince William Sound. The resident killer whale pods of Prince William Sound are a valued wildlife resource contributing substantially to the wilderness, aesthetic, tourism, and recreational values of the region.

B. Summary of Injury

The whales of Prince William Sound were studied intensively before the spill, and their social structure and population dynamics are well known. Damage assessment studies of killer whales involved boat-based photo-identification surveys in Prince William Sound. Photographs of killer whales were compared to the Alaska killer whale photographic database for the years 1977 to 1989 to determine the changes in whale abundance, seasonal distribution, pod integrity, mortality and natality rates.

One of the Prince William Sound pods, AB pod, had 36 whales when last sighted before the spill in September 1988. When sighted on March 31, 1989, seven days after the spill, seven individuals were missing. Six additional whales were missing from AB pod in 1990. Assuming that whales missing for two consecutive years are dead, the mortality rates for the AB pod were 19.4 percent in 1988-1989 and 20.7 percent in 1990-1991. The average annual mortality in AB pod in 1984 to 1988 was 6.1 percent. An additional whale was missing in 1991, but a calf was also born into the pod. The approximate calving interval of killer whales is four years, so some long-term effects may not be obvious for many years.

Several of the missing whales from AB pod were females which left behind juveniles; such abandonment of juveniles is unprecedented in killer whales. As a consequence, the social structure of AB pod has changed and significant mixing of maternal subgroups has been documented.

Killer whales, which may have died as a result of the oil spill, probably would have sunk and not been found by researchers. So, it has not been possible to directly link the missing whales of AB pod with the *Exxon Valdez* oil spill.

WHAT

A. Goal

The purpose of this study is to obtain photographs of individual killer whales occurring in AB pod and to document natural recovery. Photographs collected will be compared to the National Marine Mammal Laboratory's photographic database for the years 1989 to 1991 to determine if changes continue to occur in whale abundance, pod integrity, mortality and natality rates.

B. Objectives

1. Count the number and individually identify killer whales within AB pod.

2. Test the hypothesis that pre- and post-spill killer whale pod structure and integrity within AB pod have remained constant.

3. Determine killer whale reproductive rates and trends in abundance for AB pod within Prince William Sound.

WHY

Researchers have documented a decline in Prince William Sound's AB pod in 1989 and again in 1990. The AB pod has been the predominant resident pod of killer whales in Prince William Sound. It is important to pursue studying AB pod despite the difficulty of proving the link of injury to the *Exxon Valdez* oil spill because of its high intrinsic value as a wildlife resource of the Sound. Continued monitoring of the status of AB pod in Prince William Sound through photo-identification studies is required to document natural recovery of the injured population. The information gained from this work may lead to initiating additional actions to protect killer whales by protecting sensitive habitats, minimizing fishery interactions, reducing or redirecting other human-use impacts, and promoting public education.

Because killer whale recovery rates are essentially unknown (it may take 25-30 years or more), there is a clear need to continue monitoring population trends for killer whales in the spill area. Since the historical database was found inadequate to reliably predict killer whale movements or habitat requirements to support decisions to implement restoration options (habitat protection), additional habitat-use investigations (beyond satellite tagging) may be necessary in the future.

HOW

1. Personnel from the National Marine Mammal Laboratory (NMML) will develop and coordinate all killer whale research activities with this monitoring study. NMML has had extensive involvement in all phases of this research since 1989 and will provide the needed scientific continuity required for this research. Field studies will be conducted by NOAA and contract personnel who have recognized expertise in the study areas of concern. A shore-based camp (equipped with a suitable small boat for whale identification work) will be used in Prince William Sound to conduct photo-identification studies on killer whales from July to September 1993. Study areas will be similar to those worked when assessing injury to killer whales from 1989 through 1991. The camp would be fully self-contained with necessary items for safety and staffed by at least two biologists. For consistency in data collection, key personnel remain in the field throughout the study period.

   Weather permitting, field personnel will spend an average of 8 to 10 hours per day conducting boat surveys searching for AB pod. When encountered, other pods of killer whales should be photographed as well. Specific areas, known for whale concentrations, are investigated first. However, if reports of whales are received from other sources, those areas are examined. If AB pod is not located in "known" areas and opportunistic sighting reports are not available; a general search pattern is developed and implemented. Travel routes typically taken by AB pod will be surveyed. When whales are sighted, researchers stop further search efforts and approach the whales to collect photo-identification information. When whales are encountered, researchers select a vessel course and speed to approximate the animals' course and speed to facilitate optimal photographic positioning.

2. Association patterns of individual whales/maternal subgroups will be examined to evaluate the current social structure of AB pod. Whale association patterns will be compared to the three-year database available at NMML (1989-1991) to determine if changes have occurred in AB pod structure and integrity.

3. Mortality (number of missing whales) and natality (number of births) will be calculated from the 1993 season through photo-identification studies. The 1993 vital rates will be compared to NOAA's historical database on Prince William Sound killer whales to determine trends in abundance.

ENVIRONMENTAL COMPLIANCE

This is a field research project in which routine data collection will take place which is limited in context and intensity. Consequently, this project is categorically excluded from being required to provide an Environmental Impact Statement or Environmental Assessment.

Permits required by the Marine Mammal Protection Act will be obtained prior to the field season.

WHEN

Apr. 1, 1993	Contract negotiation
June 1, 1993	Select contractor
July 15, 1993 to Sep. 15, 1993	Field research
Dec. 30, 1993	Draft report
Feb. 15, 1994	Final report

BUDGET ($K)

	NOAA
Personnel	$ 18.8
Travel	4.2
Contractual	89.0
Commodities	6.0
Equipment	0.0
Capital Outlay	0.0
Sub-total	$ 118.0
General Administration	9.1
Project Total	$ 127.1

EXXON VALDEZ OIL SPILL PROJECT DESCRIPTION

Project Number: 93043

Project Title: Sea Otter Population Demographics and Habitat Use in Areas Affected by the *Exxon Valdez* Oil Spill

Project Category: Restoration Monitoring/Restoration Habitat Protection

Project Type: Marine Mammals

Lead Agency: Department of the Interior - Fish and Wildlife Service

Cooperating Agencies: None

Project Term: April 1, 1993 to March 31, 1994

INTRODUCTION

A. Background

The sea otter (*Enhydra lutris*) is a well-known marine mammal species in Alaska. They historically occurred throughout coastal waters of the Pacific, but as a result of fur harvests in the 18th and 19th centuries, they came close to extinction. They have since increased in abundance and distribution, and presently are found in most coastal areas of southern Alaska. Sea otters prey on a variety of invertebrate species, including mussels, clams, crabs and sea urchins, and may have a strong influence in structuring prey populations.

B. Summary of Injury

Immediate losses of sea otters due to the *Exxon Valdez* oil spill probably ranged from 3,500 to 5,000 animals. Current sampling of sediments and sea otter prey items indicate exposure of otters to hydrocarbons may be continuing. The results of several NRDA studies indicate that this exposure, at a minimum, may be affecting sea otters at an organismic level and, at a maximum, may be affecting survival and therefore recovery of the population. Comparisons of post-spill sea otter surveys found no change in abundance between July 1990 and July 1991, with significantly lower densities in the oil spill area compared to non-oiled areas. The age distribution of sea otter carcasses recovered in oiled areas of Prince William Sound continues to reflect elevated mortality in prime-age sea otters, and a 1990-91 study determined the survival rate of weanling sea otters was significantly lower in oiled than nonoiled areas of PWS. This evidence, together with results from blood and contaminant analyses, suggests that the sea otter population within the spill zone may still be compromised by exposure to oil and that recovery to pre-spill levels is not occurring.

C. Location

The major focus of this project will be on sea otters in Prince William Sound.

WHAT

A. Goals

The overall goal of this project is to restore sea otter populations affected by the *Exxon Valdez* oil spill by determining what is limiting their recovery and identifying areas with high value for sea otter habitat within Prince William Sound for possible protection.

B. Objectives

1. Monitor the recovery of sea otters in oiled areas by determining their abundance, distribution and mortality
2. Construct a population model to evaluate the potential recovery of the sea otters
3. Identify patterns of habitat use
4. Identify and evaluate areas with high value of sea otter habitat within PWS for possible protection

WHY

Studies to date have determined that initial damages to the sea otter population were severe (a loss of 3,500 to 5,000 sea otters), and suggest that chronic damages to sea otters are also occurring, delaying recovery of affected populations. Through monitoring of affected populations and evaluation of patterns of habitat use, this restoration project will guide the development of strategies to aid in the recovery of the otters. The various project activities will enhance our understanding of the demographics of sea otter populations, and identify potential sites for protection of sea otter habitat. Protection of habitats important to sea otters (including foraging, pup rearing, pup weaning and haulout areas) will promote population recovery over the long-term as well as provide protection for other members of the nearshore marine community.

HOW

A. Methodology

In order to evaluate recovery of the sea otter population affected by the oil spill, annual monitoring will be undertaken. Since the spill, detailed data on population size has been collected primarily in the Prince William Sound portion of the spill area. Efficient standardized survey techniques to increase precision and accuracy of population estimates were being developed through RESTORATION FEASIBILITY PROJECT #3, which was conducted in 1991 but not in 1992. The project evaluated the feasibility of using a small float-equipped airplane (Piper P-18 super-cub) as a survey platform in a strip transect survey of sea otters. The design involves counting otters along transects according to a strict protocol and conducting "intensive searches" at pre-determined intervals to estimate the proportion of animals that remain uncounted (e.g., due to diving) during the strip count. Through the information gleaned in the feasibility project and subsequent work by the USFWS, this census technique can be implemented within Prince William Sound in 1993. Survey methodology will be field tested outside Prince William Sound in 1993, and an extended monitoring program may be implemented in subsequent years. In addition to aerial surveys, mortality surveys (recovery of beach-cast carcasses) will be continued as part of

this project. The mortality surveys will build on data collected over a decade in PWS.

A population model will be developed based on age structure and age-specific reproduction and survival rates estimated from the carcasses recovered following the oil spill. Model parameters will be modified to reflect available information on post-spill population size, reproduction and survival rates (including data from a 1992-93 USFWS study on juvenile sea otter survival in PWS) to predict recovery rates under a range of assumptions, including those related to potential restoration or management strategies. Data collected in subsequent years will be used to refine and update the model and predictions. This work will be conducted cooperatively with Service personnel and other individuals having expertise in modeling sea otter populations.

The habitat evaluation component of the project will 1) utilize data from a 1992-93 USFWS juvenile survival study to develop a database on sea otter movements and patterns of habitat use, 2) integrate this information with other sea otter data on distribution and abundance (pre- and post-spill), and 3) evaluate available data on commercial, recreational, and subsistence uses of PWS. Continuing efforts (planned for 1994-95) will utilize the database compiled on habitat use patterns to identify and evaluate potential areas of high habitat value in PWS for protection.

B. Coordination with Other Efforts

To date, aircraft and boat surveys have not been conducted concurrently. Collection of survey data by both methods in 1993 would complement both projects by providing a basis for comparison of methods and continuity of data collection in subsequent years. Data from both surveys will contribute to the analyses of habitat use patterns.

ENVIRONMENTAL COMPLIANCE

This project does not involve capture or handling of sea otters, or any other methods that are intrusive. It appears to qualify for categorical exclusion under the National Environmental Policy Act.

WHEN

The first year of the project will be April 1, 1993 to March 31, 1994. The population and reproductive surveys will be conducted in the summer of 1993. Mortality surveys will be conducted in the late spring of 1993. The population modeling and evaluation of habitat use patterns do not involve field work. Data compilation and analyses for these components of the project will occur throughout the year. Progress reports for all components of the project will be produced by January 30, 1994, and "final" reports on 1993 activities will be produced by March 31, 1994. The identification of potential sites for habitat protection would occur in 1994-95. Monitoring of population recovery (through abundance, distribution, reproduction and mortality, and continued modeling) is planned as a long-term activity, extending through 2001 (pending availability of continued funding), or through recovery.

April 1993	Data compilation and entry; preparation for field work
April - Nov. 1993	Compilation and analysis of existing data for habitat and population modeling work
May - Sept. 1993	Field activities for population, reproductive and mortality survey work
Sept. 1993-Jan. 94	Data entry, analysis, report preparation
Jan. 30, 1994	Annual report due on progress to date
Feb. 1, 1994	Draft report to peer review
March 31, 1994	Final report on 1993 activities due

BUDGET ($K)

	USFWS
Personnel	$ 142.8
Travel	10.0
Contractual	42.7
Commodities	16.9
Equipment	27.5
Capital Outlay	0.0
Sub-total	$ 239.9
General Administration	24.4
Project Total	$ 264.3

EXXON VALDEZ OIL SPILL PROJECT DESCRIPTION

Project Number: 93045

Project Title: Surveys to Monitor Marine Bird and Sea Otter Populations in Prince William Sound during Summer and Winter

Project Category: Restoration Monitoring

Project Type: Birds, Marine Mammals (Sea Otters)

Lead Agency: Department of the Interior, Fish and Wildlife Service

Cooperating Agencies: None

Project Term: January 1, 1993 to March 15, 1994

INTRODUCTION

A. Background

The U.S. Fish and Wildlife Service conducted boat surveys of marine bird and sea otter populations in Prince William Sound in the early 1970s, the mid-1980s and in 1989, 1990 and 1991 following the *Exxon Valdez* oil spill. These surveys documented overall declines in Prince William Sound marine bird populations between 1972-1973 and the years after the spill for grebes, cormorants, northern pintail, harlequin duck, oldsquaw, scoters, goldeneyes, bufflehead, black oystercatcher, Bonaparte's gull, black-legged kittiwake, arctic tern, pigeon guillemot, marbled murrelet, Kittlitz's murrelet, and northwestern crow. For five of these species or groups--cormorants, harlequin duck, black oystercatcher, pigeon guillemot and northwestern crow--populations declined more in the oiled area than in the non-oiled area, suggesting an oil spill effect. Specific studies of three of these species--harlequin duck, black oystercatcher and pigeon guillemot--have corroborated the population changes found by the survey project. In addition, these studies have investigated how the reproduction and foraging ecology of these species have been affected by the spill. These studies have also examined hydrocarbon contamination in these species. Links between the oil spill and effects on these species are still being investigated.

Relative to sea otters, the boat surveys documented declines in sea otter density and abundance in shoreline habitats of Prince William Sound following the spill. The surveys also detected a continuing pattern of significantly lower sea otter densities in oiled coastal areas, suggesting that mortality or displacement of sea otters from these areas was considerable.

B. Summary of Injury

About 35,000 birds and 1,000 sea otters were recovered following the spill. Based on modeling studies using carcass, search effort, and population data, the total number of marine birds killed by the spill was between 300,000 and 645,000 birds, with the best approximation between 375,000 and 435,000 birds. The majority of birds killed were murres. The total number of sea otters killed by the spill in Prince William Sound was estimated to be between 3,500 and 5,000

otters. These estimates reflect direct mortality occurring in the first five months after the spill and do not include chronic effects or loss of reproductive output.

C. Location

This study will be conducted in Prince William Sound. The entire sound, including oiled and unoiled areas, will compose the study area.

WHAT

A. Goal

The purpose of this study is to obtain annual estimates of the summer and winter populations of marine birds and sea otters in Prince William Sound to determine whether species whose populations may have declined due to the *Exxon Valdez* oil spill are recovering.

B. Objectives

1. To determine distributions and estimate abundances, with 95% confidence limits, of marine birds and sea otters in Prince William during summer and winter.

2. To estimate trends in populations of marine bird species whose populations declined more in oiled areas than in unoiled areas of Prince William Sound since the early 1970s, specifically cormorants, harlequin ducks, black oystercatchers, and pigeon guillemots.

3. To support restoration studies on harlequin ducks, black oystercatchers, pigeon guillemots, marbled murrelets, other marine birds and sea otters by providing data on population changes, distribution and habitat use of Prince William Sound populations.

WHY

A. Benefit to Injured Resources/Services and Relationship to Restoration Goals

This study meets the Trustee Council restoration goal of restoration monitoring. Restoration of marine bird and sea otter populations will require population estimates to determine whether recovery is occurring or if declines are continuing. This project will benefit marine birds and sea otters by revealing species that show continuing injury due to the *Exxon Valdez* oil spill; this information is necessary to plan meaningful restoration actions.

This project will also provide valuable information on the distribution and habitat use of these species. Survey data from this project have been used for these purposes by investigators of harlequin ducks, marbled murrelets, black oystercatchers and sea otters. Survey methods are flexible enough to provide for collection of more detailed information (such as age class data) if such information is requested by investigators of those species.

HOW

A. Methodology

Boat surveys will be conducted using methods developed by NRDA Bird Study 2. Surveys will be conducted in March (winter) and July (summer) of each year. Surveys will be conducted using three 25-foot boats each staffed by an operator and two crew members. All three will serve as observers. Observers will record all birds and mammals within 100m of each side of the boat within survey transects, and whether the animal is in the water, on land or in the air. The survey window will extend approximately 40-50m ahead of and 100m above the moving boat, but will be extended for animals that exhibit strong avoidance behavior when the boat is more than 50m away (e.g., scoters, murrelets, harlequin ducks, harbor seals). Surveys will be conducted only when seas are less than two feet. Date and time of survey, and environmental variables including wind velocity and direction, air and water temperature, weather, observation conditions, sea state, tide, presence of oil, and presence of human activity will be recorded for each transect.

A stratified random sampling design using shoreline, coastal/pelagic and pelagic strata will be used. The current design is powerful enough to detect small population changes (e.g., 15%) for some species. Data collected previously will be used to improve the design for other species, possibly lowering costs at the same time. The size of individual blocks in pelagic and coastal/pelagic strata will be decreased, and blocks reselected, to decrease variances. Such alteration will not affect our ability to compare population estimates among years.

Analyses aimed at reducing survey variances, detecting population changes, and identifying habitat use and distribution will continue. Such analyses include exploration of post-stratification by habitat (using shoreline type or bathymetry to define habitats), examination of differences among observers' abilities to identify and count animals, and calculation of optimal sampling unit size and number of samples. Future analyses should include the effects of survey vessel disturbance and distance from the vessel on counts of different species.

B. Coordination with Other Efforts

This study will provide data on distribution and abundance of selected species for use by restoration study investigators (assuming these studies are approved). Proposed studies that would use data collected by this project include the following: sea otters, black oystercatchers, pigeon guillemots, habitat (marbled murrelet portion), murres, and habitat acquisition.

ENVIRONMENTAL COMPLIANCE

This study relies on observations from boats and is a non-intrusive study. Based on a review of the CEQ regulation 40 CFR 1500-1508, this study appears to be categorically exempt from the requirements of NEPA in accordance with 40 CFR 1508.4.

WHEN

This project will require, at minimum, 15 months to complete. Surveys are proposed to continue for several years. The need to continue the surveys on an annual basis, and the need to conduct both winter and summer surveys in each year, will be evaluated.

Jan. 1 - Mar. 1, 1993	Logistical planning
Mar. 1 - Mar. 20, 1993	Winter survey - data collection
Apr. 1 - May 30, 1993	Data compilation
July 1 - July 20, 1993	Summer survey - data collection
Aug. 1 - Nov. 15, 1993	Data compilation and data analysis
Dec. 15 - 1994	Draft report for internal review
Feb. 1 - 1994	Draft report to peer review committee
Mar. 31 - 1994	Final report complete

BUDGET ($K)

	USFWS
Personnel	$ 108.5
Travel	12.0
Contractual	80.0
Commodities	10.0
Equipment	30.0
Capital Outlay	0.0
Sub-total	$ 240.5
General Administration	21.9
Project Total	$ 262.4

EXXON VALDEZ OIL SPILL PROJECT DESCRIPTION

Project Number: 93046

Project Title: Habitat Use, Behavior, and Monitoring of Harbor Seals in Prince William Sound, Alaska

Project Category: Restoration Monitoring, Habitat Protection

Project Type: Marine Mammals

Lead Agency: Alaska Department of Fish and Game

Cooperating Agencies: National Marine Fisheries Service (NMFS)

Project Term: January 10, 1992 to September 30, 1995

INTRODUCTION

Harbor seals (*Phoca vitulina)* occur year-round in Prince William Sound (PWS) where they often haul out on rocks, reefs, beaches, and glacial ice. They pup, breed, molt, and feed in the Sound. During extensive surveys of PWS in 1991, 2,500-3,000 harbor seals were counted on haulouts. Another 1,700 were counted in the Copper River Delta and Orca Inlet. This under-estimates the population since some seals were in the water and some small haulouts were not surveyed. From 1984 to 1988, harbor seal numbers at trend sites in PWS declined by 43% for unknown causes. The decline continued in 1989-1990, exacerbated in oiled areas by the *Exxon Valdez* oil spill (EVOS); 1990 counts were 57% lower than in 1984. Following the oil spill, counts of harbor seals at oiled trend count sites declined by 35%, compared to 13% at unoiled sites, indicating a reduction of about 20% at oiled haulouts. It is likely that over 200 harbor seals were killed by the EVOS in PWS. Although molting surveys in 1991 suggested that numbers might be increasing, pupping counts were 10% lower in 1992 than in 1991. Whether there are long-term effects is unknown.

Harbor seals are important to residents of PWS for subsistence. In 1987-1989, they made up 13%-19% of the total harvest of subsistence foods in Tatitlek. In Chenega Bay in 1985-1986, harbor seals accounted for 27% of the total pounds harvested. Harbor seals are also watched by tourists and recreational users of PWS and they interact with and are incidentally killed in commercial fisheries. Like all marine mammals, they have special Federal protection under the Marine Mammal Protection Act. If the current decline continues or if up-to-date population data are not available, harbor seals could be placed in a more restrictive legal classification.

The proposed study will take place in PWS. The information obtained will benefit residents of Tatitlek, Chenega Bay, and other PWS communities who use harbor seals for subsistence, and tourists and other recreational users by providing information on trends in abundance, biology of the seals, and insight into possible causes for the ongoing decline. Data will benefit PWS fishermen by ensuring that restrictive measures regarding incidental take of harbor seals are not implemented unnecessarily due to lack of data. Information contributed by this study may lead to management recommendations will ensure that human activities do not have further impacts on

harbor seals.

WHAT

A. Goals

The goals of this study are as follows:

1. to monitor the abundance and trends of harbor seals in oiled and unoiled areas of PWS in order to determine trends in numbers since their decline following the EVOS; and

2. to characterize habitat use and hauling out and diving behavior of harbor seals so that important habitat can be identified and properly managed.

B. Objectives

The objectives are as follows:

1. to conduct aerial surveys of harbor seals at 25 trend count sites in PWS during pupping and molting in 1993 and 1994;

2. to compare data from surveys to data collected following the EVOS to determine whether seals are recovering; 3) to describe hauling out and diving behavior, and by inference, feeding behavior of satellite-tagged seals in PWS relative to date, time of day, and tide; 4) to describe use of and frequency of movements between haulouts; and 5) to determine movement patterns within PWS and between PWS and adjacent areas.

WHY

We cannot assume that the number of seals in oiled areas will return naturally to pre-spill levels. It is necessary to have current data to know whether seal numbers in PWS have stabilized or are continuing to decline. The proposed surveys will provide such information. To date, the data are equivocal: 1991 molting counts increased slightly but 1992 pupping counts declined. Molting counts in oiled areas were 30% lower in 1991 than they were in 1988 before the EVOS. By comparison, counts at unoiled sites were approximately the same in 1988 and 1991. Overall since 1984, there has been a decline of more than 50% in numbers that have left much of the harbor seal habitat in PWS vacant. Subsistence hunters and other local residents complain about the scarcity of seals and want to know why there has been a decline.

While count data are essential for monitoring trends in abundance, they are of little help in explaining the decline or designing conservation and management measures to facilitate recovery. There is no information on site fidelity, movements between sites, seasonal changes, habitats used for feeding, or feeding behavior. It is clear based on data from harbor seals that were satellite-tagged as part of a pilot EVOS restoration study that some seals in PWS make unexpectedly long movements in short periods of time, and that there is more interchange among

seals in PWS and the Copper River delta than was anticipated. Areas of particular biological significance must be identified and appropriately managed to be able to aid recovery in any way possible.

Under Federal law, subsistence is the priority use of marine mammals. Data on seal abundance should be shared with PWS residents so that hunters can regulate their seal harvest to ensure that the harvest is sustainable. If data are not current and adequate to determine that subsistence takes and fisheries removals are sustainable, this could result in very restrictive incidental take regulations for PWS salmon fisheries. While it is not clear what caused the declines prior to the EVOS, there is little question that the EVOS compounded the decline. Consequently, post-spill monitoring must continue until residual effects of the EVOS are no longer evident. This project will complement other activities of NMFS on conservation and management of harbor seals.

HOW

We are proposing a two-year field study (1993, 1994) with final data analysis and reporting to take place in year three. Harbor seal abundance will be monitored by flying aerial surveys during pupping (June) and molting (August/September). A fixed-wing aircraft will be used to fly a survey of 25 trend count sites at an altitude of 500 feet. These 25 sites have been used for PWS harbor seal trend counts since 1984, including NRDA studies in 1989-1991. The observer will count all seals and photograph large groups. Pups will be counted separately in June. We will attempt to survey each site 7-10 times during a survey period to reduce statistical variance of the counts. Methodology and observers will be the same as those used in 1989-1991 NRDA studies. Several surveys will also be conducted of seals in the Copper River Delta to gain understanding of the relationship between seal counts in PWS and the Delta. Counts will be compared to data collected prior to and during the EVOS in order to document whether and how rapidly recovery in the oiled area occurs. Project investigators will travel to Chenega Bay and Tatitlek at least once each year to exchange information with village residents.

Satellite-linked time-depth recorders (PTTs) will be attached to 12 seals per year (6 each in spring and autumn) at a variety of locations in PWS in order to better evaluate geographical and seasonal differences in movements and behavior. Seals will be caught by nets placed near haulouts and PTTs will be glued to their backs with epoxy resin. Each PTT will transmit signals to polar-orbiting satellites when the seal is hauled out or when it surfaces for a sufficient time. Sensor information will indicate when the animal is hauled out, and how deep and for how long it dives. PTTs will be shed during the annual molt in autumn. Pilot studies demonstrated that the project is feasible. During 1991-1992, PTTs were attached to eight seals and data were received for 3-67 days. Several seals made substantial movements within PWS and to the Gulf of Alaska and the Copper River Delta.

Aerial survey data will be analyzed using the trimean statistic as the measure of central tendency. Between-year comparisons of pup production and abundance during the fall molt will be done using a Repeated Measures Analysis of Variance (ANOVA) performed on the trimeans of site count data. Hypotheses will be tested using orthogonal contrasts derived from the specialized ANOVA. Data on geographic location and movements will be plotted by computer. Rates of movement and average lengths and depths of dives will be calculated depending on location,

date, and size of the seal. Hauling out periods relative to tidal stage will be examined by analyzing sensor data that indicates whether the seal is on land or at sea.

ENVIRONMENTAL COMPLIANCE

No environmental analysis is required for this study. As required by the Marine Mammal Protection Act, ADF&G has been authorized under Permit No. 700 to instrument up to 100 harbor seals with PTTs during the period 1992-1995. No additional permits are required.

WHEN

This project will be conducted during 1993 and is proposed for 1994 also, with final report submission in either 1994 or 1995 depending upon whether the second year of field effort is conducted. Aerial surveys will be conducted during June and August/September of each year. Each survey period will be 7-14 days, depending on weather and tides. One of the investigators will visit Chenega Bay and Tatitlek once a year to discuss survey results with residents. Satellite tags will be attached during 10-14 day periods in May and September of each year. Because a lead time of 3-6 months is required to obtain PTTs, we will have to order PTTs by November of 1992 and 1993. Satellite data acquisition costs must be prepaid to Service ARGOS by February of each year. Data are received monthly and preliminary analysis will begin as soon as data diskettes are received. Final analyses cannot be completed until the PTTs have ceased to function (April-June 1995). A report of field activities will be submitted in letter form within 30 days following any field activity. Annual progress reports will be submitted by 31 December 1993 and 1994. A final report will be submitted by 30 September 1995. Results will be prepared for publication in a peer-reviewed journal.

BUDGET ($K)

	ADF&G
Personnel	$ 104.7
Travel	10.2
Contractual	46.7
Commodities	49.9
Equipment	0.0
Capital Outlay	0.0
Sub-total	$ 211.5
General Administration	19.0
Project Total	$ 230.5

EXXON VALDEZ OIL SPILL PROJECT DESCRIPTION

Project Number: 93047

Project Title: Subtidal Monitoring: Recovery of Sediments, Hydrocarbon-degrading Microorganisms, and Eelgrass Communities in the Shallow Subtidal Environment

Project Category: Restoration Monitoring

Project Type: Subtidal

Lead Agency: National Oceanic and Atmospheric Administration

Cooperating Agencies: Alaska Department of Fish and Game; Alaska Department of Environmental Conservation

Project Term: March 1, 1993 to September 30, 1995

INTRODUCTION

A. Background

This project will monitor the recovery of subtidal sediments, hydrocarbon-degrading microorganisms, eelgrass communities, and bottom fish from shallow subtidal areas of Prince William Sound. An important component of this study is tracking the loss of oil from the environment and from organisms in the spill area.

Hydrocarbons were found in the shallow subtidal sediments and in species (rockfish, flounders) associated with the shallow bottom sediments. Investigators attempting to restore or monitor recovery of populations of shallow subtidal organisms following the *Exxon Valdez* oil spill will want to know what concentrations of petroleum hydrocarbons are present in sediments, and if they continue to contaminate the organisms and have sublethal impacts.

We anticipate that complete recovery to background levels of hydrocarbons in subtidal sediments in the Sound is likely to take several years.

B. Summary of Injury

Subtidal sediments have been found to be contaminated by oil at no fewer than 15 sites within Prince William Sound by June 1990. Hydrocarbon contamination of sediments had reached a depth of 20m at least 8 sites. Evidence of hydrocarbon movement down-slope into subtidal sediments was detected by 1991; further oil movement to greater depths is suspected (from weathering, cleaning, etc.) but is unknown.

A few dead rockfish were found after the spill. Species exposure in rockfish and flounders (contaminated bile) was documented between 1989-91, but not since. Eelgrass beds in oiled areas were affected by the spill. Persistence of hydrocarbons and their impacts on associated species were not examined in 1992, and the current status of recovery is unknown.

C. Location

All locations of the study will be in Prince William Sound (PWS; except for potential control sites outside PWS if needed). All projects within the study will sample the same oiled sites all of which were sampled in previous years. Five oiled and five reference sites will be studied intensively by all agencies cooperating in the project.

The oiled sites will include Herring Bay, Northwest Bay, Sleepy Bay, Snug Harbor, and Bay of Isles. The control sites will include Drier Bay, Lower Herring Bay, Moose Lips Bay, Olsen Bay, and Zaikof Bay. All sites were sampled repeatedly under the NRDA program. Sites will be sampled in June-July 1993 and 1994.

WHAT

A. Goal

Monitor recovery of sediments, hydrocarbon-degrading microorganisms, eelgrass beds, and shallow fish species in the subtidal environment.

B. Objectives

1. National Oceanic and Atmospheric Administration

    a. Determine Hydrocarbons concentration and composition in subtidal sediments in PWS by GC-MS (6 depths; 10 sites).

    b. Determine hydrocarbon movement down slope in three oiled bays (150 samples per bay, all from 0-20 meters) by fast screening UV-Fluorescence procedures.

    c. Determine changes in exposure of fishes to hydrocarbons by monitoring bile, MFO activity and histopathological lesions in near-shore bottom fish.

2. Alaska Department of Environmental Conservation

    a. Measure the numbers of hydrocarbon-degrading microorganisms and their activity as an indicator of persistence of biodegradable oil in PWS sediments.

3. Alaska Department of Fish and Game

    a. Determine impacts and recovery of shallow eelgrass communities in western PWS that were impacted by the spill.

WHY

A. Benefit to Injured Resources/Services

The sediment hydrocarbons sub-project will determine the recovery of oiled sediments, if any, and the movement of subtidal oil, if any. The other sub-projects will determine if contamination continues in species, and if responses to contamination or impacts continues.

Management of species and habitats may be influenced by the level of recovery (e.g., no contamination or detectable responses would permit higher rates of harvest for target species). Information on rates of recovery of contaminated habitats and species is needed to protect those habitats and species.

HOW

A. Methodology

All of the sites proposed for sampling by this project were sampled by the cooperating agencies between 1989-91. None of the sub-projects proposed here were implemented in 1992. All sub-projects will use methods comparable to the methods they employed in 1989-91 to insure temporal comparability of the results. The project will be limited to 10 sites within PWS.

Specific methods vary considerably between sub-projects. Sediments will be collected primarily by divers (some grab samples will be taken at greater depths) and will be analyzed by GC-MS. All sediment samples will be screened using the UV-Fluorescent procedures developed for analyzing sediments from the mussel bed study. Details of the methods for monitoring biological impacts/contamination will be given in detailed study plans and will follow the methods used in previous years.

Chain of custody procedures will be followed after collection of all samples.

B. Coordination with Other Efforts

The sub-projects will coordinate closely with each other to insure concurrent sampling dates and similar stations between studies. Also, this project will coordinate with the mussel bed project, and will make use of the shoreline evaluations particularly to identify stations for the intense subtidal sampling at 3 oiled bays.

ENVIRONMENTAL COMPLIANCE

It is not anticipated that this study will have a significant effect on the environment and an Environmental Impact Statement or Environmental Assessment will not be necessary.

WHEN

All field work will be conducted in June-July 1993 and 1994. An interim progress report will be completed by 1 December 1993 and 1994. Final reports for sub-projects with one field season

will be completed by 1 May 1994; those for sub-projects with two field seasons will be completed by 1 May 1995.

BUDGET SUMMARY

All sub-projects are self-contained. Budgets include analytical costs, vessel-field logistics, university overhead, and final analyses/interpretation/write up.

Note: Because the summer field season occurs in the fourth quarter of the fiscal year, much of the sample analysis will fall in the first two quarters of the next fiscal year.

BUDGET ($K)

	NOAA	ADEC	ADF&G	TOTAL
Personnel	$ 230.6	$ 2.5	$ 7.0	$ 240.1
Travel	20.8	0.0	0.0	20.8
Contractual	185.0	62.4	230.0	477.4
Commodities	51.0	0.0	0.0	51.0
Equipment	9.0	0.0	0.0	9.0
Capital Outlay	0.0	0.0	0.0	0.0
Sub-total	$ 496.4	$ 64.9	$ 237.0	$ 798.3
General Administration	47.6	4.7	17.2	69.5
Project Total	$ 544.0	$ 69.6	$ 254.2	$ 867.8

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EXXON VALDEZ OIL SPILL PROJECT DESCRIPTION

Project Number: 93051

Project Title: Habitat Protection Information for Anadromous Streams and Marbled Murrelets

Project Category: Habitat Protection and Acquisition

Project Type: Survey

Lead Agency: Department of Agriculture, Forest Service

Cooperating Agencies: Alaska Department of Fish and Game; Department of Interior, Fish and Wildlife Service

Project Term: October 1, 1992 to September 30, 1994

INTRODUCTION

This project will acquire detailed information on the locations and characteristics of habitats and services of injured resources so that habitat/protection or acquisition options can be evaluated. Data collection efforts will focus on anadromous fish and murrelets. Anadromous fish were affected by the oil spill in a number of ways: pink salmon had high egg and fry mortalities, reduced growth rates, and possible morphological abnormalities; sockeye salmon suffered poor smolt survival due to overescapement. Murrelet populations were impacted by initial mortalities and continue to be depressed.

This project will encompass lands throughout the spill-affected area.

WHAT

This project has two components:

1. Murrelet nesting habitat assessment; and,

2. Stream habitat assessment.

1. Murrelet Nesting Assessment

The purpose of this sub-project is to help restore murrelet populations injured due to the *Exxon Valdez* oil spill by providing information that could be used to protect, through acquisition or other means, murrelet nesting habitat. This sub-project will further characterize the nesting habitat of marbled and Kittlitz's murrelets in the spill-affected area. Two objectives will be implemented to achieve this goal:

a. Determine habitat features that are reliable indicators of high density murrelet nesting areas in the spill-affected area.

b. Determine feasibility of using radio telemetry to determine nesting habitat of murrelets in the spill-affected area.

2. Stream Habitat Assessment

The stream habitat assessment project is intended to be a comprehensive survey of anadromous fish stream resources that will provide basic information needed to evaluate candidate lands for restoration, protection, enhancement or acquisition actions.

The project is composed of two sub-projects:

a. Stream Habitat Assessment Study: Surveying anadromous fish distribution and documenting the total number and extent of anadromous fish streams on candidate lands.

b. Stream Classification Study: Developing channel typing procedures that will allow comparative evaluations of stream habitat on private and public lands.

WHY

Marbled murrelets and anadromous fish, were injured by the oil spill. Murrelets nest in trees throughout the spill area but little is known about their nesting requirements. Work conducted in 1992 is providing some information on nesting requirements but additional information is needed before nesting habitat can be reliably determined. Any habitat protection applied to uplands for murrelets would be dependent on the ability to accurately estimate the quality and quantity of nesting habitat.

Anadromous fish, such as pink salmon were also injured by the oil spill. The surveying portion of the project will locate and map new anadromous streams within candidate lands that may require habitat protection. The stream classification study will provide a GIS-based tool that will allow comparative evaluations of streams throughout the spill area. This component will also provide a level of information that can be expanded upon through additional field work, should such information become necessary.

HOW

Based on results from the 1992 season, selected habitat types will be tested for predicted levels of murrelet activity, particularly behaviors indicating occupation of the habitat for nesting. Potential nesting areas will be surveyed using intensive dawn watches along elevational or distance-from-water gradients. Previously monitored high-density nesting areas will be surveyed to determine the relative level of murrelet upland activity for 1993. The U.S. Forest Service will determine forest cover attributes (specifically, forest structure, volume and stand class as well as plant associations) for dawn watch sites within each survey area. These data will be used to determine the habitat characteristics of occupied and unoccupied sites. The study area for this portion of the project will include Prince William Sound (PWS) and areas outside PWS (Kenai Peninsula, Kachemak Bay, Afognak Island). The specific areas to be studied outside of PWS will be determined after results from 1992 field work are available.

Radio-telemetry could be a useful technique for determining the nesting areas of murrelets, however, capture methods, radio life-span and ability to track murrelets are still experimental. We propose to conduct a pilot study on capturing and tagging murrelets to determine the feasibility of using radio-telemetry to determine the nesting habitat of murrelets in the spill zone. Given the experimental nature of this work, we propose to conduct the study in Kachemak Bay, which is relatively accessible and has a high density of both murrelet species.

Streams within candidate private lands will be walked to determine the extent of anadromous fish habitat. Concurrent with the streams walks, information on channel types will be collected and entered into the stream classification study.

The stream classification study will use existing air photographs to classify streams within the spill area. Selected sites will be surveyed during the field season to verify and correct the maps. All the maps will be placed into an ARC-INFO based GIS.

ENVIRONMENTAL COMPLIANCE

The proposed project qualifies for a categorical exclusion under terms of the National Environmental Policy Act.

WHEN

Several of the planned project components are continuing studies previously funded by the Trustee Council. The general timelines for the individual components are as follows:

1. Stream habitat assessment: Present - September 1994.
2. Murrelet nesting habitat assessment: Present - September 1994
3. Stream channel typing: January - September 1994

BUDGET ($K)

	USFS	ADF&G	USFWS	TOTAL
Personnel	$ 195.6	$ 182.8	$ 106.0	$ 484.4
Travel	19.0	15.0	20.0	54.0
Contractual	255.1	101.0	102.0	458.1
Commodities	21.0	1.0	5.0	27.0
Equipment	42.5	1.5	14.0	58.0
Capital Outlay	0.0	0.0	0.0	0.0
Sub-total	$ 533.2	$ 301.3	$ 247.0	$ 1,081.5
General Administration	47.1	34.4	23.0	104.5
Project Total	$ 580.3	$ 335.7	$ 270.0	$ 1,186.0

EXXON VALDEZ OIL SPILL PROJECT DESCRIPTION

Project Number: 93053

Project Title: Hydrocarbon Data Analysis, Interpretation, and Database Maintenance for Restoration and NRDA Environmental Samples Associated with the *Exxon Valdez* Oil Spill

Project Category: Technical Support

Lead Agency: National Oceanic and Atmospheric Administration

Cooperating Agencies: None

Project Term: January 1, 1993 to September 30, 2000

INTRODUCTION

A. Background

The analytical expertise of this project was developed through rigorous performance criteria and quality control/quality assurance standards imposed on participating analytical labs during the damage assessment process. Several thousand environmental samples have been collected and analyzed for hydrocarbons in support of the *Exxon Valdez* NRDA effort, and it is anticipated that at least several hundred more samples will be collected and analyzed as part of Restoration efforts to evaluate the recovery of areas affected by the spill. The data from completed NRDA analyses are stored in a database at the Auke Bay Laboratory, where methods are under continuing development to distinguish samples containing oil from the *Exxon Valdez* oil spill from samples containing oil from other sources, and to determine the oil concentration and weathering status of *Exxon Valdez*-oiled samples. The results of these efforts provide numerical correlates that are directly related to oil, and that may be used by principal investigators (PIs) of other restoration projects, by other governmental agencies, and by the public, to assess associations of observed biological effects with concentrations of *Exxon Valdez* oil. The purpose of the proposed project is to apply and extend these hydrocarbon interpretation methods to samples analyzed for the restoration effort, and to insure the comparability of analytical and interpretive results with those of the NRDA effort.

B. Summary of Injury

This project provides technical support to other projects addressing injuries resulting from the *Exxon Valdez* oil spill. This project will provide fundamental interpretive services to all restoration PIs, governmental agencies, and the public at large, and as needed.

C. Location

This project will be undertaken at the Auke Bay Laboratory in Juneau, Alaska.

WHAT

A. Goal

This project will support the measurement of other restoration projects performances with respect to achieving standards and success criteria of those projects. The goal of this project is to estimate the amount of *Exxon Valdez* oil that is present in environmental samples analyzed for hydrocarbons that are collected for the restoration effort, such that the methods used and the results are comparable with those used for *Exxon Valdez* NRDA samples and to continue maintenance of results in a database for access by all appropriate parties. This project will not be responsible for archival and disposal of collected samples.

B. Objectives

1. Provide a statistically defensible basis for deciding which environmental samples analyzed for hydrocarbons contain oil from the *Exxon Valdez* spill;

2. Estimate the original concentration of *Exxon Valdez* oil in environmental samples that have been determined to contain *Exxon Valdez* oil;

3. Assess the weathering status of sediment hydrocarbon samples; and

4. Archive these results in a database extension of the NRDA database and as physical maps.

WHY

A. Benefit to Injured Resources/Services

This project will make possible the evaluation of the following:

1. the recovery of areas affected by the oil spill by identifying the amount of *Exxon Valdez* oil remaining, and

2. the association of continuing biological impacts of the spill with *Exxon Valdez* oil remaining in impacted areas.

B. Relationship to Restoration Goals

The Trustees should fund this project so that they can determine the extent of recovery (here defined as absence of *Exxon Valdez* oil) of areas oiled by the spill.

HOW

A. Methodology

Hydrocarbon data from environmental samples will be examined using pattern recognition techniques related to principal component analysis. The pattern of hydrocarbon measurements in a sample will be compared with the pattern in samples of pure and of weathered *Exxon Valdez* oil, and the pattern variance of known samples of weathered *Exxon Valdez* oil will be used to evaluate the likelihood that the pattern observed in an environmental sample could have derived from *Exxon Valdez* oil contamination. Samples with patterns that could likely have derived from *Exxon Valdez* oil will be presumed to contain *Exxon Valdez* oil, and the concentration of oil initially present will be determined after correction for weathering or biological alteration by calculating the minimum concentration of *Exxon Valdez* oil necessary to explain the observed hydrocarbon pattern in the sample. Sample archival and database procedures will follow NRDA. NRDA and restoration databases will be merged and placed on a database server to facilitate data retrieval.

B. Coordination with Other Efforts

This project will provide basic, interpreted hydrocarbon results that will be of great use to all other projects that either monitor the persistence of *Exxon Valdez* oil in affected areas, or assess the biological effects of persistent *Exxon Valdez* oil. In addition, this project will promote consistency among published results by providing a uniform and consistent approach to hydrocarbon interpretation.

ENVIRONMENTAL COMPLIANCE

This is not a field study nor does it have any significant effect on the environment. Consequently, neither an Environmental Impact Statement nor Environmental Assessment need to be provided.

All Federal, State, and local laws are followed in the management of chemical analysis.

WHEN

The project will continue as long as samples are collected and need interpretation. Restoration sample data will be interpreted as received. Therefore, there is no set beginning or ending time. We intend to work with PIs to interpret and map their data to their needs on an ongoing basis. We anticipate this need to continue as long as restoration hydrocarbon samples are collected. We propose to interpret and analyze a set of data within several months of receipt.

BUDGET ($K)

	NOAA
Personnel	$ 82.9
Travel	6.2
Contractual	0.0
Commodities	4.0
Equipment	0.0
Capital Outlay	0.0
Sub-total	$ 93.1
General Administration	12.4
Project Total	$ 105.5

EXXON VALDEZ OIL SPILL PROJECT DESCRIPTION

Project Number: 93057

Project Title: Damage Assessment GIS

Project Category: Technical Support

Lead Agency: Alaska Department of Natural Resources

Cooperating Agencies: None (USF&WS considered separately)

Project Term: March 1, 1993 to September 30, 1993

INTRODUCTION

A. Background

This project provides a baseline information repository (shoreline, oiling, Environmental Sensitivity Index, shore type, ownership, salmon streams, bathymetry data) for statistical analysis and mapping in support of damage assessment projects scheduled for completion during this last budget period, and for final database and product documentation, repository storage, and distribution and dissemination.

WHAT

A. Goal

Complete statistical analysis and GIS mapping support for existing damage assessment studies, and provide a quality controlled and documented database of baseline information for restoration study use and data publication.

B. Objectives

Complete statistical reports and maps for shoreline assessment; produce updated land status maps and anadromous streams maps; deliver fully documented, digital GIS database of oil spill related themes for final public release, and for use by restoration and habitat acquisition projects; provide direct technical support to PIs on document graphics and maps. Workload and analysis based on those projects scheduled for completion by September 1993.

WHY

A. Benefit to Injured Resource/Service

Completing the damage assessment database of baseline information will provide restoration studies with information relevant to their projects: current ownership and designated use status, oiled areas, oiling change over time, beach treatment areas, geographic links to injury determinations, baseline information critical to habitat acquisition objectives.

HOW

A. **Methodology**

Complete major documentation project to prepare data layers for final publication. Quality control newly acquired data, and produce statistical reports and maps for the shoreline assessment study, against Spring 1991 and Spring 1992 data. Acquire current ownership data from various sources (BLM, DNR, USFS), synthesize data, produce most current land status maps, and distribute to damage assessment and restoration studies.

ENVIRONMENTAL COMPLIANCE

ADNR GIS is a technical service project, and is subordinate to the environmental compliance of the damage assessment projects supported.

WHEN

Data publication, ready for public distribution by August of 1993. Spring 1991 shoreline data maps quality controlled, and produced Spring 1993. Produce shoreline maps and reports from Spring 1992 data within 3 to 4 months of receipt and quality control of data. Technical assistance to PIs subject to PI deadlines, all work complete by October 1993.

BUDGET ($K)

	ADNR
Personnel	$ 53.0
Travel	0.0
Contractual	5.0
Commodities	1.5
Equipment	0.0
Capital Outlay	0.0
Sub-total	$ 59.5
General Administration	8.0
Project Total	$ 67.5

EXXON VALDEZ OIL SPILL PROJECT DESCRIPTION

Project Number: 93059

Project Title: Habitat Identification Workshop

Project Category: Habitat/Land Protection

Project Type: Technical Support

Lead Agency: Department of Agriculture, Forest Service

Cooperating Agencies: Alaska Department of Environmental Conservation; Alaska Department of Fish and Game; National Oceanic and Atmospheric Administration; Alaska Department of Natural Resources; U.S. Department of the Interior

Project Term: January 10, 1992 to September 30, 1993

INTRODUCTION

Public comment, to date, has overwhelmingly supported use of the Habitat Protection and Acquisition option as a method of preventing further harm to, and assisting the recovery of, natural resources and services injured by the oil spill. Numerous proposals or nominations of lands believed to be deserving of protection or acquisition were received from the public as FY93 work plan proposals.

In response, where an imminent threat is determined to exist, this project accelerates important elements of the Habitat Protection and Acquisition option within the context of maintaining the integrity of the overall Restoration Planning process and accompanying compliance with NEPA and other legal and regulatory requirements. An imminent threat is defined as a change in land use which (1) is likely to foreclose restoration options, and (2) can reasonably be expected to occur before adoption and implementation of the Restoration Plan.

WHAT

A. Goal

The goal of this project is to identify those parcels of non-public lands within the oil spill affected area which contain critical habitats necessary for the recovery of natural resources and services injured by the oil spill and which are determined to be under imminent threat.

WHY

The Habitat Protection and Acquisition option is but one of a number of restoration tools being considered in the draft Restoration Plan scheduled for release for public review and comment in February 1993. A final Restoration plan is expected in May 1993. In the interim, protection of key parcels of non-public lands which contain critical habitats is needed to ensure that the Habitat Protection and Acquisition option is not foreclosed by events preceding Trustee Council adoption

and implementation of a final Restoration Plan.

HOW

1. BY NOVEMBER 1, 1992 - The Habitat Protection and Acquisition workgroup, in cooperation with The Nature Conservancy, will conduct and document a series of workshops to be attended by scientists and other resource specialists for the purpose of (1) assessing the rate and degree of recovery of resources and services injured by the oil spill, and (2) identifying and characterizing the habitats associated with the recovery of injured resources or services.

2. BY NOVEMBER 1, 1992 - The Habitat Protection and Acquisition workgroup will identify those parcels of non-public land within the oil spill affected area which face an imminent threat.

If the threat analysis indicates that there is no imminent threat, further analysis of the nomination may be deferred to the more detailed evaluation process emanating from the Restoration Planning process.

ENVIRONMENTAL COMPLIANCE

This project, which is initial data gathering, is categorically excluded from formal documentation in an Environmental Impact Statement or environmental analysis.

WHEN

The project will commence October 1, 1992. The initial imminent threat analysis is expected to be completed by January 1993. Each subsequent year lands will be evaluated for imminent threat and, if necessary and appropriate, protection tools will be applied.

BUDGET ($K)

	USFS
Personnel	$ 0.0
Travel	0.0
Contractual	39.5
Commodities	0.0
Equipment	0.0
Capital Outlay	0.0
Sub-total	$ 39.5
General Administration	2.8
Project Total	$ 42.3

EXXON VALDEZ OIL SPILL PROJECT DESCRIPTION

Project Number: 93060

Project Title: Accelerated Data Acquisition

Project Category: Habitat Protection

Lead Agency: U.S. Department of Agriculture Forest Service

Cooperating Agencies: Alaska Department of Environmental Conservation, Department of Interior, Alaska Department of Natural Resources, National Oceanic and Atmospheric Administration and Alaska Department of Fish and Game.

Project Term: October 1, 1992 to September 30, 1993

INTRODUCTION

This project, in cooperation with The Nature Conservancy, accelerates the collection, and compilation of existing resource data needed for evaluation of proposals for habitat protection and acquisition and for other restoration activities.

WHAT

A. Goal

Facilitate acceleration of the Habitat Protection and Acquisition option by collecting and organizing existing resource data needed to evaluate habitat protection and acquisition proposals and for other restoration activities.

WHY

A substantial amount of data on injured resources and services is essentially unusable in its present form due to the data being located in a variety of different Federal and State agencies and in a variety of different and sometimes conflicting formats. A common database usable by all of the Trustee Agencies is needed for these data to be most useful in analysis and identification of critical habitats in the spill affected area.

HOW

The Nature Conservancy, in cooperation with the Trustee Council Agencies and others, will complete collection and compilation of existing resource data from the oil spill affected areas into a database having the following characteristics and "layers":

DATABASE CHARACTERISTICS

The database will be compatible with existing Trustee agency hardware and software. Database "layers" will include, but are not exclusive to the following:

DATABASE "LAYERS"	SOURCE
Line graph (shoreline corrected post-earthquake)	DNR
Cities, towns, villages, roads	DNR (update with current
Land ownership (surface and subsurface; (2.5 acre resolution outside of built up areas)	DNR, FS, FWS, BLM, NPS
Hydrography (remote sensing update)	DNR, FS, USGS, FWS
Hypsography (elevation)	USGS, FS, DNR
Vegetation	FS
Anadromous streams	DFG, FS, DNR
Wildlife habitat	FWS, DFG, FS, NPS, NMFS
Shoreline oiling	DNR, DEC
Management boundaries, conservation units	DNR, FS, FWS, NPS
Easements	BLM, FS, DNR, FWS, NPS
Land use activities	DFG, COE, DNR, DEC, DGC
Bathymetry	DNR
Spruce Bark Beetle Infestation	DNR, FS

ENVIRONMENTAL COMPLIANCE

This project is categorically excluded from formal documentation in an Environmental Impact Statement or Environmental Analysis under Department of Agriculture and Forest Service regulations.

WHEN

The project will start October 1, 1992 and be completed by January 31, 1993.

BUDGET ($K)

	USFS
Personnel	$ 0.0
Travel	0.0
Contractual	41.0
Commodities	0.0
Equipment	0.0
Capital Outlay	0.0
Sub-total	$ 41.0
General Administration	2.9
Project Total	$ 43.9

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EXXON VALDEZ OIL SPILL PROJECT DESCRIPTION

Project Number: 93062

Project Title: Restoration GIS

Project Category: Technical Support

Lead Agency: Alaska Department of Natural Resources

Cooperating Agencies: None (USF&WS considered separately)

Project Term: March 1, 1993 to September 30, 1993

INTRODUCTION

A. Background

Alaska Department of Natural Resources (ADNR) is currently a major repository for EVOS damage assessment GIS data, most of which is highly relevant to restoration analysis and planning. ADNR GIS provides the most comprehensive, automated land status ownership data available. ADNR also has extensive experience dealing with the various land status implications that result from State and Native selection rights, inholdings and access, and entitlement rights such as navigability and tidelands. ADNR GIS also has extensive experience providing the multi-thematic GIS analysis and mapping that will be required as habitat protection and acquisition becomes a central focus of the Restoration Team.

WHAT

A. Goal

Provide statistical and spatial analysis, and GIS mapping support for approved restoration projects. Products will be map series, data transmittal, and online query support. Consistent, current, and quality control repository services will be provided for this comprehensive geographic database.

B. Objectives

Acquire, convert, and process necessary incremental resource themes that must be integrated geographically to support restoration. For example, acquire slope/aspect data, perform needs analysis with PI, and perform the programming and data synthesis necessary to identify ideal habitats for *Fucus* recovery. Provide maps and statistical analysis products, data repository services and data dissemination. Report to the Restoration Team GIS Review Committee.

WHY

A. **Benefits**

Using GIS for restoration project support will allow the most informed analysis of geographically dependent information. Using ADNR GIS will allow the current economies of highly specialized personnel, database access, system and project management to transition from the historic damage assessment themes to the restoration focus. ADNR has access to, both directly and through multi-agency contacts, land use planning and land cover databases. Complex restoration alternatives may be rapidly evaluated using a GIS approach.

HOW

A. **Methodology**

ADNR GIS will work directly with the PIs directing the approved Restoration projects to assess necessary GIS and analysis support. The Restoration Team has provided a tentative list of data themes required for *habitat protection.* These themes are referenced and evaluated below.

Line graph	-	Complete as of date.
Cities, towns, villages	-	Complete as of date.
Land ownership	-	Mostly complete as of date, precision and currency may need to be updated and revised to consider specific project needs.
Hydrography	-	Currently being completed, 1:63360, KAP area outstanding only.
Hypsography	-	Currently requested from USFS/USGS.
Vegetation	-	Currently have some land cover in the affected area, will require largest data gathering and acquisition process for restoration needs.
Anadromous streams	-	Currently integrating this information with the hydrography above. Some is complete, with the rest currently scheduled for completion.
Wildlife habitat	-	Some of this information is already available via damage assessment studies. Habitat information for uplands will need to be acquired, converted and processed; this work may require extensive effort.
Shoreline oiling	-	Complete as of date.
Easements	-	Complete for State lands, need to acquire for other lands, convert, and process.
Land-use activities	-	Need to acquire, convert, and process from various sources.
Bathymetry	-	Complete as of date.

Additional approved Restoration projects that have high GIS potential are as follows:

Restoration of Second Growth Habitat for Wildlife in PWS
Harlequin Duck Restoration and Monitoring Study
Natural Recovery of Oiled and Treated Shoreline
Mussels and Sediments
Develop Harvest to Aid Restoration of Injured Terrestrial Mammals and Sea ducks

ADNR GIS will work with the GIS Review Committee of the Restoration Team to identify, analyze, and schedule all data acquisition, conversion, processing, and GIS production work. Additionally, ADNR GIS will work with CACI staff to design and implement an interactive GIS workstation environment to support immediate query needs of the Restoration Team. Analysis and representation of generalized data themes, such as vegetation, land use, and habitat, will be coordinated with and reviewed by the contributing agencies. This type of information coordination, in addition to work with the PIs, is anticipated with the USFS, ADF&G, USF&WS, native corporations, and ADEC. Other coordination efforts may be necessary to integrate broad resource agency information into PI studies.

ENVIRONMENTAL COMPLIANCE

ADNR GIS is a technical service project, and is subordinate to the environmental compliance of the restoration projects supported.

WHEN

ADNR GIS staff will continue to advise the Restoration Team on ongoing data acquisition and processing efforts that are projected to continue, or be initiated, in this seven month period. To the extent feasible, data acquisition that can be initiated before this period, for receipt and processing during this period, will be facilitated by ADNR GIS.

BUDGET ($K)

	ADNR
Personnel	$ 87.3
Travel	0.0
Contractual	11.0
Commodities	7.0
Equipment	5.0
Capital Outlay	0.0
Sub-total	$ 110.3
General Administration	13.0
Project Total	$ 123.3

EXXON VALDEZ OIL SPILL PROJECT DESCRIPTION

Project Number: 93063

Project Title: Survey and Evaluation of Instream Habitat and Stock Restoration Techniques for Anadromous Fish

Project Category: Restoration Manipulation and Enhancement

Lead Agency: Alaska Department of Fish and Game (ADF&G)

Cooperating Agencies: U.S. Forest Service (USFS)

Project Term: March 1, 1993 to October 31, 1993

INTRODUCTION

This project will develop project designs for appropriate and cost-effective salmon spawning habitat restoration and enhancement projects. The *Exxon Valdez* oil spill injured wild pink and chum salmon eggs and fry. Various amounts of oil were deposited in intertidal spawning habitats in Prince William Sound (PWS) where up to 75% of the spawning occurs. Salmon eggs deposited in 1989 and all subsequent years have shown increasing egg mortality. Recently detected genetic damages resulting from oil contamination in spawning beds may further reduce the productivity and fitness of wild salmon populations for many years to come. This project will be undertaken in PWS where portions of the spawning habitat was injured. The benefits of the project will be realized in the communities of Whittier, Valdez, and Cordova which support the commercial fishing industry in the region.

WHAT

The goal of this project is to develop proposals and designs for appropriate and cost-effective instream habitat and stock restoration projects. The following objectives will be achieved:

1. Review existing literature and databases, determine preliminary restoration techniques for specific sites, and identify sites where field studies are needed,

2. Conduct field studies at specific sites to collect data needed to evaluate restoration techniques,

3. Compile available data and select the most appropriate fish restoration projects,

4. Collect additional field data if necessary to develop project design and cost estimates, and write proposals for specific projects, and

5. Estimate the total area of anadromous fish spawning habitat that was oiled in PWS.

WHY

This is an ongoing project currently evaluating various sites in PWS for application of established spawning habitat restoration and enhancement techniques. The project is essential to responsibly develop project proposals and designs to restore and replace damaged salmon spawning habitat. The project was initially funded in September, 1991 near the end of the field season in PWS. Field activities in 1991 focused on evaluation of 41 sites for construction of fish passes and fry weirs. Field activities in 1992 are focused on evaluation of 15 sites for construction of spawning channels. The ADF&G is currently installing standpipes and water temperature/level recorders at these sites to obtain data on groundwater stability and water temperatures. The equipment must be in place throughout the winter to determine minimum temperatures and water levels at each site. Additional funds in FY93 are essential to retrieve the equipment being placed in the field now, analyze data, and prepare project designs.

HOW

Fifteen potential spawning channel sites have been identified in PWS (Willette and Carpenter 1991). Standpipes and electronic water temperature/level recorders are currently being installed at these sites to evaluate groundwater stability and temperature. This equipment must be retrieved from the field in FY93. Data obtained from electronic water temperature/level recorders will be analyzed to evaluate groundwater stability and the probable rate of intragravel flow at potential spawning channel sites. The rate of intragravel flow is an important variable affecting egg-to-fry survival in salmon spawning beds (McNeil 1966).

Data collected from field surveys conducted in FY92 (Willette and Carpenter 1991) will be evaluated in FY93 along with data describing groundwater characteristics. Criteria outlined by Bonnell (1991) will be used to evaluate the suitability of specific sites for the construction of spawning channels. In addition, the estimated increase in fish production and the benefit/cost ratio of the proposed project will be considered. Additional field work may be required to collect engineering data needed to develop detailed project designs. All restoration survey efforts will be coordinated with local landowners and governments.

Literature Cited

Bonnell, R.G. 1991. Construction, operation, and evaluation of groundwater-fed side channels for chum salmon in British Columbia. In: Proceedings of the Fisheries Bioengineering Symposium, American Fisheries Society Symposium no. 10, pp. 109-124.

McNeil, W.J. 1966. Distribution of spawning pink salmon in Sashin Creek, Southeastern Alaska, and survival of their progeny. USFWS, Spec. Sci. Rpt.-Fisheries NO. 538.

Willette, T.M. and G. Carpenter. 1991. Survey and evaluation of instream habitat and stock restoration techniques for anadromous fish. Draft Status Report to the *Exxon Valdez* Oil Spill Trustee Council, 34p.

Willette, T.M. and G. Carpenter. 1991. Survey and evaluation of instream habitat and stock restoration techniques for anadromous fish. Detailed Study Plan (Oil Year 4). Submitted to *Exxon Valdez* Oil Spill Trustee Council, 12p.

ENVIRONMENTAL COMPLIANCE

The project qualifies for a categorical exclusion under the National Environmental Policy Act, because it does not involve any significant manipulation of biological resources or their habitats.

WHEN

This project will continue for five months in FY93. This will allow project staff sufficient time to retrieve equipment placed in the field in FY92, analyze data, collect additional engineering design data if necessary, and prepare detailed project proposals.

June	Retrieve standpipes and electronic water temperature/level recorders from 15 sites.
July	Compile and evaluate data, select sites for development of detailed project proposals.
August	Collect additional engineering data if necessary for project design.
Sept.-Oct.	Prepare detailed project proposals including engineering designs.

BUDGET ($K)

	ADF&G
Personnel	$ 38.0
Travel	2.1
Contractual	17.5
Commodities	1.4
Equipment	0.0
Capital Outlay	0.0
Sub-total	$ 59.0
General Administration	0.4
Project Total	$ 59.4

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EXXON VALDEZ OIL SPILL PROJECT DESCRIPTION

Project Number: 93064

Project Title: Habitat Protection Fund

Project Category: Habitat/Land Protection

Project Type: Habitat Protection

Lead Agency: Alaska Department of Natural Resources

Cooperating Agencies: Alaska Department of Fish and Game; National Oceanic and Atmospheric Administration; Department of Interior; Alaska Department of Environmental Conservation; U.S. Forest Service

Project Term: January 10, 1992 until completed

INTRODUCTION

Public comment, to date, has overwhelmingly supported use of settlement funds for Habitat Protection and Acquisition as a method of preventing further harm to, and assisting the recovery of, natural resources and services injured by the *Exxon Valdez* oil spill. Numerous proposals or nominations of lands believed to be deserving of protection or acquisition were received from the public as FY93 work plan proposals.

In response, this project demonstrates a strong commitment on the part of the Trustees to accelerate important elements of the Habitat Protection process. The project would be conducted within the context of maintaining the integrity of the overall Restoration Planning process and accompanying compliance with NEPA and other legal and regulatory requirements.

WHAT

The goal of this project is to capitalize on available opportunities to provide protection for those parcels of non-public lands within the oil spill affected area which contain important habitats linked to those natural resources and services injured by the oil spill. The initial focus of the effort will be on those parcels facing imminent threat, where the lack of protection could foreclose restoration opportunities.

This project also allows for the activities necessary to acquire additional data to accurately evaluate and protect/purchase privately held lands within the spill affected area. Also, once acquisition activities commence, it will be necessary to obtain information such as appraisals, preliminary title reports, litigation reports and hazardous material surveys. Furthermore, on-site verification of habitat values may also be necessary.

WHY

Habitat protection and acquisition is one of a number of restoration tools being considered in the draft Restoration Plan scheduled for release for public review and comment in Fall 1993. A final Restoration Plan is expected in May 1994. In the interim, protection of key parcels of non-public lands which contain important habitats is needed to ensure that habitat protection and acquisition is not foreclosed by events preceding Trustee Council adoption and implementation of a final Restoration Plan. This will also allow the application of the full-spectrum of habitat protection actions ranging from moratorium to fee title. This fund provides the wherewithal to bring negotiations to closure when appropriate; exhibits good faith intent on the part of the Trustees; and allows access to monies without long delays.

HOW

1. BY NOVEMBER 15, 1992 - The Habitat Protection and Acquisition Work Group, in cooperation with The Nature Conservancy, will conduct and document a series of workshops to be attended by scientists and other resource specialists for the purpose of (1) assessing the rate and degree of recovery of resources and services injured by the oil spill, and (2) identifying and characterizing the habitats associated with the recovery of injured resources or services. This task is part of Project 93059.

2. ONGOING - The Habitat Protection and Acquisition Work Group will identify those parcels of non-public land within the oil spill affected area which face an imminent threat.
If the threat analysis indicates that there is no imminent threat, further analysis of the nomination may be deferred to the more comprehensive habitat protection process.

3. BY DECEMBER 1, 1992 - The Habitat Protection and Acquisition Work Group, through the Restoration Team, will request authority from the Trustee Council to negotiate protection on specific parcels.

4. FOLLOWING DECEMBER 1992 - The Trustee Council approves the results of the negotiations on specific parcels.

5. SUBSEQUENT TO #4 ABOVE - Additional evaluations (i.e. appraisals, biological surveys, title searches) of specific parcels will occur subsequent to Trustee Council approval of the negotiated terms.

WHEN

The project will commence October 1, 1992. There is no set completion date for the project because protection measures will vary depending upon the specifics of each parcel and negotiations may occur over multiple years.

ENVIRONMENTAL COMPLIANCE

Each habitat protection action will be evaluated to determine the level of environmental analysis and documentation necessary to comply with the National Environmental Policy Act (NEPA). It is

expected that NEPA compliance for most contemplated protection measures would not exceed an Environmental Analysis level of documentation.

BUDGET ($K)

	ADNR	ADEC	USFS	AGENCY (TBD)	TOTAL
Personnel	$ 0.0	$ 0.0	$ 0.0	$ 0.0	$ 0.0
Travel	0.0	0.0	0.0	0.0	0.0
Contractual**	100.0	100.0	200.0	0.0	400.0
Commodities	0.0	0.0	0.0	0.0	0.0
Equipment	0.0	0.0	0.0	0.0	0.0
Capital Outlay*	7,500.0	0.0	0.0	12,100.0	19,600.0
Sub-total	$ 7,600.0	$ 100.0	$ 200.0	$12,100.0	$ 20,000.0
General Administration	0.0	0.0	0.0	0.0	0.0
Project Total	$ 7,600.0	$ 100.0	$ 200.0	$ 12,100.0	$ 20,000.0

* The total amount dedicated to interim habitat protection may be amended by the Trustee Council following completion of the imminent threat analysis and negotiation process.

** This contractual line-item reflects the expenditure of funds to acquire data necessary to analyze parcels and support acquisition activities.

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EXXON VALDEZ OIL SPILL PROJECT DESCRIPTION

Project Number: 93065

Project Title: Prince William Sound Recreation

Project Category: Recreation

Lead Agency: U.S.D.A. Forest Service

Cooperating Agencies: Alaska Department of Natural Resources

Project Term: February 16, 1993 to September 30, 1993

INTRODUCTION

Prince William Sound, the site of the *Exxon Valdez* oil spill, is surrounded by the Chugach National Forest. There are seven Alaska State Marine Parks, six proposed marine parks and large tracks of private land, primarily in Native ownership within the Sound. Prince William Sound offers numerous recreation opportunities, ranging from ocean touring kayaks to large cruise ships. The western part of Prince William Sound lies within the congressionally designated Nellie Juan and College Fiord Wilderness Study Areas and is administered by the Forest Service for its wilderness values.

Both the Chugach National Forest Land Management Plan and the Prince William Sound Area Plan for State Lands emphasize recreation uses within Prince William Sound. Private landowners are also interested in developing recreation opportunities on their lands.

Immediately after the oil spill use by both commercial and non-commercial recreation use decreased. While there is no studies documenting continued reduced levels of recreation use, public perceptions remain that the area has been changed and some tour operators indicate their business has still not returned to pre-spill levels.

WHAT

A small group of recreation experts will be formed to work with the Restoration Team to provide advice and information to the Trustee Council on:

1. Development of an integrated approach for implementing restoration options for recreation in Prince William Sound.

There is an obvious conflict between user groups on the development of any recreation facilities or opportunities that has become apparent in reviewing public input into the development of recreation options for the Restoration Plan. Reaching consensus amongst user groups on appropriate projects and locations is central to this goal. A similar approach to dealing with recreation restoration options for the rest of the oil spill area may be appropriate at a later date.

2. Evaluate recreation management in the Sound to emphasize the world class recreation

opportunities available which may include State and/or Federal special recreation designation.

Task 1 objectives:

1. Assemble and evaluate current information and public comment on the recreation opportunities in Prince William Sound.

2. Coordinate opportunities for recreation development with the various public and private land managers, recreation service providers and users in Prince William Sound and build consensus for implementing restoration options.

3. Develop integrated recreation project proposals for FY94 and beyond.

Task 2 objectives:

1. Identify the steps and/or procedures for State and Federal special designations for any or all of Prince William Sound.

2. Develop goals and objectives for the long term management of Prince William Sound.

HOW

Recreation specialists and planners with site-specific knowledge about Prince William Sound will review information collected on recreation as part of the Draft Restoration Plan and other sources. Working with landowners and commercial and non-commercial recreation user groups they will develop an implementation program for recreation restoration. Specific proposals for implementing the restoration options identified in the Draft Restoration Plan will be developed.

A major part of the work will be in developing a consensus amongst recreation users on the best way to implement restoration options. This will involve working directly with user groups. Some of the work will involve travel to local communities to get participation and agreement from the users.

Task 2 will consist of reviewing agency procedures to outline the steps for carrying out a special area designation for Prince William Sound, should the Trustee Council decide to implement this option.

ENVIRONMENTAL COMPLIANCE

This project is categorically exempt from formal documentation in an Environmental Assessment or Environmental Impact Statement under Forest Service regulations [FSH 1909.15 31.1a(3)].

WHEN

Task 1 will be completed in coordination with the 1994 Work Plan. Task 2 will be completed by September 30, 1993.

BUDGET ($K)

	USFS	ADNR	TOTAL
Personnel	$ 27.6	$20.0	$ 47.6
Travel	6.0	3.3	9.3
Contractual	3.7	2.0	5.7
Commodities	1.0	1.0	2.0
Equipment	0.0	0.0	0.0
Sub-total	$ 38.3	$ 26.3	$ 64.6
General Administration	4.4	3.0	7.4
Project Total	$ 42.7	$ 29.3	$ 72.0

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EXXON VALDEZ OIL SPILL PROJECT DESCRIPTION

Project Number: 93067

Project Title: Prince William Sound Pink Salmon Stock Identification and Monitoring Studies

Project Category: Recovery Monitoring and Restoration

Project Type: Fish and Shellfish

Lead Agency: Alaska Department of Fish and Game

Cooperating Agencies: Prince William Sound Aquaculture Corporation; Valdez Fisheries Development Association

Project Term: October 1, 1992 to September 30, 1993

INTRODUCTION

A. Background

Wild stock production of pink salmon in PWS has ranged from 10 to 15 million fish in recent years. Much of the spawning for pink salmon (up to 75% in some years) occurs in intertidal areas. Intertidal spawning areas are susceptible to marine contaminants and there is strong evidence the March 24, 1989, *Exxon Valdez* oil spill (EVOS) adversely affected spawning success and early marine survival in Prince William Sound (Sharr et. al. 1992, Willette and Carpenter 1993). Salmon stocks impacted by the *Exxon Valdez* oil spill (EVOS) are also heavily exploited in commercial, sport, and subsistence fisheries. These stocks can most effectively be restored through stock-specific management practices designed to reduce exploitation on impacted stocks. The stocks in areas heavily impacted by the EVOS are present in fisheries dominated by hatchery and wild stocks from unaffected areas of the Sound. The management of this mixed stock fishery has historically been based on maintaining good temporal and spatial distribution of spawning escapement for groups of stocks in eight major fishing districts. The success of this management strategy relies upon the manager's ability to control stock-specific exploitation rates. Restoration premised on stock specific management of the commercial fishery for reduced exploitation of impacted stocks will require even more accurate inseason catch stock composition estimates if different harvest rates are to be achieved for damaged wild stocks versus unimpacted wild stocks or hatchery stocks.

The foundations for this project were firmly established in feasibility studies which were conducted beginning in 1986 and extending through 1988. During the damage assessment process large scale tagging and recovery projects were instituted and perfected by Natural Resources Damage Assessment (NRDA) Fish/Shellfish (F/S) Study #3 . Damage assessment funds were expended for tagging hatchery releases of pink salmon in 1989 and 1990 and wild populations of pink salmon in 1990 and 1991. Tag recovery efforts for wild and hatchery pink salmon were funded by damage assessment funds in 1989, 1990, and 1991 and by restoration funds in 1992. Following the loss of funds for further tagging of hatchery stocks of pink salmon in 1990, the private non-profit aquaculture associations in Prince William Sound have continued to tag pink salmon releases at their own expense. Tags applied to pink fry from the four pink salmon hatcheries in Prince William Sound

in 1992 must still be recovered. If recovery efforts proposed here are not instituted in 1993 important restoration and population monitoring data will be irretrievably lost. Prince William Sound Aquaculture Corporation, Valdez Fisheries Development Association, and the Alaska Department of Fish and Game have pooled their resources to come up with approximately half of the funds required to field a full fledged pink salmon tag recovery effort in 1993. This project proposal is for matching funds to complete tag recovery efforts and data analyses in 1993.

B. Injury

Results of the Damage to Eggs and Pre-Emergent Fry Project (NRDA F/S Study 2 and Restoration Study 60C, Sharr et al. 1992) indicate that salmon embryos in oiled streams have exhibited a much higher mortality than embryos from comparable unoiled streams since 1989. Results of the Run Reconstruction Project (Restoration F/S Study 28) indicate that the annual adult returns from the southwestern portion of PWS alone may still be hundreds of thousands of fish lower than expected as a result of chronic damage from increased mortalities in embryos from oiled streams and from reduced growth and survival among juveniles rearing in oiled portions of the Sound. This level of chronic population level damage may result in severe over exploitation and drastic reductions in spawning escapement to affected streams. Ultimately, if corrective measures are not taken, these populations may be in danger of extinction.

In the absence of improved stock-specific management capabilities afforded by this project, salmon stocks in western PWS which have already been stressed and depleted by the oil impacts will potentially be over exploited in the commercial, sport and subsistence fisheries. Population levels of stocks may be reduced below those needed for rapid recovery and in some instances may result in virtual elimination of impacted stocks. If adequate stock monitoring programs are not in place, changes in fishing effort to areas of less oil impact could also result in over exploitation of otherwise healthy, unimpacted stocks.

C. Location

Sampling of salmon catches from commercial and cost recovery fisheries will occur in shore based processing plants in Cordova, Valdez, Whittier, and Kodiak. Extraction and decoding of tags will be accomplished by the ADF&G coded-wire tag lab in Juneau. All data analyses will be completed in Cordova with assistance from Anchorage based Alaska Department of Fish and Game biometrics staff.

WHAT

A. Goal

This project is designed to provide estimates of hatchery and wild fish contributions to commercial and cost recovery fisheries in Prince William Sound. These estimates will allow fisheries managers to lessen interceptions of wild fish in mixed stock fisheries.

This project is designed to provide accurate, real time, catch contribution estimates for pink salmon stocks of Prince William Sound. Accurate escapement estimates from ongoing ADF&G escapement monitoring projects will enable mangers to identify stocks which are experiencing escapement

shortfalls. Accurate and timely catch contribution estimates from this coded-wire tag recovery project will enable managers to identify times and areas where exploitation on depleted wild stocks can be minimized and still permit the harvest of surplus hatchery returns. Post season analyses of the catch contribution estimates together with results from salmon escapement enumeration projects will provide stock-specific estimates of total return and survival and enable managers to assess the effectiveness of stock-specific management strategies.

B. Objectives

(1) Sample approximately 20% of the pink salmon catches from commercial and cost recovery fisheries in PWS for coded-wire tags;
(2) Sample approximately 95% of the hatchery pink salmon brood stock in PWS for coded-wire tags;
(3) Assess the feasibility of using the number of adipose clips observed to estimate temporal and spatial contributions of tagged hatchery stocks of pink salmons to PWS commercial and hatchery harvests;
(4) Make inseason estimates of the temporal and spatial contributions of tagged hatchery stocks of pink salmon to PWS commercial and hatchery harvests based on the number of tags detected in adipose clipped fish which are recovered during catch sampling;
(5) Provide timely in-season estimates of hatchery and wild stock contributions to harvests by time and area to fisheries managers so they can closely regulate exploitation of injured wild stocks;
(6) Use data from fully decoded tags recovered from commercial catches, cost recovery harvests, and hatchery brood stock to verify or adjust inseason contribution estimates;
(7) Estimate marine survival rates for each uniquely coded hatchery release group and;
(8) Write a final report which summarizes temporal and spatial distributions of hatchery and wild contributions to commercial and cost recovery harvests in PWS, survival estimates by stock, and fisheries management actions taken to reduce the exploitation on wild stocks based on in-season catch stock composition estimates.

WHY

A. BENEFITS

Pink salmon are the most numerous of the salmon species which spawn in PWS. They act as a vital transport mechanism for energy and nutrients from the high seas to the nearshore and upland areas adjacent to more than one thousand streams around the perimeter of the Sound. Furthermore, wild pink salmon are the cornerstone of the fisheries industry which dominates the PWS economy. Sustained production of wild pink salmon populations is essential to the health and maintenance of many other fish, bird, marine mammal, terrestrial mammals and human populations which reside in PWS. This project will provide a tool for fisheries managers to use in efforts to protect damaged wild populations from commercial fisheries which target on large hatchery returns in western PWS. Marine, freshwater, and upland ecosystems in and around affected streams will benefit as will local fisheries which ultimately depend upon the restoration and long-term health of wild populations.

HOW

A. Methodology

Tag Recovery

(1) Commercial Catches

The Alaska Department of Fish and Game will oversee the recovery of coded-wire tagged fish in commercial salmon harvests in Prince William Sound. The recovery samples will be from a stratified sample (Cochran 1977). Fisheries will be stratified by district and discrete time segments. The recovery will be further stratified by processor as described in Peltz and Geiger (1988). For each time and area-specific stratum, 15% of the pink salmon catch will be scanned for fish with a missing adipose fin. Catch sampling will be done in four fish processing facilities in Cordova, one facility in Whittier, and three facilities in Valdez. When feasible, sampling will occur at facilities in Kodiak, Kenai, Anchorage, and Seward and on large floating processors. All deliveries by fish tenders to these facilities will be monitored by radio and by daily contact with processing plant dispatchers to ensure that the catch deliveries being sampled are district specific.

Scanning commercial pink salmon catches for coded-wire tags involves visually selecting adipose clipped fish from a mixture of unclipped and clipped fish on a conveyor belt. Samplers will select fish on the basis of whether they have a good view of the adipose fin region; negative sampling bias may occur by consistent exclusion of tagged fish. This possible sampling bias will be periodically tested by comparing the tag recovery rates of sampled fish to recovery rates in a complete censuses of sampled loads of fish.

(2) Hatchery Sales Harvests

In addition to catch sampling at the processing facilities, approximately 15% of the fish in the hatchery terminal harvest areas will be scanned for fish missing adipose fins. Because sales harvests are processed at the same processing facilities as commercial harvests, methods and means of sampling sales harvest will be identical to those described for commercial catches.

(3) Hatchery Brood Stocks

Brood stock sampling is critical to estimating hatchery and wild contributions. Due to differential mortality between tagged and untagged fish as well as differential tag loss between release groups, the tag expansion factor at release for hatchery fish may no longer accurately reflect the tag expansion factor in the adult population. Theoretically, brood stock are composed of 100% fish which originated from the hatchery where sampling occurs and are representative of returns from each fry release group. Based on this assumption, tag recovery rates from brood stock can be used to adjust the initial tag expansions for each tagged hatchery release group.

There will be a brood stock tag recovery effort at each of the four hatchery facilities where tags were initially applied. Technicians will be stationed at each of these hatcheries to scan the brood stock during egg take. After the salmon are manually spawned, technicians will use visual and tactile methods to scan approximately 95% of the fish. Total number of fish scanned and total number of fin-clipped fish found will be recorded on a daily basis. Heads and their corresponding data sheets will be picked up on a regular basis and returned to Cordova for editing and shipping to the Juneau tag lab.

Results of this study will provide estimates of hatchery and wild stock contributions to commercial harvests, hatchery cost recovery harvests, hatchery brood stocks and wild stock escapements. Stock-specific catch contributions will be by date and fishing district and will be used inseason by fisheries managers to reduce effort on damaged stocks and target effort on healthy hatchery returns. Post season analyses of current year, as well as historic tag recovery data, will be coupled with escapement data for wild stocks to make estimates of wild stock total returns and survival. These data are important as a tool for assessing the effectiveness of various management strategies. Post season analyses of tagging data will also identify trends in the temporal and spatial distributions of stocks in the fisheries. Stock-specific management strategies for oiled populations and other populations affected by altered fisheries management will be developed using tagging data in conjunction with escapement data.

B. Coordination with Other Efforts

The project is funded by the Alaska Department of Fish and Game, Prince William Sound Aquaculture Corporation, Valdez Fisheries Development Association, and the Oil Spill Trustee Council. The project will be administered and supervised by the Alaska Department of Fish and Game.

ENVIRONMENTAL COMPLIANCE

All sampling activities for this project are non-intrusive and occur within fish processing plants or fish hatcheries. This project received a categorical exclusion from the requirements of the National Environmental Policy Act. No additional permits are required from the State.

WHEN

June 20 - Sept. 10, 1993	Tag recoveries in commercial fisheries, cost recovery harvests, and brood stocks. In-season catch stock composition estimates by time and area for management of commercial and cost recovery fisheries.
Nov 30, 1993	Draft report
Jan 30, 1994	Final report

BUDGET ($K)

Personnel	$ 155.0
Travel	9.6
Contractual	20.4
Commodities	10.3
Equipment	0.0
Capital Outlay	0.0
Sub-total	$ 195.3
General Administration	24.7
Project Total	$ 220.0

EXXON VALDEZ OIL SPILL PROJECT DESCRIPTION

Project Number: 93068

Project Title: Prince William Sound Chinook, Sockeye, Chum and Coho Salmon Stock Identification and Monitoring Studies

Project Category: Recovery Monitoring and Restoration

Project Type: Fish and Shellfish

Lead Agency: Alaska Department of Fish and Game

Cooperating Agencies: Prince William Sound Aquaculture Corporation, Valdez Fisheries Development Association

Project Term: October 1, 1992 to September 30, 1993

INTRODUCTION

A. Background

Salmon stocks impacted by the EVOS are heavily exploited in commercial, sport, and subsistence fisheries and their restoration can most effectively be realized through stock-specific management practices designed to reduce such exploitation on impacted stocks. The damaged populations exist in fisheries dominated by hatchery and wild stocks from unaffected areas of the Sound. The management of this mixed stock fishery has historically been based on maintaining good temporal and spatial distribution of spawning escapement for groups of stocks in eight major fishing districts and its success has relied upon the manager's ability to control stock-specific exploitation rates. Restoration premised on such a management strategy will require even more accurate in-season catch stock composition estimates if lower harvest rates are to be achieved for damaged wild stocks versus unimpacted wild stocks or hatchery stocks.

In the absence of improved stock-specific management capabilities afforded by this project, salmon stocks in western PWS which have already been stressed and depleted by the oil impacts will potentially be over exploited in the commercial, sport and subsistence fisheries. Population levels of stocks may be reduced below those needed for rapid recovery and in some instances may result in virtual elimination of impacted stocks. If adequate stock monitoring programs are not in place, changes in fishing effort to areas of less oil impact could also result in over exploitation of otherwise healthy, unimpacted stocks.

The foundations for this project were firmly established in feasibility studies which were conducted beginning in 1986 and extending through 1988. During the damage assessment process large scale tagging and recovery projects were instituted and perfected by Natural Resources Damage Assessment (NRDA) Fish/Shellfish (F/S) Study #3 . Damage assessment funds were expended for tagging hatchery releases of sockeye, coho and chinook salmon in 1989 and 1990 and releases of chum salmon in 1990. Tag recovery efforts for wild and hatchery salmon were funded by damage assessment funds in 1989, 1990, and 1991. Some age classes of these tagged stocks will still be

returning in 1993. If recovery efforts proposed here are not instituted in 1993, important restoration and population monitoring data will be irretrievably lost. Funding was also provided for the Coghill Restoration Project for 1993. In order to assess the success of this project, sockeye tags need to be recovered. Without a method to segregate the wild Coghill sockeye stock from the hatchery stocks, there will be no way to determine the numbers of Coghill sockeye returning to Coghill Lake.

B. Injury

Recent wild stock production in Prince William Sound (PWS) has included from 800 to 900 thousand chum salmon, 300 to 500 thousand sockeye salmon and 10 to 20 thousand coho and chinook salmon. Up to 75% of wild pink and chum salmon spawn in intertidal areas with the greatest proportion of intertidal spawning occurring in streams flowing into the southwestern portion of PWS. Oil from the *Exxon Valdez* oil spill (EVOS) was deposited in intertidal spawning areas for pink and chum salmon and may have adversely affected spawning success and early marine survival for these species in Prince William Sound (Sharr et. al. 1992, Willette and Carpenter 1993). In addition, emergent fry and smolt of all salmon species from throughout PWS migrated through and reared in areas contaminated by oil. The suite of injuries already identified have led to a decline in the size and overall well being of wild pink salmon populations and these effects may persist for several years. Adult returns and tag recoveries for sockeye, chum, and chinook which return at older ages are not complete and the full extent of damage to these species is not yet known.

C. Location

Sampling of salmon catches from commercial and cost recovery fisheries will occur in shore based processing plants in Cordova, Valdez, Whittier, and Anchorage. There will also be sampling in Seward, Kenai, and aboard floating processors if significant numbers of Prince William Sound salmon are processed at those locations. Extraction and decoding of tags will be accomplished by the ADF&G coded-wire tag lab in Juneau. All data analyses will be completed in Cordova with assistance from Anchorage based Alaska Department of Fish and Game biometrics staff.

WHAT

A. Goal

This project is designed to provide estimates of hatchery and wild fish contributions to commercial and cost recovery fisheries in Prince William Sound. These estimates will allow fisheries managers to monitor the size and health of wild salmon populations and lessen interceptions of wild fish in mixed stock fisheries.

This project will provide accurate, real time, catch contribution estimates for salmon stocks of Prince William Sound. Accurate escapement estimates from ongoing ADF&G escapement monitoring projects will enable managers to identify stocks which are experiencing escapement shortfalls. Accurate and timely catch contribution estimates from this coded-wire tag recovery project will enable managers to identify times and areas where exploitation on depleted wild stocks can be minimized and still permit the harvest of surplus hatchery returns. Post season analyses of the catch contribution estimates together with results from salmon escapement enumeration projects will provide stock-specific estimates of total return and survival and enable managers to assess the

effectiveness of stock-specific management strategies.

B. Objectives

(1) Sample 25% of the sockeye, chum, chinook and coho salmon catches from commercial and cost recovery fisheries in PWS for coded-wire tags;
(2) Sample approximately 95% of the hatchery sockeye, chum, chinook and coho salmon brood stock in PWS for coded-wire tags;
(3) Make in-season estimates of the temporal and spatial contributions of tagged hatchery stocks of sockeye, chum, chinook and coho salmon to PWS commercial and hatchery harvests based on the number of tags detected in adipose clipped fish which are recovered during catch sampling;
(4) Provide timely in-season estimates of hatchery and wild stock contributions to harvests by time and area to fisheries managers so they can closely regulate exploitation of injured wild stocks;
(5) Use data from fully decoded tags recovered from commercial catches, cost recovery harvests, and hatchery brood stock to verify or adjust in-season contribution estimates and;
(6) Estimate marine survival rates for each uniquely coded hatchery release group where possible.

WHY

A. Benefits

Despite being numerically overshadowed by hatchery stocks in recent years, wild stocks of sockeye, chum, chinook and coho salmon are much more important to the PWS ecosystem and continue to play a vital role in the commercial salmon fishery. Sockeye, chinook and coho salmon also play important roles in diverse freshwater ecosystems around PWS. Sustained production of wild salmon populations is essential to the health and maintenance of many other fish, bird, marine mammal, terrestrial mammals and human populations which reside in PWS.

This project will provide a tool for fisheries managers to use in efforts to protect damaged wild populations from commercial fisheries which target on large hatchery returns in western PWS. Marine, freshwater, and upland ecosystems in and around affected streams and lakes will benefit as will local fisheries which ultimately depend upon the restoration and long-term health of wild populations.

HOW

A. Methodology

Tag Recovery

(1) Commercial Catches

The Alaska Department of Fish and Game will oversee the recovery of coded-wire tagged fish in commercial salmon harvests in Prince William Sound. The recovery samples will be from a stratified sample (Cochran 1977). Fisheries will be stratified by district and discrete time segments. The recovery will be further stratified by processor as described in Peltz and Geiger (1988). For each time and area-specific stratum, 25% of the sockeye, chum, chinook and coho salmon catch will be scanned for fish with a missing adipose fin. Catch sampling will be conducted in four fish processing facilities in Cordova, one facility in Whittier, three facilities in Valdez and one facility in Anchorage. When feasible, sampling will occur at facilities in Kodiak, Kenai and Seward and on large floating processors. All deliveries by fish tenders to these facilities will be monitored by radio and by daily contact with processing plant dispatchers to ensure that the catch deliveries being sampled are district specific.

Scanning commercial salmon catches for coded-wire tags involves visual and tactile assessments of sampled fish on a fresh-frozen line for clipped adipose fins. Technicians will sample fish on the basis of whether they have a good view of the adipose fin region.

(2) Hatchery Sales Harvests

In addition to catch sampling at the processing facilities, approximately 30% of the fish in the hatchery terminal harvest areas will be scanned for fish missing adipose fins. Because sales harvests are processed at the same processing facilities as commercial harvests, methods and means of sampling sales harvest will be identical to those described for commercial catches.

(3) Hatchery Brood Stocks

Brood stock sampling is critical to estimating hatchery and wild contributions. Due to differential mortality between tagged and untagged fish as well as differential tag loss between release groups, the tag expansion factor at release for hatchery fish may no longer accurately reflect the tag expansion factor in the adult population. Theoretically, brood stock are composed of 100% fish which originated from the hatchery where sampling occurs and are representative of returns from each fry release group. Based on this assumption, tag recovery rates from brood stock can be used to adjust the initial tag expansions for each tagged hatchery release group. For species such as sockeye, chum and chinook, which return at different ages, this brood stock information is collected and accumulated and then applied when all age classes of each brood year have returned.

There will be a brood stock tag recovery effort at each of the three hatchery facilities where tags were initially applied to sockeye, chum, chinook and coho salmon. Technicians will be stationed at each of these hatcheries to scan the brood stock during egg take. After the salmon are manually spawned, technicians will use visual and tactile methods to scan approximately 95% of the fish. Total number of fish scanned and total number of fin-clipped fish found will be recorded on a daily basis. Heads and their corresponding data sheets will be picked up on a regular basis and returned to Cordova for editing and shipping to the Juneau tag lab.

Results of this study will provide estimates of hatchery and wild stock contributions to commercial harvests, hatchery cost recovery harvests, hatchery brood stocks and wild stock escapements. Stock-specific catch contributions will be by date and fishing district and will be used inseason by fisheries managers to reduce effort on damaged stocks and target effort on healthy hatchery returns. Post-season analyses of current year, as well as historic tag recovery data, will be coupled with escapement data for wild stocks to make estimates of wild stock total returns and survival. These data are important as a tool for assessing the effectiveness of various management strategies. Post-season analyses of tagging data will also identify trends in the temporal and spatial distributions of stocks in the fisheries. Stock-specific management strategies for oiled populations and other populations affected by altered fisheries management will be developed using tagging data in conjunction with escapement data.

ENVIRONMENTAL COMPLIANCE

All sampling activities for this project are non-intrusive and occur within fish processing plants or fish hatcheries. This project meets Federal lead agency requirements for a categorical exclusion from the requirements of the National Environmental Policy Act. No additional permits are required from the State.

WHEN

May 15 - Sept. 30, 1993	Tag recoveries in commercial fisheries, cost recovery harvests, and brood stocks. In-season catch stock composition estimates by time and area for management of commercial and cost recovery fisheries.
November 30, 1993	Draft summary report
January 15, 1994	Final report

BUDGET ($K)

Personnel	$ 105.8
Travel	1.1
Contractual	2.8
Commodities	.6
Equipment	0.0
Capital Outlay	0.0
Sub-total	$ 110.3
General Administration	16.1
Project Total	$ 126.4