Genetic Structure of Prince William Sound Pink Salmon

Project Number:	97196
Restoration Category:	Research and Monitoring
Proposer:	Alaska Department of Fish and Game
Lead Trustee Agency:	Alaska Department of Fish and Game
Cooperating Agencies:	
Alaska SeaLife Center:	Yes
Duration:	4th year, 6-year project
Cost FY 97:	$236,000
Cost FY 98:	$130,000
Cost FY 99:	$50,000
Cost FY 00:	$0
Cost FY 01	$0
Cost FY 02:	$0
Geographic Area:	Prince William Sound
Injured Resource/Service:	Pink Salmon

ABSTRACT

Previous workers found that wild-stock pink salmon suffered both direct lethal and sublethal injuries as a result of the *Exxon Valdez* oil spill. An understanding of the population structure of pink salmon in Prince William Sound is essential to assess the impact of these injuries on a population basis and to devise and implement management strategies for restoration. This project is designed to delineate the genetic structure of populations of wild pink salmon inhabiting the Sound.

INTRODUCTION

In this continuing project we delineate the genetic structure of populations of wild pink salmon (*Oncorhynchus gorbuscha*) inhabiting Prince William Sound (PWS). We are testing for both temporal and geographical structuring among even- and odd-year races by examining genetic differences between early-and late-season spawners, upstream and tidal spawners, and among stream of spawning. This knowledge of genetic structure will be used in order to:

A. Correctly interpret and apply the findings obtained from the proposed ecosystem analyses (97320) on a population basis.

B. Provide genetic information needed for risk assessment and genetic monitoring of supplementation programs (e.g., proposed as a result of Trustee Council Projects R105, 95320 A-P, 95093, or 96320) to guide population-specific restoration and enhancement.

C. Better direct harvest management decisions made for restoration purposes on a population-specific rather than species-specific basis. Our goal is to provide the basis for key management decisions by defining the genetic structure of representative populations from throughout PWS, measuring both within- and between-population diversity.

We propose to examine spawning aggregates from the even-year broodline and the odd-year broodline each for two years. Two years of analysis are needed in order to confirm stability of population structure across years.

To date the Trustee Council has funded collection of 18 odd- and 45 even-year putative populations for genetic analyses. A comprehensive suite of both nuclear (allozyme) and mitochondrial (mtDNA) markers is being screened. In 1994 we contracted with Washington Department of Fish and Wildlife to analyze 32 even-year and two odd-year collections using allozymes. In 1995 we received the results from the 1994 analyses, and we analyzed these and the mtDNA data for the same collections to examine among elevation (upstream vs intertidal spawners) and region (five management regions) variability. Preliminary results of the even-year class show significant differences between upstream and intertidal spawning aggregates within the same stream; we have also observed significant differences between west-Sound, east-Sound, north-Sound and Montague collections. We are continuing to analyze samples; thus far we have analyzed in the lab 19 odd-year collections for allozyme variation and have begun screening odd-year collections for restriction fragment length polymorphism of mtDNA. We also collected odd-year samples in 1995 from throughout the Sound including early and late samples within six sites and upstream and tidal samples within four streams.

NEED FOR THE PROJECT

A. Statement of Problem

Historically, wild stocks produced approximately five-hundred-million pink salmon fry which emerged from streams throughout PWS each year to migrate seaward. Adult returns of wild pink salmon averaged from 10 to 15 million fish annually. Unlike returns of adult hatchery fish, these returning wild-stock adults play a critical role in the total PWS ecosystem: they convey essential nutrients and minerals from the marine ecosystem to estuaries, freshwater streams, and terrestrial ecosystems. Both juveniles and adults are important sources of food for many fishes, birds, and mammals. 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.

Wild-stock pink salmon suffered both direct lethal and sublethal injuries as a result of the *Exxon Valdez* oil spill (EVOS). Pink salmon embryos and alevins suffered increased mortality, diminished growth, and a high incidence of somatic cellular abnormalities as a result of spawning ground contamination and rearing in oiled areas. Elevated mortality of embryos in the oiled streams has continued through 1993, three generations after the oiling, suggesting that genetic damage may have occurred (see discussions in Sharr et al. 1993; Miller et al. 1994). Also, in 1989 the commercial harvest of pink salmon had to be shifted away from the hatchery and wild stocks in the oiled areas to target only the wild stocks in eastern PWS. This resulted in over-harvest and depletion of these stocks evidenced by general run failures of eastern PWS stocks of non-hatchery origin in 1991.

PWS is also the center of one of the State of Alaska's largest aquacultural industries. Alaska Department of Fish and Game (ADF&G) has been grappling with management of the wild stocks in face of complicated hatchery/wild-stock interactions for nearly a decade. The EVOS-related damages to wild stocks, coupled with full-scale hatchery egg takes, has exacerbated wild-stock management concerns. The commercial fishing industry and the two aquaculture associations are facing serious financial challenges due to the alterations in management imposed as a result of declines in abundance of wild pink salmon.

B. Rationale/Link to Restoration

It is essential to manage and restore the damaged pink salmon resources on a population basis in order to conserve between-population diversity. While "stock" is used by biologists as a convenient term designating fish that spawn at a certain time at a certain place, stocks may not be genetically distinct from each other; also, a stock may be composed of multiple genetically divergent groups. "Population" describes genetically distinct groups of fish which are the building blocks of species. Gene flow is restricted between populations (thus carbon flow is restricted--see related proposals in Trustee Council project 97320), and this resulting between-population diversity is responsible for many aspects of the fitness of the species. In the case of commercially harvested species like pink salmon, fitness is defined to include the peak productivity and long-term sustainability. Between-population diversity provides optimal

production for species inhabiting diverse ecosystems such as PWS; highly diverse population mixes also provide a biological buffer to environmental change (droughts, floods, major earthquakes, and other routine events that occur in Alaskan ecosystems).

Understanding genetic structure of the wild stocks inhabiting PWS is critical to their management and conservation. For example, managing on too fine a scale may adversely affect the fishing industry and waste management resources, while managing on too large a scale may result in loss of genetic adaptations and diversity in the wild pink salmon populations within PWS. Knowledge gained through this project is needed to correctly interpret and apply the findings obtained from the proposed ecosystem analyses on a population basis, more properly define the population-level nature of the damage documented in previous study of EVOS-damaged pink salmon, and otherwise guide the decision-making process in the management-oriented restoration of the EVOS-damaged pink salmon populations. The same knowledge of population structure will be used for genetic monitoring and risk assessment, required to evaluate any supplemental restoration programs (e.g., related work in projects such as proposed Trustee Council Project 97093). This monitoring and risk assessment is analogous to the process currently being conducted to evaluate supplemental restoration of damaged populations on the Columbia River by the Northwest Power Planning Council (Waples et al. 1991).

Even- and odd-year classes have independent population structures because of the rigid two-year life cycle of pink salmon. For example, climactic, tectonic or other such events (such as the 1964 earthquake or the 1989 oil spill) may affect the population structure of the either odd or even year classes while leaving the alternate year-class relatively unchanged. Therefore, we are examining the population structure of both even- and odd-year classes.

We are continuing to examine population structure by using both nuclear (using allozyme electrophoresis) and mtDNA approaches in this ongoing project. Both allozyme analysis and mtDNA analysis will be used to discriminate populations and describe population structure. Genetic studies using allozyme analysis have proven especially useful for the conservation and management of populations of pink salmon (e.g., Shaklee et al. 1991; White and Shaklee 1991); we are also expanding our pilot analysis using mtDNA analyses, as our preliminary data have shown potential usefulness for detecting geographic isolation.

Allozyme analysis remains the preferred approach for study of population genetics of salmonids because of its power to resolve populations of many species in the tetraploid-derived family by assaying many nuclear loci rapidly and at low cost (Allendorf 1994). Additional advantages of allozymes in this study include the fact that a pre-spill allozyme data set exists for comparison, and also many laboratories cooperate on inter-institutional examinations of pink salmon using allozymes, providing a support structure including a wealth of compatible data for comparison among Pacific rim populations (e.g., Beacham et al. 1985, 1988; Shaklee et al. 1991; White and Shaklee 1991; Shaklee and Varnavskaya 1994).

The utility of mtDNA approaches to diversity studies is controversial (especially for study of

salmonids) for reasons such as high relative cost and slow relative throughput (Allendorf 1994); additionally, sometimes mtDNA data reveal less diversity than that detected through allozymes because mtDNA loci are absolutely linked, cannot recombine, and are maternally inherited as a single locus (Smouse et al. 1994)(compare the lack of diversity observed for mtDNA in chum salmon in Park et al. (1993) with the abundance of allozyme diversity scored for similar populations in Winans et al. (1994)). However, adjacent pink salmon populations tend to be closely related (Shaklee and Varnavskaya 1994), and our FY 95 haplotype data indicate an east-west-island and upstream-intertidal separation of populations within PWS. We believe that the complementary use of the two techniques should provide optimal resolution of the population structure for this study.

C. Location

The field portion of this project will be conducted in PWS (based out of Cordova, Alaska); part of the allozyme analyses may be performed by WDFW in Olympia, Washington; and the remaining allozyme analysis, the mtDNA analysis, experimental matings and fish culture, and data analyses will be completed in Anchorage, Alaska. The laboratory and fish-rearing portions of the project will be moved to the Alaska SeaLife Center in Seward when that facility is available.

COMMUNITY INVOLVEMENT

This project also had strong support from the Prince William Sound Aquaculture Corporation and the Cordova fishing community when it was first drafted in 1991. Wherever possible, local-hire will be used to fill field positions required for sampling or for routine laboratory positions. People from the communities in PWS will have an opportunity to participate in this project as employees of the ADF&G which gives local residents priority in hiring for state employment.

The laboratory portion of the project is currently performed in Anchorage. It will be moved to the Alaska SeaLife Center in Seward when that facility is available. Again, local hire will be used when possible, and ADF&G plans to participate in all of the educational and outreach programs scheduled for the Center.

PROJECT DESIGN

A. Objectives

Our objective is to define the genetic structure of pink salmon stocks in the EVOS-affected area of PWS. We will test for:

1. genetic differences between upstream and intertidal pink salmon spawners within the same streams.

2. genetic differences between pink salmon spawners from different streams within PWS.

3. genetic differences between pink salmon spawners from different regions within PWS.

4. genetic differences between pink salmon spawners with different run timings within the same streams.

5. genetic differences between odd- and even-year pink salmon spawners.

6. inheritance of putative allozyme alleles and loci.

B. Methods

1. Field Sampling

Physiography of Prince William Sound

Tissues for baseline genetic data will be collected from up to 100 individuals from each of 30 spawning aggregations of each year class. Sampling will be based on the physiography of PWS and will include areas uplifted and areas unaffected by the 1964 earthquake (Figure 1). Sampling locations will incorporate a broad geographical distribution within the Sound (Table 1) including three hatcheries (Solomon Gulch, Cannery Creek and Armin F. Koernig) and 27 spawning aggregates from wild-stock streams.

Sampling will be designed to include both early and late stocks and inter-tidal and upstream-spawning stocks. Because abundance of pink salmon varies annually, selection of spawning aggregations will be determined by field personnel who will be instructed to sample streams that maximize the ability to investigate temporal (between years and within years) and spatial (between streams and within streams) comparisons. Tissue samples from heart, liver, muscle, and vitreous humor from each individual will be immediately frozen on liquid nitrogen and returned to Anchorage for storage at -80° C.

2. Laboratory Analysis

Allozymes

Genetic data will be collected using the techniques of allozyme electrophoresis on all samples (Utter et al. 1987; Seeb et al. 1987). A pre-spill data base of allozyme frequencies from 12 loci exists for PWS pink salmon (Seeb and Wishard 1977) which facilitates analyses of potential changes of population structure and gene flow. An extensive allozyme screening was undertaken by Washington Department of Fish and Wildlife (WDFW), subcontractor on this project in 1994-95, to maximize the potential number of available gene markers for examination in this project. The 77 loci resolved

(Table 2) are greater in number than those examined in any previous study (Beacham et al. 1988; Shaklee et al. 1991; Shaklee and Varnavskaya 1994).

Allozyme techniques will follow those of Harris and Hopkinson (1976), May et al. (1979), and Aebersold et al. (1987); nomenclature will follow the American Fisheries Society standard (Shaklee et al. 1990). Gels will be scored using on-line scoring programs developed by the ADF&G and WDFW Genetics Laboratories. Both data collection and management systems provide extensive documentation of results and error checking capabilities; and both facilitate rapid collation, analysis, and reporting of genetic data in order to ensure rapid turnaround, complete documentation, and immediate availability of summary statistics.

S-plus analytical software (Mathsoft, Inc., Seattle WA) will be used to calculate allele frequency estimates, to test for conformation of genotype frequencies to Hardy-Weinberg expected frequencies using likelihood ratios, and calculate Nei's (1978) genetic distance and Cavalli-Sforza and Edwards (1967) genetic distance. This application will also be used to perform hierarchical analyses using log likelihood (modified from Weir 1990) to determine if significant population substructuring exists among PWS pink salmon based on the following criteria: even versus odd-year, upstream versus intertidal spawning location, early versus late run, and geographic location of spawning.

We will estimate genetic relationships by deriving UPGMA (Sneath and Sokal 1973) and neighbor-joining trees (Saitou and Nei 1987) with Cavalli-Sforza and Edwards (1967) genetic distance and a UPGMA tree with Nei's (1978) genetic distance. In addition multi-dimensional scaling (Lessa 1990) will be performed using Cavalli-Sforza and Edwards (1967) genetic distances.

Finally, all allozyme data will be merged into the state and federal inter-agency databases maintained by NMFS, ADF&G, and WDFW.

Mitochondrial DNA

An initial screening with 20 restriction enzymes was done in 1995 to identify polymorphic sites in both even- and odd-year cohorts. Samples for the screening came from spawning aggregates from tidal collections from three geographically separated streams (Duck River, Swanson Creek, and Humpback Creek; Seeb et al. 1996). Seven enzymes that detected polymorphisms were then used to screen the remaining even-year collections. We propose to expand the full screening to include 20 individuals from three upstream collections because of the differences observed haplotype frequencies between upstream and tidal collections thus far (Seeb et al. 1996). We will re-evaluate the seven-enzyme screen that is proposed for all remaining collections, should new polymorphic sites be detected.

DNA will be extracted using Puregene DNA isolation kits for animal tissues (Gentra Systems, Inc. P.O. Box 13159, Research Triangle, N.C. 27709-13159). This process includes: (1) a cell lysis solution to break down cell and nuclear membranes; (2) a Proteinase K digest to denature proteins; (3) an RNase treatment to digest RNA; (4) protein precipitation to remove Proteinase K, RNase, and denatured proteins; (5) isopropanol to precipitate DNA; (6) 70% ethanol to wash DNA; and finally (7) a hydration solution to rehydrate DNA.

After extraction, the DNA will be amplified using the polymerase chain reaction (PCR; Saiki et al. 1988; Kocher et al. 1989). Amplified DNA will be cut with about seven restriction enzymes found to detect haplotype polymorphisms (of the 20 screened ; Table 3) and electrophoresed on agarose gels. Fragments will be visualized under UV light, and a photographic record will be made of each gel.

Since genes which are encoded by the mitochondrial genome are inherited as a single unit (i.e., analogous to linked loci), the restriction sites detected for each enzyme, for all regions examined, will be pooled as composite haplotypes. The frequencies and distributions of these composite haplotypes will then be used to examine the structure of salmon populations.

Nucleotide (*d*) and haplotype (*h*) diversity measures (Nei 1987) will also be calculated for all collections using the restriction enzyme analysis package (*REAP*) of McElroy et al. (1992). These measures estimate the number of nucleotide substitutions per site between DNA sequences (i.e., sequence divergence) and the amount of DNA polymorphism within collections, respectively. These values will then be used to calculate an overall genetic distance (Nei 1978) between collections, which in turn, will be used to generate a branching diagram using UPGMA in the *PHYLIP* (Felsenstein 1993) package. This dendrogram will depict relationships among the collections.

Experimental Matings

In addition to collecting allozyme data from field collections, we will do experimental matings to verify the genetic basis of isozyme variation for putative allelic polymorphisms that have not been tested in pink salmon.

In the 1994 examination of even-year collections, the subcontractor identified numerous isozyme polymorphisms that were previously undescribed (Table 4). The recently tetraploid salmonids often express an abundance of isozymes from the duplicated loci, and new alleles can initially be difficult to score (cf., Marsden et al. 1987). Difficulty can arise in distinguishing among cryptic variation, single-locus variation from isolocus pairs, and phenotypic variation with a non-genetic basis. The genetic basis and state of duplication for these newly-found polymorphisms must be confirmed before they are incorporated into population structure analyses (e.g., see May et al. 1975; Seeb and Seeb 1986).

The best method to confirm the genetic basis of such polymorphisms is though inheritance studies. We will screen 50 males and 50 females from the Armin F. Koernig Hatchery to identify those individuals expressing polymorphism for the isozymes listed in Table 4 in both even and odd years. Tissues and gametes will be collected at the hatchery and flown to Anchorage. Allozyme analysis will be conducted on the same day, and single-pair matings will be done producing one or more families segregating for each of the polymorphisms. Families will be raised at the ADF&G Genetics Laboratory in Anchorage until electrophoresis can be performed on the appropriate tissues. Inheritance will be determined by scoring phenotypes of the progeny and performing a goodness-of-fit test to Mendelian values expected from both duplicated and non-duplicated loci. Scores for polymorphisms with confirmed genetics basis will be incorporated into the data base for further analyses (above). Joint segregation, if observed, will be reported as a courtesy to the scientific community (cf., May et al. 1982).

Table 1. Tributaries and hatcheries in Prince William Sound targeted for sampling of odd-year class. Samples were collected opportunistically from 16 spawning aggregates in 1991 and as part of 95196 in 1995. The early, late, upstream, and intertidal aggregations to be sampled in 1997 will be chosen from those listed and will depend on abundance of spawning adults. Physiogeographic characteristics and approximate sampling dates for collecting early- and late-runs are included. Map #'s correspond to numbered locations on Figure 1. Tectonic change is the vertical shift (in meters) resulting from the 1964 earthquake (derived from Plafker and Mayo 1965; isobase map).

Location		Physiographic characteristics		Year	
Map #	Name	Tidal/Upstream	Tectonic change	1991	1995
1	Rocky	Both	+2.4 to + 3.0		8/23
2	Wilby	Tidal	+3.0	8/30	
3	Hayden	Tidal	+3.0	8/18	
4	AFK	Hatchery	+2.4	9/02	
5	Erb	Both	+0.6	8/04*	7/24
				9/05*	8/24
6	Mink	Both	-0.6	7/28*	7/25
					8/25
7	Swanson	Tidal	-1.2 to -1.8	8/06	7/26
					8/26
8	Cannery	Hatchery	0.0	9/12	
9	Long	Tidal	0.0		8/15
10	Solomon G.	Hatchery	0.0	8/08	
				8/20	
11	Duck	Tidal	+0.6 to +1.2	8/20	

Location		Physiographic characteristics		Year	
Map #	Name	Tidal/Upstream	Tectonic change	1991	1995
12	Lagoon	Both	+.2	8/02*	7/27
					8/27
13	Olsen	Both	+0.6 to +1.2	7/21*	7/28
					8/28
14	Koppen	Both	+1.2 to +1.8	9/06*	7/29
				8/03**	8/29
15	Humpback	Tidal	+1.8 to +2.4	7/25	
				8/31	
16	Hartney	Tidal	+1.2 to +1.8	7/31	
17	Constantine	Both	+1.8	8/24*	8/01
					9/01

* Tidal samples only
** Upstream samples only.

Table 2. Enzymes, loci, and their primary tissue-buffer combinations proposed to screen for allozyme variation. Enzyme nomenclature follows Shaklee et al. (1990), and locus abbreviations are given. Buffer abbreviations are as described in the text. These are the same loci and tissue-buffer combinations used in the even-year analysis so the data will be compatible.

Enzyme	Enzyme Number	Locus	Tissue	Buffer
Aspartate aminotransferase	2.6.1.1	*sAAT-1,2**	Heart	CAMEN 6.8
		*sAAT-3**	Eye	TRIS-GLY
		*sAAT-4**	Liver	TRIS-GLY
		*mAAT-1**	Heart	CAMEN 6.8
		*mAAT-2**	Muscle	CAME 6.5
Adenosine deaminase	3.5.4.4	*ADA-1**	Muscle	CAM 6.1
		*ADA-2**	Muscle	CAM 6.1
Aconitate hydratase	4.2.1.3	*mAH-1**	Heart	CAMEN 6.8
		*mAH-2**	Heart	CAMEN 6.8
		*mAH-3**	Muscle	CAME 6.8
		*mAH-4**	Muscle	CAME 6.8
		*sAH**	Liver	CAMEN 6.8
Adenylate kinase	2.7.4.3	*AK**	Muscle	TRIS-GLY
Alanine aminotransferase	2.6.1.2	*ALAT**	Muscle	TRIS-GLY
Creatine kinase	2.7.3.2	*CK-A1**	Muscle	TRIS-GLY
		*CK-A2**	Muscle	TRIS-GLY
		*CK-B**	Eye	TRIS-GLY
		*CK-C1**	Eye	TRIS-GLY
		*CK-C2**	Eye	TRIS-GLY
Esterase-D	3.1.1.-	*ESTD**	Muscle	CAME 6.5
Formalin dehydrogenase	1.2.1.1	*FDHG**	Heart	CAMEN 6.8

Enzyme	Enzyme Number	Locus	Tissue	Buffer
Fumarate hydratase	4.2.1.2	*FH**	Muscle	CAME 6.8
β-N-Acetylgalactosaminidase	3.2.1.53	*βGALA**	Muscle	TRIS-GLY
Glyceraldehyde-3-phosphate dehydrogenase	1.2.1.12	*GAPDH-1**	Muscle	CAM 6.1
		*GAPDH-2**	Heart	CAMEN 6.8
		*GAPDH-3**	Heart	CAMEN 6.8
		*GAPDH-4**	Eye	TRIS-GLY
		*GAPDH-5**	Eye	TRIS-GLY
Guanine deaminase	3.5.4.3	*GDA-1**	Liver	TRIS-GLY
N-Acetyl-β-glucosaminidase	3.2.1.53	*βGLUA**	Liver	CAME 6.8
Glycerol-3-phosphate dehydrogenase	1.1.1.8	*G3PDH-1**	Muscle	TRIS-GLY
		*G3PDH-2**	Heart	CAMEN 6.8
		*G3PDH-3**	Heart	CAMEN 6.8
Glucose-6-phosphate isomerase	5.3.19	*GPI-B1,2**	Muscle	TRIS-GLY
		*GPI-B2**	Heart	TRIS-GLY
		*GPI-A**	Muscle	TRIS-GLY
Glutathione reductase	1.6.4.2	*GR**	Heart	TC - 4
L-Iditol dehydrogenase	1.1.1.14	*IDDH-1**	Liver	LIOH-RW
Isocitrate dehydrogenase (NADP+)	1.1.1.42	*mIDHP-1**	Muscle	CAME 6.5
		*mIDHP-2**	Heart	CAMEN 6.8
		*sIDHP-1**	Liver	CAME 6.8
		*sIDHP-2**	Liver	CAME 6.8
L-Lactate dehydrogenase	1.1.1.27	*LDH-A1**	Muscle	TRIS-GLY
		*LDH-A2**	Muscle	TRIS-GLY
		*LDH-B1**	Heart	TRIS-GLY

Table 2. Continued

Enzyme	Enzyme Number	Locus	Tissue	Buffer
		*LDH-B2**	Heart	TRIS-GLY
		*LDH-C**	Eye	TRIS-GLY
αMannosidase	3.2.1.24	*αMAN**	Heart	TRIS-GLY
Malate dehydrogenase	1.1.1.37	*sMDH-A1,2**	Heart	CAMEN 6.5
		*sMDH-B1,2**	Heart	CAMEN 6.5
		*mMDH-1**	Heart	CAMEN 6.5
		*mMDH-2,3**	Heart	CAMEN 6.5
Malic enzyme (NADP+)	1.1.1.40	*mMEP-1**	Muscle	CAME 6.8
		*mMEP-2**	Muscle	CAME 6.8
Mannose-6-phosphate isomerase	5.3.1.8	*MPI**	Heart	TRIS-GLY
Nucleoside-triphosphate pyrophosphatase	3.6.1.19	*NTP**	Muscle	CAME 6.5
Dipeptidase	3.4.-.-	*PEPA**	Muscle	TRIS-GLY
Tripeptide aminopeptidase	3.4.-.-	*PEPB-1**	Heart	TRIS-GLY
		*PEPB- 2**	Heart	TRIS-GLY
Proline dipeptiase	3.4.13.9	*PEPD- 1**	Heart	CAMEN 6.5
		*PEPD- 2**	Heart	CAMEN 6.5
Peptidase-LT	3.4.-.-	*PEPLT**	Muscle	TRIS-GLY
Phosphogluconate dehydrogenase	1.1.1.44	*PGDH**	Muscle	CAME 6.5
Phosphoglycerate kinase	2.7.2.3	*PGK-1**	Muscle	CAME 6.8
		*PGK-2**	Muscle	CAME 6.8
Phosphoglucomutase	5.4.2.2	*PGM-2**	Heart	TRIS-GLY
Superoxide dismutase	1.15.1.1	*sSOD-1**	Heart	CAMEN 6.8
		*sSOD-2**	Heart	CAMEN 6.8

Table 2. Continued

Enzyme	Enzyme Number	Locus	Tissue	Buffer
		*mSOD**	Heart	CAMEN 6.8
Triose-phosphate isomerase	5.3.1.1	*TPI-1**	Muscle	TRIS-GLY
		*TPI-2**	Muscle	TRIS-GLY
		*TPI-3**	Muscle	TRIS-GLY
		*TPI-4**	Muscle	TRIS-GLY

Table 3. Restriction enzymes that were used to screen for RFLP markers in mtDNA during Trustee Council Project 94320D and 95320D. Eighty each of even- and odd-year-class pink salmon from Prince William Sound were initially analyzed. Asterisk indicates enzymes that revealed polymorphism, and these seven will be assayed in 40 individuals each from 1996 even-year class collections for Trustee Council Project 97191.

Restriction Enzyme	Screen	Recognition Site
Apa I	*	GGGCC'C
Ase I		AT'TAAT
Ava II		C'YCGRG
Bgl I		GGCNNNN'NGGC
Bgl II		A'GATCT
BstU I	*	CG'CG
EcoR V	*	GAT'ATC
Hha I		GCG'C
Hinf I	*	G'ANTC
Mse I		T'TAA
Msp I		C'CGG
Nci I		CC'SGG
RsaI	*	GT'AC
Sac I		GAGCT'C
Sac II		CCGC'GG
Sau96 I		G'GNCC
Sca I		AGT'ACT
Taq I		T'CGA
Xba I	*	T'CTAGA
Xho I		C'TCGAG

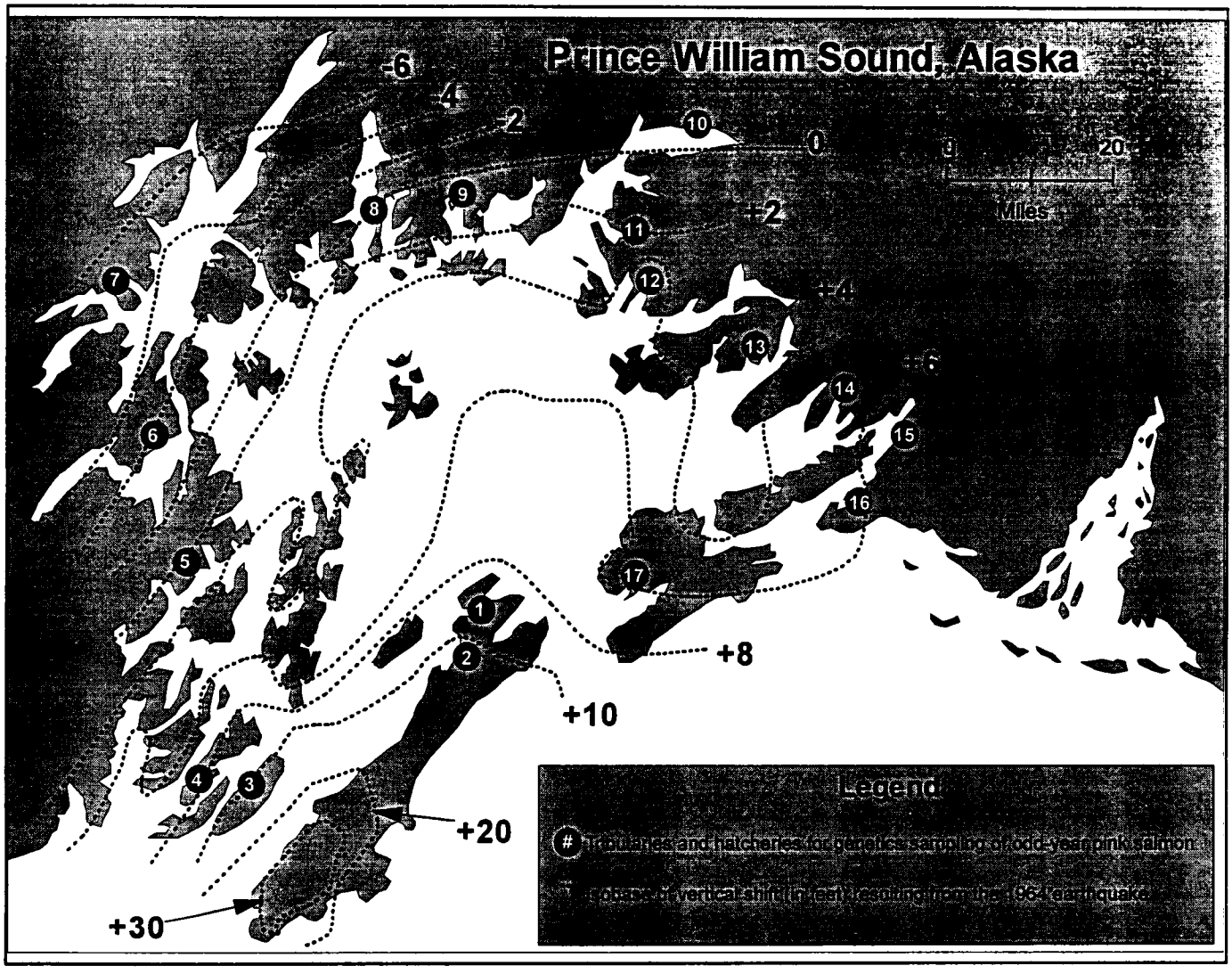
Table 4. Putative alleles that will be progeny tested in 1995-1998. Tissue-buffer combinations are those identified by Washington Department of Fish and Wildlife that optimally resolve phenotypes. Alleles expressed as relative mobility to common allele. Buffers: LIOH-R (Ridgway et al. 1970; "UC Davis recipe"); TRIS-MAL7.4 (Shaw and Prasad 1970); TRIS-GLY (Holmes and Masters 1970); TC-4 (Schaal and Anderson 1970, buffer "a"); CAM(E)(N)6.1 and 6.3 (Clayton and Tretiak 1972, (E) = with EDTA, (N) = with NADP). Alleles in **BOLD** are alleles found in our 1994 analysis of even year pink salmon in Prince William Sound that were previously undescribed in pink salmon. Only those previously undescribed alleles associated with loci that have not been subjected to inheritance studies are included.

	Alleles										
Locus	1	2	3	4	5	6	7	8	9	Tissues	Buffers
sAAT-3	*100**	*91**	***79****							E	LIOH-R
AK	*-100**	***-145****								M	TRIS-GLY
FH	*100**	*136**								M	TC-4
bGALA	*100**	*111**	*91**	*105**						M	TRIS-GLY
GDA	*100**	*108**	*113**	*113**	*118**	*115**	*123**	*82**	*110**	L,M	TRIS-GLY
	*100**	*130**	*155**	*100**	*189**	*167**	*222**	*93**	*106**	L,M	CAM(E)6.8
bGLUA	*100**	***200****								L	CAMEN6.8
GAPDH-2	*100**	*127**	*87**							M	CAM6.1

Table 4. Continued

Locus	Alleles 1	2	3	4	5	6	7	8	9	Tissues	Buffers
G3PDH-2	*100**	***120****	***90****							H	CAMEN6.8
G3PDH-3	*100**	***90****								H	CAMEN6.8
IDDH-1	*100**	*134**								L	LION-R
LGL	*100**	*80**								M,H	TRIS-GLY
aMAN	*100**	*85**								H	TRIS-GLY
mMDH-2,3	*100**	***228****								H,M	CAME(N)6.8
NTP	*100**	*53**	***130****							M,L	CAME6.8
mSOD	*100**	*145**	*14**	***185****	***118****	***69****				H	TC-4
sSOD-2	*100**	*122**								H	CAM6.1

Figure 1. Locations for sampling odd-year pink salmon in Prince William Sound and isobases indicating vertical shift (in feet) resulting from the 1964 earthquake. Numbers on map correspond to Map # on Table 1.



C. Cooperating Agencies, Contracts and Other Agency Assistance

Because of the 1994 State of Alaska hiring freeze, Alaska Department of Fish and Game Genetics Laboratory subcontracted the allozyme portion of Project 94320D to Washington Department of Fish and Wildlife as the best-qualified bidder identified through the state procurement process. The soundness of this decision was confirmed through the peer review of Project 95320D by independent consultants to the Chief Scientist of the Trustee Council.

However, the cost of the subcontract to WDFW in 1994 exceeded the total amount awarded by the Trustees to the ADF&G Genetics Lab. This cost increase was due to many factors including: (1) elevated costs of performing the work outside of ADF&G, (2) accommodation of Project 94320D to peer-review recommendations for increased analysis of stocks in southwestern PWS to test outbreeding-depression hypothesis (to explain embryo mortalities observed in results of Trustee Council Project 94191), and (3) a decision to add additional loci to the locus screen made by the principal investigator (JES) as a result of negotiations with the subcontractor. ADF&G handled the resulting budget problem internally in FY 94 by appropriately supplementing the subcontract with funds from Trustee Council Project 95191 and by postponing some of the ADF&G mtDNA analyses until FY 95.

These contractual shortfalls were ameliorated in the budget for FY 95. That budget included a subcontract for continued work by WDFW for the analyses of 2000 samples of odd-year origin. The provision for this contract-extension was included in the terms of the 1994 award to WDFW. We have contracted the allozyme portion of project 96196 to Washington Department of Fish and Wildlife to analyze the 1995 samples.

We intend to perform the allozyme analysis of the 1996 and 1997 samples in-house. The 1996 samples will be done in FY 97 under project 97196. Therefore, budgets for FY 97 and beyond reflect costs for analysis of allozyme samples in Anchorage at the ADF&G facility or in Seward at the Alaska SeaLife Center.

SCHEDULE

A. Measurable Project Tasks for FY 97 (October 1, 1996 - September 30, 1997)

Oct. 1996:	Acquire data from WDFW on 1995 collections
Oct. - Dec 1996:	Finish mtDNA analysis of 1995 collections
Oct. 1996 - Mar. 1997:	Allozyme lab analyze 1996 collections
Nov. 1996 - Jan 1997:	Statistically analyze 1995 collections
Jan 22-25 1997	Attend the Annual Restoration Workshop
Jan - June 1997:	mtDNA analysis of 1996 collections
Feb.- April 1997:	Write-up 1995 results
April 1997:	Final report of FY 96 results - 95 collections, 94 matings

Apr. - June 1997:	Allozyme lab analyze experimental matings
July - Sept. 1997:	Statistically analyze 1996 collections and 1995 matings
July - Sept. 1997:	Field collections of 1997 samples

B. Project Milestones and Endpoints

October 31, 1996:	Contractor's report for allozyme screen of 1995 samples
December 30, 1996:	Complete mtDNA screen of 1995 collections
April 15, 1997:	Complete evaluation of population structure for 1994-1995 collections
Sept 30 , 1997:	Complete screen of samples collected during 1996
April 30, 1998	Evaluation of population structure of Prince William Sound and other related spawning aggregates collected through 1996; planning for mop-up sample collection for spawning aggregates missed in previous years
December 30, 1998:	Complete screen of samples collected 1997
April 15, 1999:	Complete evaluation of stability of population structure across years

C. Completion Date

All project restoration objectives will be met in FY 99

PUBLICATIONS AND REPORTS

April 15, 1997:	Annual report for FY 96 in the form of manuscript submitted to journal
April 15, 1998:	Annual report for FY 97
September 30, 1999:	Final project report in the form of manuscript submitted to journal

Manuscripts completed (ADF&G review required prior to submittal):

Seeb, J. E, C. Habicht, J. B. Shaklee, and L. W. Seeb. Allozymes and mtDNA describe population structure of even-year pink salmon (*Oncorhynchus gorbuscha*) affected by the *Exxon Valdez* oil spill in Prince William Sound.

Fetzner J. W., L. W. Seeb, and J. E. Seeb. Variation in the mitochondrial ND5/6 region of even- and odd-year pink salmon (*Oncorhynchus gorbuscha*) from Alaska.

PROFESSIONAL CONFERENCES

AFS National Meeting in 1997
AFS Alaska chapter 1996

NORMAL AGENCY MANAGEMENT

The need for characterization the genetic structure of pink salmon within the Sound has increased as a direct result of the EVOS. Western PWS stocks were directly impacted by the oil spill as discussed in Sharr et al. 1993 and Miller et al. 1994. In addition, eastern PWS stocks were depleted following the spill as a result of a shift in harvest pressure from western to eastern stocks in 1989. In order to restore these damaged stocks, supplementation projects often are proposed to the Exxon Valdez Trustee Council. Understanding of stock structure is critical to assess potential genetic impacts such projects would have on wild pink salmon (Trustee Council Projects R105, 95320 A-P, 95093). Additionally, managing the harvest of pink salmon in areas where wild populations were damaged by the spill would be benefited by a better understanding of the stock structure because this understanding will provide managers with the appropriate scale for fisheries management.

Characterization of the genetic structure of pink salmon within PWS was not high enough on the Department's priority to have occurred before EVOS . However, once the data has been collected it will be useful to the Department for future management of pink salmon within PWS and the database will be maintained and updated by the Department after the project funding ends.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

Previous assessments of egg and fry survival in oiled and unoiled streams demonstrated detrimental effects of EVOS on pink salmon (Natural Resources Damage Assessment Fish/Shellfish Study # 2 *Injury to Salmon Eggs and Preemergent Fry* and EVOS Trustee Council Projects R60C, 93003, and 94191 *Oil Related Egg and Alevin Mortalities*). The heritable, genetic nature of the damage was revealed in matings performed as a part of Project 93003. In response to those findings, coded-wire tag recoveries from pink salmon in PWS (e.g., Natural Resources Damage Assessment Fish/Shellfish Study # 3 and Projects R60A and 93067) were used to reduce the fishing effort on wild pink salmon "populations" through fisheries management. Yet the actual genetic structure of pink salmon populations in PWS remains unknown.

Therefore, Trustee Council Project 97196 was designed to provide a genetic basis for the hatchery/wild-stock components of Project 97320 *Prince William Sound Ecosystem Investigation* and to provide the information essential for population-specific management through such projects as 94184 Coded-Wire-Tag *Recoveries from Pink Salmon in Prince William Sound Fisheries* and others that may be proposed as a consequence of 96320.

EXPLANATION OF CHANGES IN CONTINUING PROJECTS

No major changes from 96196. Projects 96196, 96255, and 96191 shared equipment and

staff; Projects 96191 and 97255 are closeout in FY 97. Projects in the 9x196 series will reflect slight increases in budget because of the costs of maintenance contracts on DNA equipment and slight staffing rearrangements required to accommodate the closeout projects.

PROPOSED PRINCIPAL INVESTIGATOR

James E. Seeb
Alaska Department of Fish and Game
333 Raspberry Road
Anchorage, Alaska 99518
907-267-2385 (Phone)
907-349-2231 (Fax)
JSEEB%FISHGAME@STATE.AK.US

PERSONNEL

A. **James E. Seeb, Principal Geneticist**
Commercial Fisheries Management and Development
Alaska Department of Fish and Game
Anchorage, Alaska 99518 (907) 267-2385

PROJECT RESPONSIBILITIES: Design, analysis, reporting

EDUCATION:
B.S., Biology, 1974, University of Puget Sound
M.S., Fisheries, 1982, University of Washington
Ph.D., Fisheries, 1987, University of Washington

PROFESSIONAL EXPERIENCE:

1990-	Principal Geneticist, CFMD Division, ADF&G
1991-	Affiliate Associate Professor, U. of Alaska, Fairbanks
1988-1990	Assistant Professor, Southern Illinois University
1987-1988	Research Assistant Professor, University of Idaho
1982-1986	Graduate Research Assistant, University of Washington
1980-1982	Fish Biologist, Pacific Fisheries Research, Olympia,WA
1978-1980	Fish Biologist, Washington Department of Fisheries

SELECTED PUBLICATIONS:

Seeb, J. E., L. W. Seeb, and F. M. Utter. 1986. Use of genetic marks to assess stock dynamics and management programs for chum salmon. Trans. Amer. Fish. Soc. 115:448-454.

Seeb, J. E., and L. W. Seeb. 1986. Gene mapping of isozyme loci in chum salmon (*Oncorhynchus keta*). J. Hered. 77:399-402.

Seeb, J. E., L. W. Seeb, D. W. Oates, and F. M. Utter. 1987. Genetic variation and postglacial dispersal of populations of northern pike (*Esox lucius*) in North America. Can. J. Fish. Aquat. Sci. 44:556-561.

Utter, F. M., and J. E. Seeb. 1990. Genetic marking of fishes: overview focusing on protein variation. Am. Fish. Soc. Sym. 7:426-438.

Seeb, J. E., G. H. Kruse, L. W. Seeb, and R. J. Weck. 1990. Genetic structure of red king crab populations in Alaska facilitates enforcement of fishing regulations. Proceedings of the International Symposium on King and Tanner Crabs. Alaska Sea Grant, Fairbanks, AK. pp 491-502.

Seeb, J. E., and G. D. Miller. 1990. The integration of allozyme analyses and genomic manipulations for fish culture and management. *In*: D.H. Whitmore, Editor. Electrophoretic and Isoelectric Focusing Techniques in Fisheries Management. CRC Press, Boca Raton, pp 266-279.

Seeb, J. E, C. Habicht, J. Fetzner, W. Templin, L. W. Seeb. 1996. Allozymes and mtDNA describe population structure of even-year pink salmon (*Oncorhynchus gorbuscha*) affected by the *Exxon Valdez* oil spill in Prince William Sound. Exxon Valdez Oil Spill Restoration Project Annual Report Restoration Projects 94320D and 95320D, Alaska Dept. of Fish and Game, Anchorage, Alaska.

Seeb, J. E., G. H. Thorgaard, and T. Tynan. 1993. Triploid hybrids between chum salmon female x chinook salmon male have increased seawater tolerance. Aquaculture 117:37-45.

Utter, F. M., J. E. Seeb, and L. W. Seeb. 1993. Complementary uses of ecological and biochemical genetic data in identifying and conserving salmon populations. Fisheries Research. Fish. Res. 18:59-76.

Crane, P. A., L. W. Seeb, and J. E. Seeb. 1994. Genetic relationships among *Salvelinus* species inferred from allozyme data. Can. J. Fish. Aquat. Sci. 51(Suppl. 1):182-197.

B. Lisa W. Seeb (L. Wishard), Statewide Geneticist

Division of Commercial Fisheries Management and Development
Alaska Dept. of Fish and Game
Anchorage, Alaska 99518 (907) 267-2249

PROJECT RESPONSIBILITIES: Biometrics, analysis, reporting

EDUCATION:

A.B. Zoology, 1973, University of California, Berkeley
M.A. Zoology, 1977, University of Montana
Ph.D. Fisheries, 1986, University of Washington

PROFESSIONAL EXPERIENCE:

1991-	Statewide Geneticist, ADF&G, Anchorage
1991-	Affiliate Associate Professor, U. of Alaska, Fairbanks
1988-1990	Assistant Professor, Southern Illinois University
1984-1988	Research Assist. Prof., University of Idaho
1978-1981	Fish Geneticist, Pacific Fish. Research, Olympia WA
1977-1979	Geneticist, National Marine Fisheries Service, Seattle

SELECTED PUBLICATIONS:

Wishard, L. N., J. E. Seeb, F. M. Utter, and D. Stefan. 1984. A genetic investigation of suspected redband trout populations. Copeia 1984(1):120-132.

Seeb, J. E., L. W. Seeb, and F. M. Utter, 1986. Use of genetic marks to assess stock dynamics and management programs for chum salmon. Trans. Amer. Fish. Soc. 115:448-454

Seeb, L. W. and D. R. Gunderson. 1988. Genetic variation and population structure of Pacific ocean perch (*Sebastes alutus*). Can. J. Fish. Aquat. Sci. 45:78-88.

Seeb, L. W., J. E. Seeb, R. L. Allen and W. K. Hershberger. 1990. Evaluation of adult returns of genetically marked chum salmon, with suggested future applications. American Fisheries Society Symposium 7:418-425

Seeb, L. W., J. E. Seeb and A. J. Gharrett. 1990. Genetic marking of fish populations. pp 223-239 *in* D. H. Whitmore, ed. Electrophoretic and isoelectric focusing techniques in fisheries management. CRC Press, Boca Raton, FL.

Seeb, L. W., J. E. Seeb and J. J. Polovina. 1990. Genetic variation in highly exploited spiny lobster *Panulirus marginatus* populations from the Hawaiian Archipelago. Fishery Bulletin 88:713-718.

Seeb, L. W. and A. W. Kendall. 1991. Allozyme polymorphisms permit the identification of larval and juvenile rockfishes of the genus *Sebastes*. Environmental Biology of Fishes 30:191-201.

Utter, F. M., J. E. Seeb, and L. W. Seeb. 1993. Complementary uses of ecological and biochemical genetic data in identifying and conserving salmon populations. Fisheries Research. Fish. Res. 18:59-76.

Crane, P. A., L. W. Seeb, and J. E. Seeb. 1994. Genetic relationships among *Salvelinus* species inferred from allozyme data. Can. J. Fish. Aquat. Sci. 51(Suppl. 1):182-197.

C. Christopher Habicht, Fisheries Biologist II

Commercial Fisheries Management and Development
Alaska Department of Fish and Game
Anchorage, Alaska 99518 (907) 267-2385

PROJECT RESPONSIBILITIES: Supervision of experimental matings, laboratory analysis, coordination of laboratory and field efforts

EDUCATION:

B.S., 1986, Fisheries Science, Cornell University, Ithaca NY
M.S., 1994, Zoology, Southern Illinois University, Carbondale IL

PROFESSIONAL EXPERIENCE:

1992- Fisheries Biologist, C.F.M.D. Division, ADF&G
Supervising laboratory analysis of genetic markers for EVOS Trustee Council study 93012 (Genetic Stock Identification of Kenai River Sockeye Salmon). Conducting laboratory evaluations of genetically altered salmonids. Analyzing straying data from pink salmon and chinook salmon tag recoveries.

1989-1992 Graduate Assistant, Southern Illinois University
Conducted allozyme species identification, developed *in vivo* ova storage techniques, and optimized triploid induction and gynogenesis protocols for moronids.

1986-1989 Research Associate, Ohio State University
Provided field and laboratory support for aquatic ecology studies on bioenergetics of essocids.

PUBLICATIONS AND PRESENTATIONS:

Habicht, C. 1993. Electrophoretic Identification of *Morone* species, and *In Vivo* ova storage, induced gynogenesis, and induced triploidy in white bass (M. chrysops). Masters Thesis, Southern Illinois University, Carbondale IL.

Seeb, L. W., J. E. Seeb, C. Habicht. 1993. Population genetic analyses facilitate restoration of sockeye salmon stocks damaged by the *Exxon Valdez* oil spill. Presented at National Chapter American Fisheries Society, Portland, OR.

Habicht, C. 1994. Gene conservation of triploids in the management of salmonids. Presented at North American Fish and Wildlife Conference, Anchorage, AK.

Habicht, C., J. E. Seeb, R. B. Gates, I. R. Brock, and C. A. Olito. 1994. Triploid salmon outperform diploid and triploid hybrids between coho salmon and chinook salmon during their first year. Can. J. Fish. Aquat. Sci. 51(Suppl. 1):31-37.

LITERATURE CITED

Aebersold, P. B., G. A. Winans, D. J. Teel, G. B. Milner and F. M Utter. 1987. Manual for starch gel electrophoresis: A method for the detection of genetic variation. NOAA Technical Report NMFS 61, U. S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, 19pp.

Allendorf, F. W. 1994. Comparative utility of genetic markers in the management of Pacific salmon: proteins, nuclear DNA, and mitochondrial DNA. pp. 127-135 *in* L.K. Park, P. Moran, and R. S. Waples (eds.) Application of DNA technology to the management of Pacific salmon. NOAA Tech. Mem. NMFS-NWFSC-17, Seattle.

Beacham, T. D., R. E. Withler and A. P. Gould. 1985. Biochemical genetic stock identification of pink salmon (*Oncorhynchus gorbuscha*) in southern British Columbia and Puget Sound. Can. J. Fish. and Aquat. Sci. 42:1474-1483.

Beacham, T. D., R. E. Withler, C. B. Murray and L. W. Barner. 1988. Variation in body size, morphology, egg size, and biochemical genetics of pink salmon in British Columbia. Tran. Am. Fish. Soc. 117:109-126.

Carr, S. M. and H. D. Marshall. 1991. Detection of intraspecific DNA sequence variation in the mitochondrial cytochrome *b* gene of Atlantic cod (*Gadus morhua)* by the polymerase chain reaction. Can. J. Fish. Aquat. Sci 48:48-52.

Clayton, J. W. and D. N. Tretiak. 1972. Amine-citrate buffers for pH control in starch gel electrophoresis. J. Fish. Res. Board Can. 29:1169-1172.

Cavalli-Sforza, L. L. and A. W. F. Edwards. 1967. Phylogenetic analysis: models and estimation procedures. Evolution 21:550-570.

Chapman, R. W. and B. L. Brown. 1990. Mitochondrial DNA isolation methods. p. 107-129 . H. Whitmore, ed. Electrophoretic and isoelectric focusing techniques in fisheries management. CRC Press, Boca Raton, FL.

Felsenstein, J. 1993. PHYLIP (Phylogeny Inference Package) version 3.5c. Distributed by author. Department of Genetics, University of Washington, Seattle.

Fitch, W. M. and E. Margoliash. 1967. Construction of phylogenetic trees. Science 155:279-284.

Harris, H. and D. A. Hopkinson. 1976. Handbook of enzyme electrophoresis in human genetics. American Elsevier, NY.

Holmes, R. S. and C. J. Masters. 1970. Epigenetic interconversions of the multiple forms of mouse liver catalase. FEBS Letters 11:45-48.

Kocher, T. D., W. K. Thomas, A. Meyer, S. V. Edwards, S. Paabo, F. X. Villablanca and A. C. Wilson. 1989. Dynamics of mitochondrial DNA evolution in animals: Amplification and sequencing with conserved primers. Proc. Natl. Acad. Sci. USA 86:6196-6200.

Marsden, J. E., C. C. Krueger, H. L. Kincaid and B. May. 1987. Inheritance of duplicated fumarase and phosphoglucomutase loci in lake trout (*Salvelinus namaycush*). Heredity 58: 365-372.

May, B., F. M. Utter and F. W. Allendorf. 1975. Biochemical genetic variation in pink and chum salmon. J. Hered. 66: 227-232.

May, B., J. E. Wright and M. Stoneking. 1979. Joint segregation of biochemical loci in Salmonidae: Results from experiments with *Salvelinus* and review of the literature on other species. J. Fish. Res. Board Can. 36: 1114-1128.

May, B., J. E. Wright and K. R. Johnson. 1982. Joint segregation of biochemical loci in salmonidae. III. Linkage associations in salmonidae including data from rainbow trout (*Salmo gairdneri*). Biochem. Genet. 20: 29-40.

McElroy, D., P. Moran, E. Bermingham and I. Kornfield. 1992. REAP: An integrated environment for the manipulation and phylogenetic analysis of restriction data. J. Heredity 83:157-158.

Miller, G. D., J. E. Seeb, B. G. Bue and S. Sharr. 1994. Saltwater exposure at fertilization induces ploidy alterations, including mosaicism, in salmonids. Can. J. Fish. Aquat. Sci. 51(Suppl.1):0000-0000.

Nei, M. 1978. Estimation of average heterozygosity and genetic distance from a small number of individuals. Genetics 9:583-590.

Nei, M. 1987. Molecular Evolutionary Genetics. Columbia University Press. New York.

Park, L. K., M. A. Brainard, D. A. Dightman and G. A. Winans. 1993. Low levels of variation in the mitochondrial DNA of chum salmon *Oncorhynchus keta*. Mol. Mar. Biol. Biotechnol. 2:362-370.

Plafker, G. and L. R. Mayo. 1965. Tectonic deformation, subaqueous slides and destructive waves associated with the Alaska March 27, 1964 earthquake: an interim geological evaluation. U. S. Geological Survey Open-File Report. U. S. G. S., Menlo Park, California. 34p.

Ridgway, G. J., S. W. Sherburne, and R. D. Lewis. 1970. Polymorphisms in the esterases of Atlantic herring. Trans. Amer. Fish. Soc. 99:147-151.

Saiki, R. K. D. H. Gelfand, S. Stoffel, S. J. Scharf, R. Higuchi, G. T. Horn, K. B. Mullis and H. A. Erlich. 1988. Primer-directed enzymatic amplification of DNA with thermostable DNA polymerase. Science 239:487-491.

Saitou, N. and M. Nei. 1987. The neighbor-joining method: a new method for reconstructing phylogenetic trees. Mol. Biol. Evol. 4:406-425.

Schaal, B. A. and W. W. Anderson. 1974. An outline of techniques for starch gel electrophoresis of enzymes form the American oyster *Crassostrea virginica* Gmelin. Technical Report of the Georgia Marine Science Center. 74-3. 18pp.

Seeb, J. E. and L. W. Seeb. 1986. Gene mapping of isozyme loci in chum salmon. J. Hered. 77: 399-402.

Seeb, J. E., L. W. Seeb, D. W. Oates and F. M. Utter. 1987. Genetic variation and postglacial dispersal of populations of northern pike (*Esox lucius*) in North America. Can. J. Fish. Aquat. Sci. 44:556-561.

Seeb, J. E. and L. W. Wishard. 1977. Genetic characterization of Prince William Sound pink salmon populations. Pacific Fisheries Research, Seattle, Washington, Report to Alaska Department of Fish and Game. 21pp.

Shaklee, J. B., F. W. Allendorf, D. C. Morizot and G. S. Whitt. 1990. Gene nomenclature for protein-coding loci in fish. Transactions of the American Fisheries Society 119:2-15.

Shaklee, J. D., D. C., Klaybor, S. Young and B. A. White. 1991. Genetic stock structure of odd-year pink salmon, *Oncorhynchus gorbuscha* (Walbaum), from Washington and British Columbia and potential mixed-stock fisheries applications. J. Fish Biol. 39:21-34.

Shaklee, J. D. and N. V. Varnavskaya. 1994. Electrophoretic characterization of odd-year pink salmon (*Oncorhynchus gorbuscha*) populations from the Pacific coast of Russia and comparison with selected North American populations. Can. J. Fish. Aquat. Sci. 51(Suppl. 1):0000-0000.

Sharr, S., B. Bue, S. D. Moffitt and A. Craig. 1993. Injury to salmon eggs and pre-emergent fry in Prince William Sound. Natural Resources Damage Assessment Fish and Shellfish Study Number 2, Alaska Department of Fish and Game, Cordova. 47pp.

Shaw, C.R. and R. Prasad. 1970. Starch gel electrophoresis - a compilation of recipes. Biochem. Genet. 4:297.

Smouse, P. E., C. J. Kobak, and S. Xu. 1994. Some thoughts on information content in allozyme and DNA markers in genetic stock identification. pp 121-126 in L.K. Park,

P. Moran, and R. S. Waples (eds.) Application of DNA technology to the management of Pacific salmon. NOAA Tech. Mem. NMFS-NWFSC-17, Seattle. 178pp.

Sneath, P. H. and R. R. Sokal. 1973. Numerical Taxonomy. W. H. Freeman, San Francisco, CA 573pp.

Utter, F. M., P. Aebersold and G. Winans. 1987. Interpreting genetic variation detected by electrophoresis. p. 21-45 *in* N. Ryman and F. M. Utter, eds. Population genetics and fishery management. University of Washington Press, Seattle, WA

Waples, R. S., D. J. Teel and P. B. Aebersold. 1991. A genetic monitoring and evaluation program for supplemented populations of salmon and steelhead in the Snake River basin. Northwest Fisheries Science Center, National Marine Fisheries Service. Portland. 50pp.

Weir, B. S. 1990. Genetic Data Analysis. Sinauer Associates, Inc. Sunderland, MA. 377pp.

White, B. A. and J. B. Shaklee. 1991. Need for replicated electrophoretic analyses in multiagency genetic stock identification (GSI) programs: examples form a pink salmon (*Oncorhynchus gorbuscha*) GSI fisheries study. 48(8):1396-1407.

Winans, G. A., P. B. Aebersold, S. Urawa, and N. V. Varnavskaya. 1994. Determining continent of origin of chum salmon (*Oncorhynchus keta*) using genetic stock identification techniques: status of allozyme baseline in Asia. Can. J. Fish. Aquat. Sci. 51(Suppl. 1):0000-0000.

1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1996 - September 30, 1997

Budget Category:	Authorized FFY 1996	Proposed FFY 1997	LONG RANGE FUNDING REQUIREMENTS					
Personnel	$87.9	$125.8						
Travel	$4.2	$8.8						
Contractual	$23.8	$21.1						
Commodities	$35.8	$30.0						
Equipment	$12.0	$30.0						
Subtotal	$163.7	$215.7	Estimated FFY 1998	Estimated FFY 1999	Estimated FFY 2000	Estimated FFY 2001	Estimated FFY 2002	
General Administration	$14.8	$20.3						
Project Total	$178.5	$236.0	$130.0	$50.0				
Full-time Equivalents (FTE)		3.3						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments:

1997

Prepared:

Project Number: 97196
Project Title: Pink Salmon Stock Genetics
Agency: ADF&G

FORM 3A
TRUSTEE
AGENCY
SUMMARY
4/16/96

1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1996 - September 30, 1997

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FFY 1997
	NonPerms		4.0	3,000		12.0
	FWT II	9C	10.0	3,023		30.2
	FWT II	9D	11.0	3,103		34.1
	FWT II	9B	11.0	2,900		31.9
W. Templin	FB II	16B	4.0	4,390		17.6
						0.0
	Subtotal		40.0	16416.0	0.0	
					Personnel Total	$125.8

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FFY 1997
10 Round trips Anchorage to Cordova	200	10			2.0
1 Round trip to Scientific meeting	800	1			0.8
40 days per diem at 150/day			40	150	6.0
				Travel Total	$8.8

1997

Prepared:

Project Number: 97196
Project Title: Pink Salmon Stock Genetics
Agency: ADF&G

FORM 3B
Personnel
& Travel
DETAIL

4/16/96

1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1996 - September 30, 1997

Contractual Costs:	Proposed FFY 1997
Description	
Equipment Maintenance	8.0
Air Charter	9.1
Photography	2.0
Publication	2.0
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$21.1

Commodities Costs:	Proposed FFY 1997
Description	
Biochemicals	20.0
Miscellaneous laboratory supplies	4.5
Field Sampling Supplies	4.0
Office supplies	1.5
Commodities Total	$30.0

1997

Prepared:

Project Number: 97191
Project Title: Pink Salmon Stock Genetics
Agency: ADF&G

FORM 3B
Contractual & Commodities DETAIL

4/16/96

1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1996 - September 30, 1997

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FFY 1997
			0.0
DNA Plate Reader	1	30.0	30.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
Those purchases associated with replacement equipment should be indicated by placement of an R.		**New Equipment Total**	$30.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency

1997

Project Number:
Project Title:
Agency:

FORM 3B
Equipment
DETAIL

Prepared:

4/16/96

Project Title: Alaska SeaLife Center Fish Pass

Project Number:	97197
Restoration Category:	Research
Proposer:	Alaska Department of Fish & Game
Lead Trustee Agency:	Alaska Department of Fish & Game
Cooperating Agencies:	
Alaska SeaLife Center:	Yes
Duration:	First year, One year project
Cost FY 97:	$745,100
Cost FY 98:	$0
Cost FY 99	$0
Cost FY 00	$0
Cost FY 01	$0
Cost FY 02	$0
Geographic Area:	Seward
Injured Resource/Service:	Salmon

ABSTRACT

In this project we design, construct, and install a fish pass at the Alaska SeaLife Center in Seward. The fish pass will be used to propagate experimental runs of Pacific salmon for new and ongoing genetic studies to be conducted at the Center. A cooperative agreement, similar to the agreement for the SeaLife Center, will be written by ADF&G with the City of Seward to implement this project.

INTRODUCTION

The purpose of the installation of a fish pass at the Alaska SeaLife Center is to enhance long-term research and monitoring of salmon, especially pink salmon, affected by the oil spill. This project includes pre-construction final engineering, permit acquisition, surveys, construction, and installation of the fish pass and associated research pool. The fish pass would allow development of self sustaining runs of salmon to be established for ongoing and new genetic studies.

Peratrovich, Nottingham & Drage, Inc. assisted Livingston Slone Inc. in the preparation of a conceptual fish pass for review by ADF&G. A schematic design was developed to provide a cost estimate for the project. It is anticipated that this design will undergo further refinements prior to construction.

The conceptual design consists of a conventional fish pass with resting pools located at 20 lineal foot intervals along the length of the pass. Approximately 150 lineal feet of fish pass, at no more than 10% slope, would be constructed on the seaward side of the armor rock shore line protection. A concrete pool would be positioned on the upland side of the armor rock wave barrier. Fish would travel up the lower fish pass to the concrete pool and then on up to the research pools in the SeaLife Center via an upper fish pass attached to the outside of the existing sheet pile wall. In addition, a 4,500 gallon research pool will be installed on the research deck of the SeaLife Center. This pool will be used for holding adult salmon prior to spawning and for short term rearing salmon fry for imprinting prior to release.

This project includes the engineering process to determine the most cost effective and efficient design which will work at the SeaLife Center.

NEED FOR THE PROJECT

A. Statement of Problem

Many components of the marine science research conducted at the Alaska SeaLife Center will benefit from the fish pass. The self-sustaining runs are needed to study the multi-generational effects of pollution; multi-generational studies are also needed to develop and proof the population markers used for the management of affected salmon populations. EVOS-funded projects which will benefit from the completion of this project include the *Construction of a Linkage Map for the Pink Salmon Genome* (97190), *Laboratory and Field Examinations of Oil Related Embryo Mortalities in Pink Salmon Populations in Prince William Sound* (97191A), and *Population Genetics of Pink Salmon* (97196). In addition, the Neurobiology Program, conducting research at the existing University of Alaska Institute of Marine Science facility in Seward, has documented a long-standing need for self-sustaining runs of salmon that will be met by the addition of the fish pass (A. J. Paul, Institute of Marine Science, personal communication).

To date, EVOS studies of the genetic impacts on salmon have been conducted at production-oriented fish hatcheries and at ADF&G's genetics wet-lab in Anchorage. These facilities have shown fatal inadequacies to maintain experimental groups of fish for the EVOS genetics studies. Production-oriented facilities are not designed for the rearing of many replicates of small lots of fish required for scientific study. None have tanks and running sea water required for the rearing of marine fish or maturing salmon. We previously conducted early-life-history studies at the ADF&G's Big Lake Hatchery; that facility is now closed. We successfully conducted a small-scale study at the Prince William Sound Aquaculture Corporation's Armen F. Koernig Hatchery (AFK), but this project was logistically expensive and extremely difficult to support. The small ADF&G wet lab in Anchorage has been almost entirely dedicated to EVOS projects since 1992. That lab has no running sea water, and even with current plans for expansion, it will not be adequate for the long-term study of EVOS- damaged populations.

The Alaska SeaLife Center will provide a wet-lab facility capable of multi-generational studies of salmonids to conduct Trustee Council studies of genetics and biology to address these population-level impacts. No such facility currently exists in the Gulf of Alaska which can adequately provide the controlled environment necessary to conduct long-term research on the effects of EVOS on fish. The fish pass would enhance the genetics research capabilities of the SeaLife Center by allowing salmon to return to the facility uninterrupted, and it would allow for long term monitoring and development of self sustaining salmon runs to be established for these studies.

Additional benefits will accrue to the Alaska SeaLife Center through the facilitation of multi-generational research on salmonids. Salmon genetics is one of the fastest growing fields of research in the fisheries community. Installation of the fish pass will attract research projects, funded by other research agencies in addition to the Trustee Council. In contrast, absence of a fish pass will preclude the Alaska SeaLife Center from hosting projects that require multi-generational study.

B. Rationale/Link to Restoration

Many populations of anadromous fish were adversely impacted by the *Exxon Valdez* oil spill of 1989. For example, pink salmon populations in Prince William Sound were impacted by direct effects of the oil which produced elevated mortality of embryos, and sublethal genetic effects appear to be rippling through both the even- and odd-year lineages. Genetic effects of pollution would likely persist in populations of pink salmon for a longer duration than would be observed in other vertebrates because of the tetraploid nature of the salmonid genome. Salmonids evolved through a gene duplication event 25 million years ago. Pink salmon basically possess a duplicate set of chromosomes (tetraploid instead of diploid); although, some of the duplicates have been lost through subsequent evolutionary processes. However, the extra genes found for many loci would mask deleterious recessive alleles. The effects of these deleterious mutations would be uncovered in the homozygotes formed through the mating of heterozygotes in subsequent generations, requiring multigenerational study.

Additionally, several Trustee Council-funded projects attempted to mitigate the affects on native populations of salmonids through an array of management and restoration strategies. But, prior to the spill we knew little about the genetic structure of these native populations, and a better understanding of the genetic structure of the wild stocks inhabiting Prince William Sound and the greater spill area is critical to their long-term management and conservation. For example, managing on too fine a scale may adversely affect the fishing industry and waste management resources, while managing on too large a scale may result in loss of genetic adaptations and diversity in the wild salmon populations.

C. Location

The fish pass would be located in Seward and linked to the research deck (tanks, pools, wet labs) in the Alaska SeaLife Center.

COMMUNITY INVOLVEMENT

The City of Seward and the Seward Association for the Advancement of Marine Science (SAAMS) will be consulted during the design refinement process for the fish pass.

It is anticipated that the existing Cooperative Agreement between the Alaska Department of Fish and Game and the City of Seward for construction, operation and maintenance of the Alaska SeaLife Center would be amended to address the construction, operation and maintenance of the fish pass. Similar to the SeaLife Center, the City of Seward would own and maintain the fish pass.

PROJECT DESIGN

A. Objectives

The major objective of this project is the installation of a fish pass and research pool at the Alaska SeaLife Center.

B. Methods

1. The lead federal agency will be contacted to determine what NEPA procedure is applicable to this project. Reference will be made to the Environmental Impact Statement on file for the SeaLife Center.

2. A Coastal Project Questionnaire and Certification Statement will be filled out and all appropriate permits will be applied for to implement this project. It is anticipated that existing permits (eg. Corps Section 10/404) for the SeaLife Center can be amended to accommodate the fish pass.

3. The cooperative agreement to the City of Seward to construct, operate and maintain the SeaLife Center will be amended to include the addition of the fish pass.

4. The design of the fish pass will be reviewed by ADF&G, the City of Seward and SAAMS to determine the most effective design.

5. A report will be prepared following construction detailing the design and installation process.

C. Cooperating Agencies, Contracts, and Other Agency Assistance

Agencies which may be involved in this process include the University of Alaska, Institute of Marine Science.

SCHEDULE

A. Measurable Project Tasks for FY 97 (October 1, 1996 - September 30, 1997)

The Alaska Department of Fish and Game will implement this project and it will be constructed in 1997. The construction window for certain phases of this project is narrow due to the existing schedule for the SeaLife Center and also some of the seasonally constraints of the permits. It is also necessary for cost and constructability to complete construction of the fish pass at the same time as the completion of the construction of the SeaLife Center

B. Project Milestones and Endpoints

Oct. 1, 1996 - Nov 30, 1996	Comply with the NEPA requirements. Write amendment to the existing cooperative agreement with the City of Seward. Apply for appropriate permits.
Dec. 1, 1996 - Jan. 31, 1997	Review conceptual design of fish pass and research pool and produce construction drawings.
Feb. 1, 1997 - June 15, 1997	Construct fish pass and research pool.
June 16, 1997 - Sept. 30, 1997	Write final report on construction and installation.

C. Completion Date

December 31, 1998. Completion of this project will coincide with the completion date of the SeaLife Center.

PUBLICATIONS AND REPORTS

Final Report

PROFESSIONAL CONFERENCES

None

NORMAL AGENCY MANAGEMENT

This is a capital project and does not require increased agency management.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

Not applicable.

EXPLANATION OF CHANGES IN CONTINUING PROJECTS

Not applicable.

PROPOSED PRINCIPAL INVESTIGATOR

Jim Seeb
Commercial Fisheries Management and Development
Alaska Department of Fish and Game
333 Raspberry Road
Anchorage, AK 99518
907-267-2385
907-267-24
JimS%fishgame.state.ak.us

PERSONNEL

A. James E. Seeb, Principal Geneticist

PROJECT RESPONSIBILITIES: Supervision of design, cooperative agreement and reporting

EDUCATION:
B.S., Biology, 1974, University of Puget Sound
M.S., Fisheries, 1982, University of Washington
Ph.D., Fisheries, 1987, University of Washington

PROFESSIONAL EXPERIENCE:

1990-	Principal Geneticist, CFMD Division, ADF&G
1991-	Affiliate Associate Professor, U. of Alaska, Fairbanks
1988-1990	Assistant Professor, Southern Illinois University
1987-1988	Research Assistant Professor, University of Idaho
1982-1986	Graduate Research Assistant, University of Washington
1980-1982	Fish Biologist, Pacific Fisheries Research, Olympia, WA
1978-1980	Fish Biologist, Washington Department of Fisheries

B. Dan Moore, Fisheries Biologist

PROJECT RESPONSIBILITIES: Involved with design, Cooperative Agreement

EDUCATION: B.S., Fish & Wildlife Management, 1975, University of Idaho

PROFESSIONAL EXPERIENCE:

1994-	Assistant Fisheries Program Manager, ADF&G, Habitat and Restoration Division
1980- 1993	Hatchery Manager, ADF&G, F.R.E.D. Division, Big Lake Hatchery
1980-	Assistant Hatchery Manager, ADF&G, F.R.E.D. Division Big Lake Hatchery
1979	Assistant Hatchery Manager, ADF&G, F.R.E.D. Division, Elmendorf Hatchery
1977-1979	Fish Culturist, ADF&G, F.R.E.D. Division, Fire Lake, Elmendorf and Fort Richardson Hatcheries
1975-1976	Fisheries Biologist, ADF&G, Sport Fish Division
1972-1974	Fisheries Technician, ADF&G, Commercial Fisheries Division

The budget for this project is based on the conceptual design and cost estimate prepared by Peratrovich, Nottingham & Drage, Inc. and Livingston Slone Inc.

Project Administration *5% of construction*	$27,000
Design Services *15% of construction contract*	$81,000
Construction Phase Services *5% of construction contract*	$27,000
Construction Contract plus 10% Bid Contingency	$540,000
Subtotal	**$675,000**
Construction Contingency *8% of construction contract*	$43,200
Total	**$718,200**

1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1996 - September 30, 1997

Budget Category:	Authorized FFY 1996	Proposed FFY 1997						
Personnel		$0.0						
Travel		$0.0						
Contractual		$718.2						
Commodities		$0.0						
Equipment		$0.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	$0.0	$718.2	Estimated FFY 1998	Estimated FFY 1999	Estimated FFY 2000	Estimated FFY 2001	Estimated FFY 2002	
General Administration		$26.9						
Project Total	$0.0	$745.1	$0.0	$0.0	$0.0	$0.0	$0.0	
Full-time Equivalents (FTE)		0.0						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments:

This budget is based on a conceptual design and cost estimate prepared by Peratrovich, Nottingham & Drage, Inc. and Livingston Slone Inc.

1997

Prepared:

Project Number: 97197
Project Title: Alaska SeaLife Fish Pass
Agency: Alaska Department of Fish and Game

FORM 3A
TRUSTEE
AGENCY
SUMMARY

4/16/96

1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1996 - September 30, 1997

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FFY 1997
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		0.0	0.0	0.0	
					Personnel Total	$0.0

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FFY 1997
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$0.0

1997

Prepared:

Project Number: 97197
Project Title: Alaska SeaLife Fish Pass
Agency: Alaska Department of Fish and Game

FORM 3B
Personnel
& Travel
DETAIL

4/16/96

1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1996 - September 30, 1997

Contractual Costs:	Proposed
Description	FFY 1997
Cooperative Agreement amendment with the City of Seward	718.2
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$718.2

Commodities Costs:	Proposed
Description	FFY 1997
Commodities Total	$0.0

1997

Prepared:

Project Number: 97197
Project Title: Alaska SeaLife Fish Pass
Agency: Alaska Department of Fish and Game

FORM 3B
Contractual & Commodities DETAIL

4/16/96

1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1996 - September 30, 1997

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

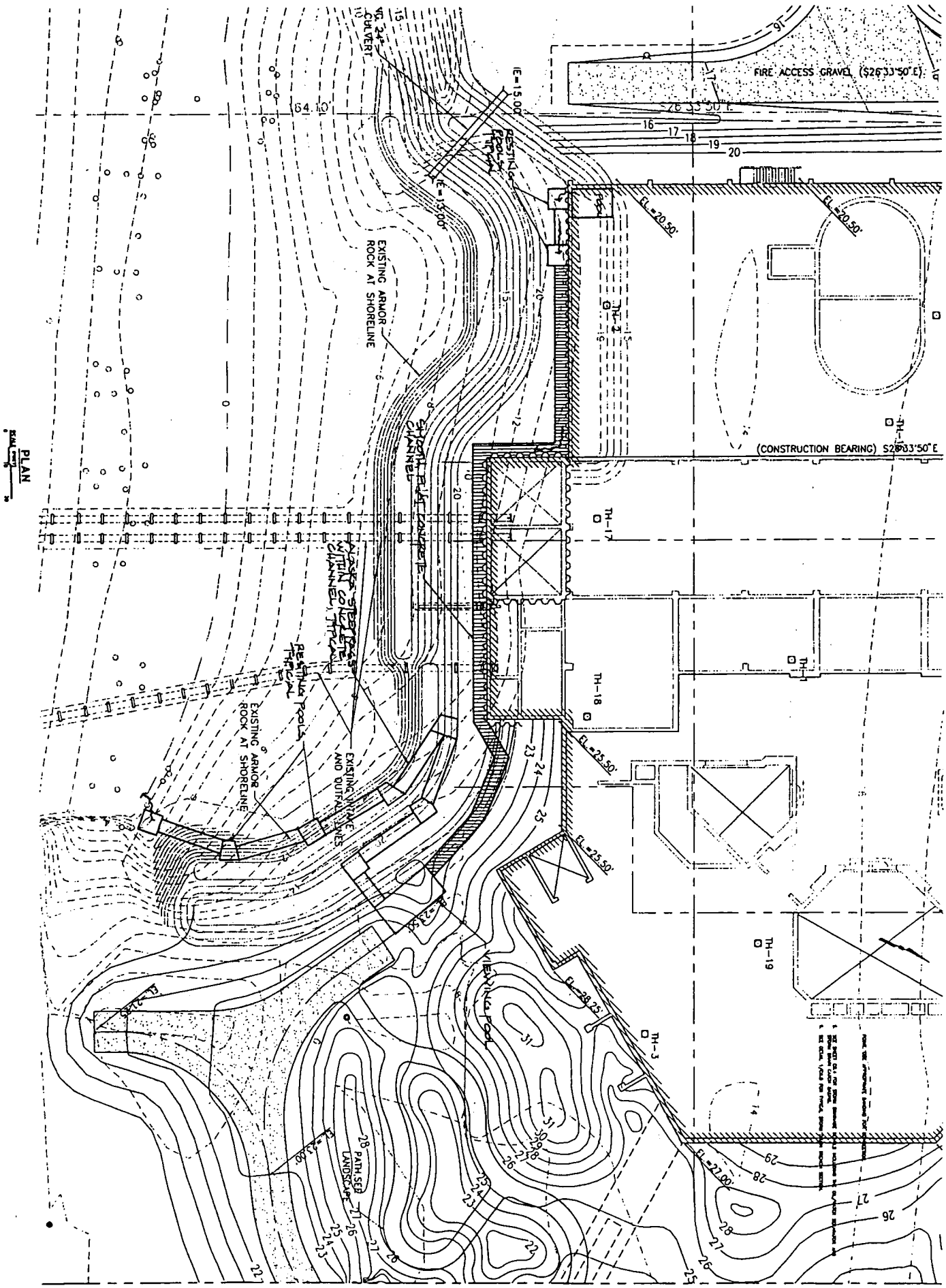
Existing Equipment Usage: Description	Number of Units	Inventory Agency

1997

Project Number: 97197
Project Title: Alaska SeaLife Fish Pass
Agency: Alaska Department of Fish and Game

FORM 3B
Equipment
DETAIL

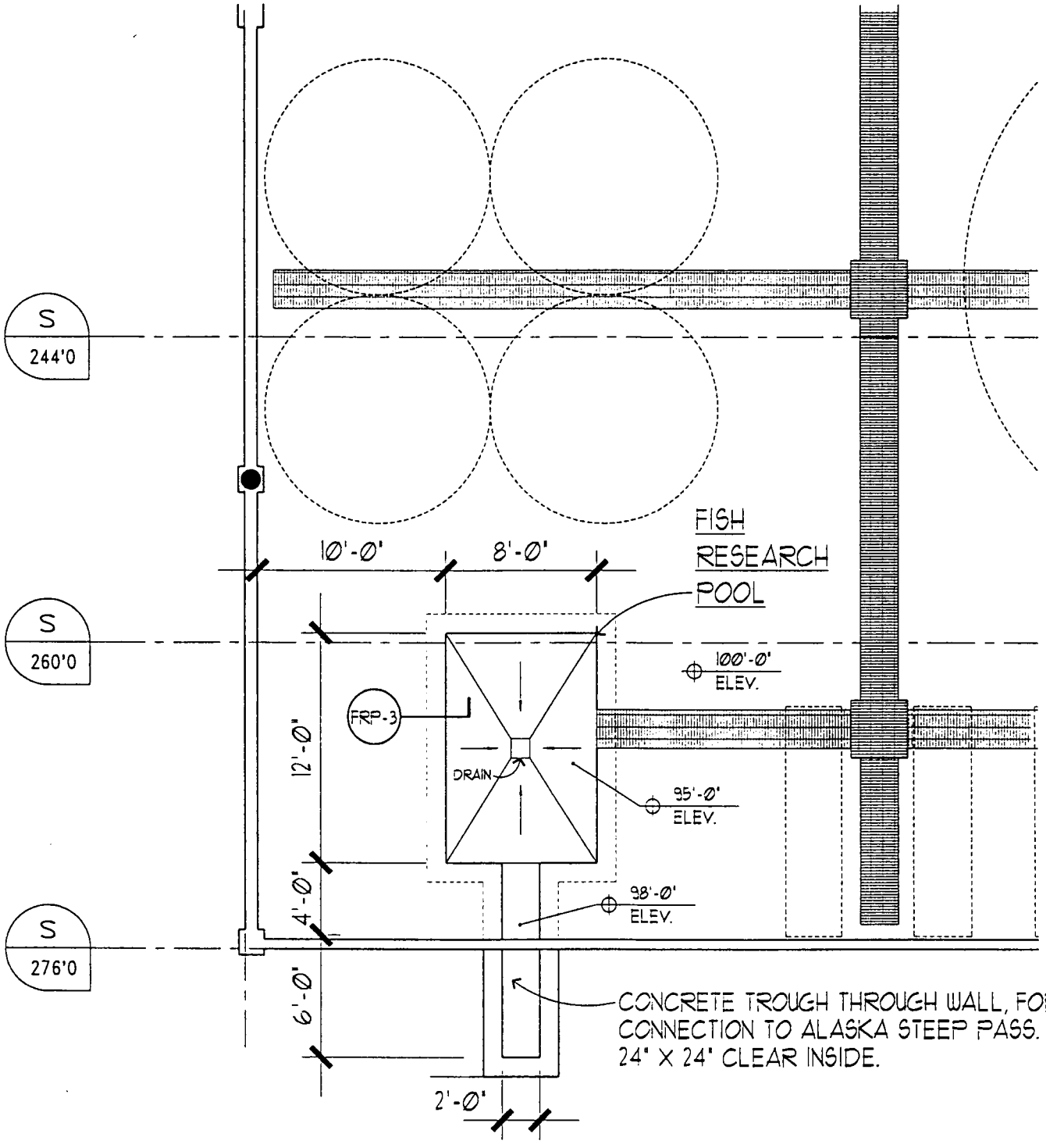
Prepared: 4/16/96



Seward Association for the Advancement of Marine Science

ALASKA SEALIFE CENTER

SEWARD, ALASKA



NOTE: THIS DRAWING IS ISSUED FOR PRELIMINARY PRICING ONLY, AND IS NOT ENGINEERED FOR CONSTRUCTION.

FISH RESEARCH POOL PLAN DRAWING

SCALE: 1/8" = 1'-0"

PROJECT NO.: 6.90
DRAWN BY: PD
CHECKED BY: PD
DATE: FEB. 29, 1996

LIVINGSTON SLONE Architecture Engineering Interior Design Planning

Alaska SeaLife Center

SKETCH NUMBER: FRP-1
ADDENDUM NUMBER: 00

Examination of Straying of Hatchery Pink Salmon into Wild Populations in Prince William Sound

Project Number:	97209
Restoration Category:	Research
Proposer:	Alaska Department of Fish and Game
Lead Trustee Agency:	Alaska Department of Fish and Game
Cooperating Agencies:	
Alaska SeaLife Center:	
Duration:	1st year, 2- year project
Cost FY 97:	$123,900
Cost FY 98:	$77,000
Cost FY 99:	$ 0
Cost FY 00:	$ 0
Cost FY 01:	$ 0
Cost FY 02:	$ 0
Geographic Area:	Prince William Sound
Injured Resource/Service:	Pink Salmon

ABSTRACT

There is a growing body of evidence indicating that the *Exxon Valdez* Oil Spill has been at least partially responsible for weak wild pink salmon returns to Prince William Sound. The most direct way to restore the wild pink salmon population is through intense fisheries management targeting hatchery fish while restricting the harvest of wild salmon. An understanding of the straying rate of hatchery fish into wild salmon systems is important for the development of fishery management plans and the evaluation of remote release programs for hatchery fish.

INTRODUCTION

This proposal is for a 1 year study (2 years funding) to evaluate the straying of hatchery fish into wild salmon streams in Prince William Sound as well as to evaluate the role coded wire tags play in straying. The first year (FY 97) will be spent planning the project and collecting field data while the second year (FY 98) will involve otolith and coded wire tag reading, data analysis, and reporting. A small funding request may be requested for FY 99 for publication page charges and presentation at a professional meeting if project conclusions warrant such action.

The 1997 pink salmon *Oncorhynchus gorbuscha* return to Prince William Sound provides an unique opportunity to evaluate straying since hatchery fish will be marked with both coded wire tags and thermal marks. Work done during the Natural Resource Damage and Assessment phase of the *Exxon Valdez* Oil Spill indicated that pink salmon may stray at a much higher rate than previously thought (Sharr et al. 1995). In that work, pink salmon marked with coded wire tags at hatcheries were detected in 27 of 32 wild salmon streams examined. In one stream, the hatchery contribution would have exceeded the wild component if the coded wire tag recoveries were expanded for the unmarked fraction. Habicht (*personal communication*; found in Appendix D of Seeb et al. 1995) examined X-ray images of fish heads containing coded wire tags recovered in wild salmon streams and the hatchery broods. He found evidence to suggest that straying was related to coded wire tag placement. These two studies brought about a great deal of discussion in the fisheries community as to whether the observed straying was normal, a consequence of oil-contamination, related to run specific migration patterns, or to coded wire tag placement. The Alaska Department of Fish and Game submitted a proposal (94192) to the *Exxon Valdez* Trustee Council in 1994 to evaluate straying in Prince William Sound. It was agreed at that time that a more definitive evaluation would be possible when all hatchery pink salmon were thermally marked. The 94192 proposal was deferred until the summer of 1997 (FY 97) when both coded wire tag and thermal marks would be present.

This project is directly linked to project 97186 *Coded Wire Tag Recoveries From Pink Salmon in Prince William Sound* and project 97188 *Otolith Thermal Mass Marking of Hatchery Reared Pink Salmon in Prince William Sound* and will provide supporting information for project 97196 *Genetic Structure of Prince William Sound Pink Salmon* and the SEA project.

NEED FOR THE PROJECT

A. Statement of the Problem

Historically, wild stocks have produced approximately five-hundred-million pink salmon fry which emerged from streams throughout Prince William Sound each year and migrated seaward. Adult returns of wild pink salmon averaged from 10 to 15 million fish annually. Unlike returns of adult hatchery fish, these returning wild-stock adults play a critical role in the Prince William Sound ecosystem: they convey essential nutrients and minerals from the marine ecosystem to estuaries, freshwater streams, and terrestrial ecosystems. Both juveniles and adults are important sources of food for many fishes, birds, and mammals. Wild pink salmon also play a major role in the economy of Prince William Sound because of their contribution to commercial, sport, and subsistence fisheries

in the area.

Wild-stock pink salmon suffered both direct lethal and sublethal injuries as a result of the *Exxon Valdez* oil spill. Pink salmon embryos and alevins suffered increased mortality, diminished growth, and a high incidence of somatic cellular abnormalities due to the oil-contamination of spawning grounds and rearing areas. Elevated mortality of embryos in the oiled streams has continued through 1993, three generations after the oiling, suggesting that genetic damage may have occurred (see discussions in Bue et al. *in press*; Sharr et al. 1993; Miller et al. 1994; Seeb et al. 1995). Also, in 1989 the commercial harvest of pink salmon had to be shifted away from the oiled areas to target the wild stocks in East Prince William Sound. This resulted in over-harvest and depletion of these stocks evidenced by general run failures of East Prince William Sound stocks of non-hatchery origin in 1991.

Prince William Sound is the center of one of the State of Alaska's largest aquaculture industries. The Alaska DF&G has been grappling with management of the wild stocks in face of seemingly intractable hatchery/wild-stock interactions for nearly a decade. The EVOS-related damages to wild stocks, coupled with full-scale hatchery egg takes, has led to alterations in fisheries management practices. The commercial fishing industry and the two aquaculture associations are facing serious financial challenges resulting from declining prices and dimished adult pink salmon returns.

B. Rationale/Link to Restoration

One of the primary methods for restoring pink salmon is through intense fisheries management. This project will provide information on the degree of hatchery straying as well as the role coded wire tags may play in straying. This knowledge in combination with information obtained by project 97196 *Genetic Structure of Prince William Sound Pink Salmon* will be available to fishery managers who must direct fishermen away from damaged wild stocks. This information will also be valuable to fishery and hatchery managers when making decisions concerning hatchery releases.

C. Location

Carcass sampling will be conducted on 21 streams in Western Prince William Sound from mid-August through mid-September 1997.

COMMUNITY INVOLVEMENT

Analyses and reporting are technical pursuits that will be conducted by or supervised by professional scientists. Whenever possible, local-hire will be used to fill field positions. The Alaska Department of Fish and Game gives local residents a priority in hiring.

PROJECT DESIGN

A. Objectives

The project has three objectives:

1. To obtain an accurate and precise estimate of the hatchery component in the escapement of twenty one streams in the western portion of Prince William Sound.

2. To evaluate the temporal trends of straying into twenty one streams in the western portion of Prince William Sound.

3. To test the hypothesis that coded wire tags can cause straying.

B. Methods

Objective 1

Thermal marks applied in the Fall of 1995 to all hatchery pink salmon will allow unbiased and precise estimation of the hatchery-wild, and between-hatchery composition of the 1997 returns. In addition to providing valuable information on the commercial catch, the thermal marks will provide a previously unavailable opportunity to accurately assess the composition of escapements into streams.

A crew of three technicians will be stationed at each of three locations, the A.F. Koernig facility on Evans Island, the Eshamy weir operated by the Alaska Department of Fish and Game at the head of Eshamy Bay, and at the Forest Service Cabin on Culross Island. Each crew will sample seven streams in their area once a week from August 15 - September 15. Each sampling event will consist of 1) selection of a pseudo-random sample of 100 otolith pairs from all carcasses in the stream, 2) a count of all carcasses in the stream, and 3) an examination of all carcasses for missing adipose fins, indicative of coded wire tag hatchery fish. Tails will be excised from all carcasses to avoid multiple sampling problems. Otoliths will be labelled and stored appropriately for examination by the Cordova otolith-reading laboratory. Heads will be excised from carcasses with missing adipose fins and sent to Cordova for X-ray analysis and to Juneau for tag processing.

A proportional allocation scheme, dependent on weekly carcass counts will be used to sample the otoliths from the four weekly collections. The resulting sample will mimic a random sample from the overall escapement. An overall proportion of hatchery fish, h, escaping over the season for a given stream will be estimated by :

$$\hat{h} = \frac{o_h}{o_T}$$

where,

o_h = number of examined otoliths determined to be of hatchery origin from the stream, and
o_T = total number of otoliths examined from the stream over the season.

The estimated proportion has approximate variance:

$$\hat{V}(\hat{h}) = \frac{\hat{h}(1-\hat{h})}{o_T}$$

All otoliths will be examined for each weekly sample to evaluate the temporal changes in straying for each stream. A sample size of 100 otoliths each week will provide an estimate of the weekly hatchery contribution to a stream within 0.085 of the true proportion 95% of the time if the true hatchery proportion was 0.25.

Objective 2

A number of studies have implied that coded wire tags can cause straying. In a histological study, Morrison and Zajac (1987) and Morrison et al. (1990) found evidence of tag-induced damage to olfactory structures in chum and coho salmon, and Habicht (*personal communication*; found in Appendix D of Seeb et al. 1995) showed that the tags of hatchery pink salmon recovered from streams in the western portion of Prince William Sound were more likely to be located in neurologically sensitive areas of the head than those of fish which had homed successfully. The authors of the latter study failed, however, to detect a similar trend in stray fish sampled from the eastern portion of the Sound. If enough coded wire tagged fish are recovered from surveyed streams, a comparison of the number of found tags to that expected from the otolith estimate of hatchery fish in the streams should provide a good test of the hypothesis that tags induce straying.

Under the null hypothesis, the number of tags found in the escapement will be a binomial(H,r) random variable where H is the number of hatchery fish in the escapement of a given stream, and r is the proportion of all returning hatchery fish bearing a tag. A very precise otolith-generated estimate of the proportion of hatchery fish in the escapement will be available, and may be used to generate a precise estimate of H. A value for r may be obtained from hatchery tagging rates, adjusted for tag shedding and differential mortality. The adjustment will be similar to that used by Sharr *et al.* (1996), except that inspection for otolith marks in the broodstock from which the adjustments are derived will alleviate the much-publicized concerns regarding the presence of wild fish in the brood ponds and their effects on the calculated adjustment factors. A P-value for the number of coded wire tags found (x) will be derived by accumulating the binomial(H,r) probabilities of finding x or more tags in the escapement. In this way, the hypothesis can be tested on a stream by stream basis. Since streams are independently sampled, a test over all streams, could be performed by simply summing up the total estimated hatchery fish and coded wire tags found in all twenty one streams to create H_T and x_T, respectively, and calculating a P value as outlined for one stream.

The above test can be made more complex if interest centers around hatchery-specific effects on tag-induced straying. Since the otoliths of all returning hatchery fish are marked with a facility-specific code, the hatchery component H, could be broken down into its constituent parts, and a facility-specific r used to reflect the proportion of returning fish bearing a tag of interest (although all fish released from Prince William Sound hatcheries in 1996 were tagged at similar rates).

In the event the hypothesis is tested at specific times within a stream, a Monte Carlo simulation is proposed for the derivation of appropriate P values, since variability in the otolith estimate of hatchery fish, and hence in estimation of the binomial *H* parameter above, will be significant, with the result that *H* can no longer be treated as fixed (sample size of 25 otoliths yields precision of only about +/- 0.2 for estimate of proportion of hatchery fish). The simulation will also be tailored to account for variability in the estimation of *r*, imprecision resulting from estimation of adjustment factors.

In addition to comparing the expected number of tags based upon otolith determinations of numbers of hatchery fish, to recovered coded wire tags, the null hypothesis that tags do not cause straying will also be tested through X-ray analysis of tag position within the head in stray and non-stray hatchery fish. The heads of all stray hatchery carcasses determined to contain a coded wire tag will be X-rayed along with 200 tagged fish which homed to one of the hatchery facilities successfully (50 per hatchery). Methods will be similar to those used by Habicht (*personal communication*; found in Appendix D of Seeb et al. 1995) in which tag locations are scored on the basis of proximity of the tag to organs associated with olfactory function. The hypothesis will be tested using an overall χ^2-test of independence between tag location (critical vs non critical) and straying (stray vs non-stray). In the event that the coded wire tags recovered from streams originate from all hatcheries, a Mantel-Haenszel test will be used in which hatchery forms a covariate.

C. Cooperating Agencies, Contracts, and Other Agency Assistance

The Alaska Department of Fish and Game will be completing all work on this project. Coded wire tags and thermal otolith marks have been applied by the Prince William Sound Aquaculture Corporation and the Valdez Fisheries Development Association. Coded wire tags will be extracted and decoded at the Alaska Department of Fish and Game tag lab in Juneau. Otoliths will be extracted in the field and read at the Cordova otolith lab operated cooperatively by the Alaska Department of Fish and Game, Valdez Fisheries Development Association and Prince William Sound Aquaculture Corporation.

SCHEDULE

A. Measurable Project Tasks for FY 97 (October 1,1996 - September 30, 1997)

January 1 - August 15, 1997	Project preparation
August 15 - September 15, 1997	Field data collection
September 15 - September 30, 1997	Begin decoding coded wire tags and otoliths

B. Project Milestones and Endpoints

August 15, 1997	Begin field data collection
September 15, 1997	End field data collection
September 15, 1997	Begin decoding coded wire tags and otoliths
November 15, 1997	End decoding coded wire tags and otoliths

November 1, 1997	Begin final report
April 15, 1998	Completion of final report

C. Completion Date

April 15, 1998

PUBLICATIONS AND REPORTS

This work will be reported at a minimum as a final report to the Trustee Council. At least one professional paper will be produced and submitted to a fisheries journal if the project findings support such work.

PROFESSIONAL CONFERENCES

Project results should be presented at either the Alaska Chapter of the American Fisheries Society annual meeting or the biennial Pink and Chum Salmon Workshop or both. The next occurrence of these meetings after the data are collected and analyzed will be in the fall of 1998 and spring of 1999 (FY 99 funding).

NORMAL AGENCY MANAGEMENT

The Alaska Department of Fish and Game did not fund this research prior to the 1989 *Exxon Valdez* Oil Spill and has no plans to continue funding after recovery is complete.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

Final edited data from this project will be stored electronically as computer databases, and final versions will be provided to the Information Modeling portion of SEA for incorporation into a centralized ecosystem database.

EXPLANATION OF CHANGES IN CONTINUING PROJECTS

Not applicable

PROPOSED PRINCIPAL INVESTIGATOR

Name	Timothy L. Joyce
Affiliation	Alaska Department of Fish and Game

Commercial Fisheries Management and Development Division
Mailing address P.O.Box 669, Cordova, Alaska 99574
Phone (907) 424-3212
FAX (907) 424-3235
E-mail TimJ%FISHGAME@STATE.AK.US

PERSONNEL

A. Timothy L. Joyce

Fisheries Biologist III, Principal Investigator
Alaska Department of Fish and Game
Commercial Fisheries Management and Development Division
P.O.Box 669, Cordova, Alaska 99574
Ph. (907) 424-3212

Employment:

Mr. Joyce was appointed to the Fisheries Biologist III position in July of 1995. Prior to this appointment he worked for the State of Alaska as a hatchery manager at Kitoi Bay which was the largest multi-species salmon production facility run by the state. He did some of the initial half-length coded wire tagging work on emergent pink salmon fry from 1982 through 1987. He co-authored an article titled Retention Rates of Half-Length Coded Wire Tags Implanted in Emergent Pink Salmon published in 1990 in the American Fisheries Society Symposium 7:253-258. He has over 17 years experience in salmon hatchery production in Alaska working with all five species of Pacific salmon, but primarily with pink salmon. Prior to his position as the hatchery manager at Kitoi Bay, Mr. Joyce worked in Sand Point, Alaska as a high school teacher instructing in Aquaculture, fish culture and biology. He was responsible for a small demonstration hatchery run by the school district with Johnson O'Malley funds where students had hands on training of salmon culture using pink and coho salmon. Mr. Joyce also has extensive experience in warm water fish culture gained while in Africa working as a Peace Corps volunteer at a UN development project under the FAO.

Other Experience:

Commercial herring spotter pilot, 1985 -1994
Research aid, Oak Creek Laboratory, Corvallis, OR. 11/71 - 6/73
Construction, 1964 - 1971

Education:

1973 - Bachelor of Science , Fisheries Science, Oregon State University.

B. David G. Evans

Biometrician
Alaska Department of Fish and Game
Commercial Fisheries Management and Development Division
333 Raspberry Rd.
Anchorage, Alaska 99518

Employment:

October, 1991 - present: Biometrician with the Alaska Department of Fish and Game. Primary responsibility has been analysis of coded wire tag data from Prince William Sound. Design of the statistical procedures and computer spread sheets used for inseason analysis of tag recovery data. Oversight of most of the post season data analyses and co-author of interim and final reports for the 1991 NRDA F/S Study #3, the 1992 Restoration Study 60C, and 1993 Restoration studies 93137 and 93184.

Education:

1991 Master of Science, Statistics, Oregon State University
1988 Doctor of Philosophy, Soil Science, University of Guelph (Ontario, Canada)
1984 Master of Science, Soil Science, University of Guelph (Ontario, Canada)
1981 Bachelor of Science, Soil Science, University of Nottingham (U.K.)

LITERATURE CITED

Bue, B. G., S. Sharr, S. D. Moffitt and A. K. Craig. *In press*. Effects of the *Exxon Valdez* oil spill on pink salmon embryos and preemergent fry. *In* Rice, S.D., R.B. Spies, D.A. Wolfe, and B.A. Wright, editors. *Exxon Valdez* Oil Spill Symposium Proceedings. American Fisheries Society Symposium 18..

Geiger, H.J. 1994. A Bayesian approach for estimating hatchery contribution in a series of salmon fisheries. Alaska Fishery Research Bulletin 1(1):66-75.

Morrison, J.K., C.L. Coyle, and S.E. Bertoni. 1990. Histological effect of tagging chum and coho salmon fry with coded wire tags. The Progressive Fish-Culturist 52:117-119.

Morrison, J., and D. Zajac. 1987. Histologic effect of coded wire tagging in chum salmon. North American Journal of Fisheries Management 7:439-441.

Miller, G. D., J. E. Seeb, B, G. Bue and S. Sharr. 1994. Saltwater exposure at fertilization induces ploidy alterations, including mosaicism, in salmonids. Canadian Journal of Fisheries and Aquatic Sciences. 51(Supp.1):42-49.

Seeb, J.E., B.G. Bue, A.K. Craig, C. Habicht, G.D. Miller, S. Sharr. 1995. Injury to salmon

embryos and preemergent fry in Prince William Sound - Restoration Project 94191. Report to the *Exxon Valdez* Trustee Council, Anchorage.

Sharr, S, C.J. Peckham, D.G. Sharp, L Peltz, J.L. Smith, M.T. Willette, D.G. Evans, and B.G. Bue. 1996. Coded wire tag studies on Prince William Sound salmon, 1989-1991. Alaska Department of Fish and Game, Commercial Fisheries Management and Development Division, Regional Informational Report No. 2A96-15, Anchorage.

Sharr, S., J. E. Seeb, B. G. Bue, S. D. Moffitt, A. K. Craig and G. D. Miller. 1994. Injury to salmon eggs and preemergent fry in Prince William Sound - 93003. Alaska Department of Fish and Game, Commercial Fisheries Management and Development Division, Regional Informational Report No. 2A94-51, Anchorage.

1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1996 - September 30, 1997

Budget Category:	Authorized FFY 1996	Proposed FFY 1997	LONG RANGE FUNDING REQUIREMENTS					
Personnel		$60.6						
Travel		$1.5						
Contractual		$43.1						
Commodities		$6.6						
Equipment		$0.0						
Subtotal	$0.0	$111.8	Estimated FFY 1998	Estimated FFY 1999	Estimated FFY 2000	Estimated FFY 2001	Estimated FFY 2002	
General Administration		$12.1						
Project Total	$0.0	$123.9	$77					
Full-time Equivalents (FTE)		1.3						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments:

This is a new project which will evaluate the number of hatchery pink salmon straying into 21 wild salmon streams in western Prince William Sound. FY97 funds will be used to plan the project and collect the field data while FY98 funding will be used to read otoliths, analyze the data, and reporting. Some funding may be requested in FY99 for publication page charges and presentation at a professional meeting if project conclusions warrant.

1997

Prepared:

Project Number: 97209
Project Title: Straying of Hatchery Pink Salmon into Wild Streams
Agency: ADF&G

FORM 3A
TRUSTEE
AGENCY
SUMMARY

4/15/96

1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1996 - September 30, 1997

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FFY 1997
Tim Joyce	Fishery Biologist III	18L	1.0	6.9	0.0	6.9
David Evans	Biometrician I	17F	2.0	5.3	0.0	10.6
Vacant	Fishery Biologist I	14C	3.0	4.4	0.8	14.0
Vacant	9 - Fish & Wildlife Tech II	9A	9	2.5	3.5	26.0
Troutman	Admin. Clerk III	10C	1	3.1	0.0	3.1
	Subtotal		16.0	22.2	4.3	
					Personnel Total	$60.6

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FFY 1997
Biometrician travel to Cordova	224.0	2	6	95.0	1.0
Principal Investigator travel to Anchorage for workshops	224.0	1	3	95.0	0.5
				Travel Total	$1.5

1997

Prepared:

Project Number: 97209
Project Title: Straying of Hatchery Pink Salmon into Wild Streams
Agency: ADF&G

FORM 3B
Personnel
& Travel
DETAIL

4/15/96

1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1996 - September 30, 1997

Contractual Costs:	Proposed
Description	FFY 1997
Air charters supplying field camps - Beaver 3.5hrs./trip @ $350/hr @ 6 trips	7.4
Boat Charter for field camp set up 8 days @ $1000/day	8.0
CWT removal and decoding 150 @ $10ea.	1.5
Otolith scanning 4200 @ $6/head	25.2
Cordova fixed office expenses - heating, electricity, water, sewer, etc.	1.0
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$43.1

Commodities Costs:	Proposed
Description	FFY 1997
Human Food - $12/day/person - 9 people for 30 days	3.2
Knives, slides, glue and other miscellaneous items for otolith and CWT Collection	0.4
Rain gear - one set per person @ $110	1.0
Wood, nails, screws, etc. for weatherport platforms	1.5
Cordova office supplies - paper, computer disks, pens, etc	0.5
Commodities Total	$6.6

1997

Prepared:

Project Number: 97209
Project Title: Straying of Hatchery Pink Salmon into Wild Streams
Agency: ADF&G

FORM 3B
Contractual & Commodities DETAIL

4/15/96

1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1996 - September 30, 1997

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

Existing Equipment Usage: Description	Number of Units	Inventory Agency

1997

Project Number: 97209
Project Title: Straying of Hatchery Pink Salmon into Wild Streams
Agency: ADF&G

FORM 3B
Equipment
DETAIL

Prepared:

4/15/96

Youth Area Watch

Project Number:	97210
Research Category:	General Restoration
Proposer:	Chugach School District
Lead Trustee Agency:	ADFG
Cooperating Agencies:	DNR
Alaska SeaLife Center:	Yes
Duration:	2nd year, 7 year project
Cost FY 97:	$190,135
Cost FY 98:	$205,000
Cost FY 99:	$175,000
Cost FY 00:	$175,000
Cost FY 01:	$175,000
Cost FY 02:	$175,000
Geographic Area:	Prince William Sound and Resurection Bay including: Cordova Harbor and Orca Inlet, Port San Juan and Evans Island, Tatitlek Narrows, Boulder Bay and Landlocked Bay

ABSTRACT

Youth Area Watch links students within the Oil Spill impacted area with research and monitoring projects funded through the Trustee Council. The goal is to involve students in the restoration process, and give these individuals the skills to participate in oil spill restoration activities now and in the years to come. Youth conduct activities identified by principal investigators who have indicated interest in working with students. Coordination between existing projects, the communities and their youth population is the key to long-term institution of the restoration plan adopted by the Trustee Council. The project serves as a positive example of long-term community involvement in the

INTRODUCTION

The impacted communities must be prepared to participate in the long-term projects. Effects of the Exxon Valdez Oil Spill will linger past the life of the Restoration Office. Yet there is infrastructure that will be in place to continue the monitoring and restoration process for years to come. To insure long-term restoration of the Oil Spill impacted area, youth must be involved in the process.

Youth Area Watch (YAW) received funding from the Trustee Council in FY 96. Given the late date of , project activities was not fully underway until January 1, 1996.Already, twelve students have participated in protocol training on four research projects identified including: pristane mussel analysis (96195); harbor seal management and biological sampling (96244F); oceanographic data collection (96320-M and 96320-H); fish monitoring (96320-E, 96320-T and 96320-U). According to protocol, students have begun collecting data and samples, and data will continue to be collected and compiled by the project coordinator located in Anchorage until a sufficient amount of information can be provided to the principal investigators of the respective projects. Activities have been a success, and they serve as positive example of productive community interaction in scientific research.

During the second year, Youth Area Watch will involve additional Trustee Council funded projects. Projects currently administered through the Chugach Forest Service will work in conjunction with YAW in the year; these projects include: Anderson Creek Fish Pass (97222), Sockeye Salmon Stocking at Solf Lake (97256b), Stocking at Columbia Lake (97256a). A Department of Natural Resources project, Information Management: Community Coordination and Training (97100b) will also work with Youth Area Watch if funded. The Chugach School District will continue to invite additional involvement of existing EVOS funded projects.

NEED FOR THE PROJECT

A. Statement of Problem

Public involvement in the restoration process is necessary for those communities affected by the oil spill. The processes for collecting information through research and restoration projects conducted must incorporate community involvement if local project are to be successful. For long-term restoration to occur, youth must be a part of this process.

Increasing the monitoring and testing of research sites will provide a more accurate picture of what is currently going on in Prince William Sound's ecosystem. The costs associated with Youth Area Watch participants are minimal in comparison to the expense of a scientist's time.

B. Rationale/Link to Restoration

Youth involvement now will ensure that the restoration process extends beyond the life of the Restoration Office. By enlisting the involvement of local youth, future understanding and enhancement of damaged resources can continue and allow resources to reach pre-spill levels. Involvement of youth in research and monitoring is essential to developing local commitment to restoration.

In the few short months that Youth Area Watch has existed, principal investigators and researchers have provided training and interacted with project students on various occasions. The response from the principal investigators has been overwhelming. The exchange of information, training of students (and then, in turn, students train other participants) and research activities has provided a long-term link to restoration activities.

C. Location

Youth Area Watch is administered through the Chugach School District's Anchorage office. The Project Coordinator is located at the school district office, where all project coordination will occur. The Project Coordinator will travel to the communities of Valdez, Seward, Cordova, Tatitlek, Chenega Bay and a remote site to monitor the research activities of the students.

The science teachers within each of the five communities will oversee the day-to-day activities relating to the various research projects that the students are involved with. Research sites are at or near the participating communities, but students will travel to off-shore research vessels sites to conduct project activities as well.

COMMUNITY INVOLVEMENT

Local communities will be directly involved in this project through their children, as well as the participation of hunters and local facilitators. Youth Area Watch is designed to increase local involvement at younger ages, so that the region's communities will be equipped to take on restoration activities as a local initiative in the future.

With the projects that are currently working with Youth Area Watch, the research is communicated at a non-technical level so that students of high school age and younger can learn the protocol and participate. Parents of participating youth serve as local facilitators bearers of traditional knowledge, hunters, chaperones and sources of local information. Youth participation is key in incorporating the local involvement in research project currently conducted.

The research sites are at or near the communities involved in the project. To date, Seward based vessels were hired for research and training purposes; it is expected that this will continue in the next year.

PROJECT DESIGN

A. Objectives

Selected students from the identified communities will participate in training and research that has been identified by the Sound Ecosystem Assessment (SEA) Program principal investigators, NOAA staff and Chugach Forest Service biologists. Students are a part of an area watch project that works with existing research and restoration. Local students collect data that is provided to the respective projects that are involved.

Youth Area Watch objectives include:

1. Increase interaction between youth within the oil spill impacted area and scientists and researchers monitoring injured resources.

2. Provide protocol training for youth to conduct research activities set out by the principal investigators.

3. Allow youth to independently conduct activities set out by the principal investigators.

4. Enable students to collect, analyze and provide information to the principal investigators.

B. Methods

Several school districts exist within the affected oil spill region. As a result, the Chugach School District will administer the YAW project, and coordinate activities with the other school districts through memoranda of agreement (MOA). While preliminary discussions have begun with the participating school districts, coordination of MOAs will occur in the month following the Detailed Project Description submittal. The school district will also solidify the working agreements with principal investigators from the projects through MOAs to ensure adequate student/PI interaction.

The Chugach School District developed an application to screen and select students for participation in the project. Up to 25 students will be selected from the communities to participate in Youth Area Watch. The distribution of students will be as follows: four students from Tatitlek, four students from Chenega Bay, five students from Seward, five students from Cordova, five students from Valdez and two remote site students.

Students will participate as many research projects that pertain to their geographic area. In this past year, four key projects were identified and students were involved in all of them. In addition, other projects may be added as PI interest is expressed. The

opportunity for one-on-one student and principal investigator coordination will also be explored during the FY 97 project year.

The Chugach School District YAW project coordinator develops protocol in conjunction with the principal investigators for all cooperating projects. The protocol establishes data collection and analysis techniques. Ensuring the continued protocol compliance is crucial to maintaining accuracy of information and ultimate success of the project.

Ongoing Youth Area Watch research and restoration projects include:

1. Pristane/mussel analysis, Project Number 96195. The NOAA Auke Bay laboratory, through Jeff Short and Pat Harris, studies the pristane levels in blue mussels. There are approximately thirty mussel collection sites in Prince William Sound; students will continue to participate in monthly collections at these sites. During the fall and winter months, students are responsible for overall mussel bed seasonal watch. Students will tag, identify mussel bed characteristics and predator/prey activities.

2. Harbor seal management and biological sampling, Project Number 96244F. This project is conducted by the Alaska Native Harbor Seal Commission, in conjunction with University of Alaska research staff. Students will pair up with local technicians/hunters and assist with bio-sampling activities. Sampling protocol is directly ensured with scientific and technician oversight.

3. Oceanographic data collection. Students learn physical and biological oceanography. Shari Vaughan, principal investigator for Project Number 96320-M, will work with students participating in 96320-M: Observational Physical Oceanography in Prince William Sound, and 96320-H: the Role of Zooplankton in Prince William Sound Ecosystem.

   Physical oceanography activities will include measuring basic oceanographic features such as temperature, salinity and weather conditions. Students will also collect zooplankton samples as part of on-going SEA biological oceanographic research.

   Research activities include:

   - Temperature: Reversing thermometer units and temperature logger will be monitored by students at the research sites;
   - Temperature and salinity: CTD (conductivity, temperature and depth) instruments are used by students to download data into a computer database;
   - Weather stations: A weather station instrument is installed at each current site and will be purchased for each additional site. These instruments measure wind speed and direction, air temperature and barometric pressure.

As part of the on-going biological oceanographic research, students will collect zooplankton samples from selected sites, thus increasing the sample range of 96320-H. Collecting nets are made available from the Zooplankton project.

4. Fish monitoring. Several Trustee Council funded projects involve monitoring specific fish species. Youth Area Watch participants monitor all fish at selected research sites to gather information about the trophic structure, or composition of predators and prey found at these locations. Data collected regularly over an extended period of time will allow the students to examine what happens over time with these predator/prey relationships. YAW students are involved in Project Number 96320-E: Juvenile Salmon Growth and Mortality; Project Number 96320-T, Juvenile Herring Growth and Habitats; and Project Number 96320-U, Pollock and Herring Energetics. Evelyn Brown, who works with the Juvenile Herring project and coordinates with the other fish monitoring projects assist with training and work with students throughout the course of the project.

5. Anderson Creek Fish Pass, Project Number 97222. Escapement counting, involving the count of adult salmon that return to the stream to spawn will provide a picture of the creek activity regarding salmon. In addition, live trapping for salmon fry will occur in the spring. Karen Murphy is the contact for this project.

6. Sockeye Salmon at Solf Lake, Project Number 97256b. Currently, the feasibility study is being completed to determine habitat improvement needs to ensure access to the lake for adult salmon. Depending on the type of enhancement work identified, opportunities for student field work might exist. Karen Murphy is the contact for this project.

7. Stocking at Columbia Lake, Project Number 97256a. Stream survey data for this project will be collected using the same process as Anderson Creek. Data compilation and analysis from 1996 will be the first activities. Escapement counts and monitoring smolt out-migration will occur in later years. Karen Murphy is also the contact for this project.

8. Information Management: Community Coordination and Training, Project Number 97100b. Dorothy Mortenson at the Department of Natural Resources is developing a GIS system to map the activity in the oil spill region. Current programs exist to increase the usability of this information within the impacted communities. This database would allow students to input new information and track habitat activity within their area.

The YAW project coordinator will rely on all project related scientific methods, and will adhere to set protocol. All collected data will be submitted to the principal investigator of the respective project for which the information or activity is occurring.

Local site teachers will receive training in project protocols from the principal investigators of each participating project; this training is scheduled to take place in Chenega Bay. Teachers will first be briefed on the projects and the activities that the students will conduct. Protocol will be videotaped for future referral and reference. Students then will receive protocol training on a boat in the impacted area to link activities to the overall research objectives. Community elders and local facilitators will participate as appropriate.

Students will conduct activities at or near their community according the protocol developed by the principal investigators. For testing or collection sites in remote areas, skiffs will be hired locally; local facilitators will assist with the hiring of local skiffs.

Throughout the project year, students will travel to research vessels and conduct activities along with the Principal Investigators of various projects. The request for travel funds will allow students to be transported to vessels; the schedule for these activities will be coordinated with the PI of each project once cruise schedule have been set.

C. Cooperating Agencies, Contracts, and Other Agency Assistance

The Chugach School District will administer the YAW project through a contract with Department of Fish and Game. The school district is the most effective means to link youth and community involvement to monitoring and research activities. This year, additional sites will be included in the projects. These sites fall within other school district lines. As a result, the Chugach School District will develop a memorandum of agreement with each school district. Those districts include: Valdez School District, Cordova School District and the Kenai Peninsula Borough School District.

The Chugach School District is coordinating with the University of Alaska Fairbanks to allow college credit, along with high school credit, for progressively responsible research activities. Currently, the Chugach School District maintains a memorandum of agreement with the University of Alaska to coordinate with the school district. The Chugach School District will work with John Kelly from the University of Alaska Fairbanks, Native Marine Sciences Program to participate in a week-long research lab experience at Kasitna Bay outside of Seldovia.

The Chugach School District works with the Chugach region non-profit, Chugachmiut, to develop the program and coordinate services for the youth. Chugach Regional Resources Commission will provide information to the school district concerning activities regarding Native natural resource management in which youth can participate.

The Chugach School District will continue to pursue other funding sources to offset the costs associated with running such a large project. Given that the program is an excellent means to communicate with the communities, and is a source of manpower students provide to other EVOS funded projects, the school district will continue to apply for some

portion of funding to the Trustee Council. Beyond the life of the restoration office, the school district will bear the costs through grants and reallocation of district funds.

SCHEDULE

A. Measurable Project Tasks for FY 97 (October 1, 1996 - September 30, 1997)

September 23 - October 7, 1996:	Students solicited to participate
October 7 - 14, 1996:	Students selected for participation
October 15 - 21, 1996:	Site teachers receive project training
October 22 - 27, 1996	Students receive protocol training
October 28 - November 4, 1996:	Sites selected for research and monitoring
November 1996:	NAAEC attendance in San Francisco
January 1997:	GIS training provided at sites
March 31, 1997:	Students funnel information to PIs
April 1 - May 31, 1997	Students analyze data from projects
April 1 - June 15, 1997	Students will conduct escapement counts
May 1997:	Students visit Alaska SeaLife Center progress
June 1, 1997:	Students complete research reports for FY 97
September 30, 1997:	Submission of YAW to peer-review journal

Tasks with unidentified dates:

October 96 - September 97:	Students conduct mussel collection
October 96 - September 97:	Students conduct oceanographic tests twice weekly
October 96 - September 97:	Students collect fish data bi-weekly
October 96 - September 97:	Students will collect request harbor seal samples with local hunters
October 96 - September 97:	Student analyze project data through GIS
October 96 - September 97:	PI's from participating projects visit and/or participate with students/local sites at least twice

B. Project Milestones and Endpoints

November 30, 1996:	Protocol training completed
May 31, 1997:	Youth provide data to principal investigators
September 30, 1997:	Interaction between youth and PI's completed for 97
September 30, 1997:	Youth have independently conducted project activities
November 30, 1997:	Protocol training completed
May 31, 1998:	Youth provide data to principal investigators
September 30, 1998:	Interaction between youth and PI's completed for 98
September 30, 1998:	Youth have independently conducted project activities

November 30, 1998:	Protocol training completed
May 31, 1999:	Youth provide data to principal investigators
September 30, 1999:	Interaction between youth and PI's completed for 99
September 30, 1999:	Youth have independently conducted project activities
November 30, 1999:	Protocol training completed
May 31, 2000:	Youth provide data to principal investigators
September 30, 2000:	Interaction between youth and PI's completed for 00
September 30, 2000:	Youth have independently conducted project activities
November 30, 2000:	Protocol training completed
May 31, 2001:	Youth provide data to principal investigators
September 30, 2001:	Interaction between youth and PI's completed for 01
September 30, 2001:	Youth have independently conducted project activities
November 30, 2001:	Protocol training completed
May 31, 2002:	Youth provide data to principal investigators
September 30, 2002:	Interaction between youth and PI's completed for 02
September 30, 2002:	Youth have independently conducted project activities

C. Completion Date

Youth Area Watch was identified as a subsistence project during the FY 96 review. This public involvement project will be completed upon termination of the restoration efforts.

PUBLICATIONS AND REPORTS

The principal investigator and the project coordinator will provide reports of Youth Area Watch successes through various educational publications. A summation of the positive results from the activities that have occurred to date will be submitted to Clearing: Northwest Environmental Education and the National Science Teacher Association Science Teacher for Secondary Education, the peer-review journals appropriate for this type of research/community integration project. A date has not been identified for submission, but will occur by the end of the FY 97 project year. No costs for these efforts have been requested in the FY 97 budget.

The Chugach School District will contract with video production services to produce a ten minute picture of Youth Area Watch activities. This video and project information will be provided to local television stations. The video will also be shown at state educational conferences.

PROFESSIONAL CONFERENCES

The YAW principal investigator and the project coordinator will travel to New Orleans for the annual conference of the National Science Teacher Association held the first week of April, 1997. The contact for conference participation is Peggy Cowan, Department of Education, Scientific Representative. The principal investigator and the project coordinator will be prepared to both submit and paper and present to the conference concerning the value of integrating community youth involvement in environmental research activities. In August of 1997, the Principal Investigator will also participate in the North American Association for Environmental Education Conference in San Francisco; the contact is Paul Zeph.

The principal investigator will present at statewide education and technology conferences throughout the project year. At these conferences, Youth Area Watch will be showcased.

NORMAL AGENCY MANAGEMENT

Youth Area Watch serves as an excellent example of public involvement, given the participation of not only the students, but parents and elders. Without the project, a significant gap in public involvement, specifically the involvement of youth, would not have been available at its proposed level.

The project provides for increased data collection, specifically during winter months. In the case of mussel collection, intensive samples will be gathered at levels and times that have not otherwise been possible. Youth Area Watch allows for local involvement and ownership of injured resource management.

While the Chugach School District is requesting a portion of the costs associated with the project from the Trustee Council, others funds have been contributed and will continue to be sought.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

The Prince William Sound Science Center (PWSSC) provides technical assistance to the YAW project on a continual basis to ensure that youth are involved in research activities. Principal investigators from the participating projects contribute their time working with the students. Equipment has also been contributed by PWSSC.

Youth Area Watch relies on the participation of other projects for its success. The project is designed to integrate youth into various research and restoration projects conducted with Trustee Council funds. In addition to their activities near their communities, students will go out with the scientists when research is conducted. Students will conduct sampling

for project principal investigators and input data into from various activities into the GIS system. Some projects have contributed scientific equipment for these effforts.

The Valdez School District, Cordova School District and Kenai Peninsula School District will provide teacher time for research project activities within the schools. These teachers may chose to involve all science class students in research activities. School space, equipment and supplies must be dedicated to the project by the school to ensure student activity success.

Funds are combined from a variety of sources, including Chugach School District allocations, grant funds, cooperating school districts, and Chugachmiut. During FY 97, additional funds will be requested from the Alaska Conservation Foundation (submission date August 1, 1996). The principal investigator time ($10,000) is contributed to the project; the project coordinator, principal investigator and a portion of the student travel is an in-kind contribution of $10,000; $30,000 in teacher time at each site; $15,000 in project coordination and reporting in-direct costs (Chugach School District and Chugachmiut); $25,000 in PWSSC staff time, equipment and general resources; $20,000 in office and classroom space, $8,000 in lodging (PI/scientist site visits, student travel lodging, teacher travel lodging, coordinator travel lodging); $15,000 in computer equipment, nets and fish gear, scales, portable GPS and weather stations.

EXPLANATION OF CHANGES IN CONTINUING PROJECTS

Youth Area Watch was initially proposed as a research project, but the Trustee Council identified the project as subsistence related. The project too provides an effective means to involve the public in the restoration efforts, as well as supply information to the oil spill impacted communities.

As a result of these modifications in Youth Area Watch, focus has been given to student preparation for research and monitoring project interaction. This change is indicated in the stated objectives for this project year. In addition, the length of the project has been extended to reflect the role that this project will continue to play in providing for public involvement throughout the life of the Restoration Office.

PROPOSED PRINCIPAL INVESTIGATOR

Roger Sampson
Chugach School District
165 E. 56th Ave., Suite D
Anchorage, AK 99518
Office: (907) 561-3666
Fax: (907) 561-8659

Mel Henning, Project Coordinator
Chugach School District
165 E. 56th Ave., Suite D
Anchorage, AK 99518
Office: (907) 561-3666
Fax: (907) 561-8659

JOB DESCRIPTION

YOUTH AREA WATCH
PROJECT COORDINATOR

The is a full-time, nine month position that works directly with EVOS project scientists, local village teachers and community youth to implement and overall youth research involvement project in Prince William Sound. This position will work at the direction of the assistant superintendent of the Chugach School District to achieve the objectives of the Youth Area Watch Project and the goals of the Exxon Valdez Oil Spill Restoration Plan.

Responsibilities

1. Coordinates with various research organizations and entities involved in EVOS funded projects.

2. Oversees student research at the local level. Ensures proper protocol is maintained.

3. Responsible for the coordination and on-going training of students in research and analysis process.

4. Responsible for coordinating research activities.

5. Works with EVOS and research agency staff to provide information on the progress of the project and makes changes as needed.

6. Coordinates meetings with appropriate project staff.

7. Fosters contacts with other research projects to expand youth involvement in research and restoration.

8. Responsible for the assessment of student research performance.

9. Responsible for coordinating student research and analysis presentations.

10. Coordinates with other communities and school districts to involve a larger number of students in subsequent years.

11. Integrates current science curriculum with research protocol to make what students are researching and learning real to their lives.

Project Coordinator cont.

Skills

Creative problem solver

Excels at community relations

Positive interpersonal skills

Ability to work with students in a rural environment

Excellent oral communication and writing skills

Qualifications

Bachelors of Education Degree

Background in marine sciences

Master Teacher

Computer technology expertise

1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1996 - September 30, 1997

Budget Category:	Authorized FFY 1996	Proposed FFY 1997						
Personnel		$46,800.0						
Travel		$42,450.0						
Contractual		$70,000.0						
Commodities		$3,300.0						
Equipment		$10,300.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	$0.0	$172,850.0	Estimated FFY 1998	Estimated FFY 1999	Estimated FFY 2000	Estimated FFY 2001	Estimated FFY 2002	
Indirect		$17,285.0						
Project Total	$108.0	$190,135.0	$175.0	$175.0	$175.0	$175.0	$175.0	
Full-time Equivalents (FTE)		0.8						
	Dollar amounts are shown in thousands of dollars.							
Other Resources		$133,000.0	$175,000.0	$175,000.0	$175,000.0	$175,000.0	$175,000.0	

Comments: Personnel costs include the Project Coordinator time located at the Anchorage Chugach School District office.

Travel costs include briefing site teachers on all projects, transporting students to protocol training and research activity sites, travel for scientists and PIs to sites, youth and teacher travel to science review session and Principal Investigator travel to professional conference.

Contractual expenses include hiring a research boat for protocol training and follow-up session, skiff hiring for local travel to research/testing sites, subsistitute teachers for sites during site teacher/coordinator protocol training, contract services from scientists (not funded through EVOS) to assist students with project research activities and contract services for a ten minute video.

Commodities include personal gear for students, chemical test kits and triple balance scales for project activities.

Equipment purchases include stereo microscopes, gillnets, video recording equipment and two computers for data compilation.

In-kind contributions include $10,000 in PI time, $30,000 in teacher time, $10,000 in travel costs, $15,000 in-direct time, $25,000 PWSSC time, $20,000 in office space, $8,000 in lodging, $15,000 in equipment.

1997

Prepared:

Project Number: 97210
Project Title: Youth Area Watch
Name: Chugach School District

FORM 4A
Non-Trustee
SUMMARY

4/15/96

1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1996 - September 30, 1997

Personnel Costs:			Months	Monthly		Proposed
Name	Position Description		Budgeted	Costs	Overtime	FFY 1997
Project Coordinator	Position responsible for all coordination of training and research activities. Will submit all data collected to the respective research and monitoring project. Position will negotiate all MOAs Between Chugach School District and participating districts. Position will serve as a liaison between participating agencies and organizations. The remaining quarter of coordinator's time will be used for curriculum development & funded elsewhere.		9.0	5.2		46.8
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		9.0	5.2	0.0	
					Personnel Total	$46.8

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FFY 1997
Site teacher/coordinator travel to project training in Chenega Bay.	620.0	10	4		6,200.0
					0.0
Student protocol and follow-up in Chenega.	650.0	12	8		7,800.0
					0.0
Student charter to research sites/vessels from each site. Costs are estimates/averages for four trips to work with researchers.	900.0	20	12		18,000.0
					0.0
					0.0
Two students and one site teacher to science review.	650.0	3	4		1,950.0
					0.0
Scientist & PI travel to each site.	800.0	7	10	130.0	6,900.0
					0.0
YAW PI to conference in New Orleans.	1100.0	1	5	100.0	1,600.0
				Travel Total	$42,450.0

1997

Prepared:

Project Number: 97210
Project Title: Youth Area Watch
Name: Chugach School District

FORM 4B
Personnel
& Travel
DETAIL

4/15/96

1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1996 - September 30, 1997

Contractual Costs:	Proposed
Description	FFY 1997
A large boat (up to 80 ft) is hired for an initial and concluding data exchange session and oil impacted area observation, for a total of eigth days at $3,000/day. A skiff up to 24 ft is hired for community research site activities at a rate of $150/day up to 150 days.	46,500.0
The Prince William Sound Science Center educational staff coordination of research activities. Activity logistics continue to be arranged regarding student participation on research cruises. Science Center staff provide present protocol tools for reseach activities, particularly for the students in the Cordova area. Staff time is calculated @ $200/day for 40 days.	8,000.0
Researchers not funded through EVOS money will provide TA to students on their projects. $600/day x 10 days.	6,000.0
Substitute teachers are necessary at the sites during site teacher/project coordinator project training. Five days for six sites total 30 days. The rate is calculated at $83.33 x 30 days, totaling $2,500.	2,500.0
Ten minute video production on Youth Area Watch Project.	7,000.0
Contractual Total	$70,000.0

Commodities Costs:	Proposed
Description	FFY 1997
$100 per student (25 youth) is necessary for rain gear, shovels, bucket and other personal equipment that is used during research and sampling activities.	2,500.0
Three chemical testing kits and replacement chemicals for water testing. Kits cost $100. Replacement chemicals total $100.	400.0
Two triple balance scales @ $200.	400.0
Commodities Total	$3,300.0

1997

Prepared:

Project Number: 97210
Project Title: Youth Area Watch
Name: Chugach School District

FORM 4B
Contractual & Commodities DETAIL

4/15/96

1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1996 - September 30, 1997

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FFY 1997
Three stereo microscopes for fish analysis @ $500.	3	500.0	1,500.0
			0.0
Fifteen gillnets @ $400.	1	2400.0	2,400.0
			0.0
Portable video recorder and associated supplies. This will be used in conjunction with the GPS to record all information, and then download it to the computer database.	1	2400.0	2,400.0
			0.0
			0.0
Two Power Book for information gathering at an additional site.	2	2000.0	4,000.0
			0.0
			0.0
			0.0
			0.0
			0.0
Those purchases associated with replacement equipment should be indicated by placement of an R.		**New Equipment Total**	$10,300.0

Existing Equipment Usage: Description	Number of Units
Two power books for remote sites.	2
Two research kits.	2
Three triple balance scales.	3
Portable GPS.	1
Three weather stations.	3

1997

Project Number: 97210
Project Title: Youth Area Watch
Name: Chugach School District

FORM 4B
Equipment
DETAIL

Prepared:

4/15/96

DOCUMENTARY ON SUBSISTENCE HARBOR SEAL HUNTING IN PRINCE WILLIAM SOUND

Project Number	97214
Restoration Category	General Restoration
Proposer	Tatitlek Village Council
Lead Trustee Agency	Alaska Department of Fish and Game
Cooperating Agencies	
Alaska SeaLife Center	
Duration	Second year of two year project
Cost FY 97	$12,100
Cost FY 98	0.0
Cost FY 99	0.0
Cost FY 00	0.0
Cost FY 01	0.0
Cost FY 02	0.0
Geographic Area	Prince William Sound
Injured Resource/Service	Harbor seals; subsistence

ABSTRACT

This is a close-out of a restoration project begun in FY 96. The purpose of the project is to make a documentary on the subsistence hunting of harbor seals in Prince William Sound, focusing on the village of Tatitlek. The video will document all facets of harbor seal hunting, including the ecological and biological knowledge hunters use to hunt seals. In FY 96, through a competitive process, Taylor Productions of Anchorage, Alaska, was awarded the contract to produce the documentary, which will be completed by February 1997. Funds requested for FY 97 will supplement a subcontract with Tatitlek to support village participation in the project and one month of staff time to assist with review of project and final report completion. Funds will also support participation by Tatitlek residents in a public screening of the completed documentary in Anchorage.

INTRODUCTION

In FY 96, the Trustee Council provided funding through the first year of this project (96214) to produce a documentary on subsistence harbor seal hunting in Prince William Sound. The project was proposed by the village of Tatitlek, which depends heavily on subsistence harvests of harbor seals and other marine resources. It is the hope of the community that their views on the importance of subsistence uses in their lives be communicated through the video to the Trustee Council, scientists, and the general public. The intent also is to contribute to the restoration of the injured harvest seal populations and subsistence uses by providing a medium for hunters to transmit their knowledge and observations, gained from years of hunting harbor seals, to the scientific community. Filming began in FY 96 and will be completed in FY 97. Objectives for FY 97 include completing filming, editing of the draft video, review of the video in Tatitlek, final editing of the video, and screening of the completed video in both Tatitlek and Anchorage.

NEED FOR THE PROJECT

A. Statement of Problem

The injured service this project addresses is subsistence; the injured resource is harbor seals. The oil spill disrupted the use of subsistence resources by injuring natural resources and creating concerns about the safety of those resources contaminated by the oil spill. One subsistence species that was in decline before the spill and may have been affected by the presence of oil, and which is currently classified not recovering, is harbor seal.

B. Rationale/Link to Restoration

The project contributes to the goal of restoring injured harbor seal populations by communicating traditional knowledge about these populations to scientists and facilitating exchange of information between scientists and subsistence hunters. The project also contributes to the goal of restoring subsistence uses by communicating subsistence values, activities, needs, and knowledge to a wide audience.

C. Location

The video is being filmed in Prince William Sound, primarily based out of the village of Tatitlek.

COMMUNITY INVOLVEMENT

The project was proposed by the community of Tatitlek. The production of this video relies heavily on community participation. Interviews are being conducted with local people, recording their knowledge of injured resources and their subsistence practices of hunting, fishing, gathering, and processing. Tatitlek residents are also involved through a subcontract with the film maker (a stipulation of the contract award process) to provide logistical support such as boats and skiffs.

PROJECT DESIGN

A. Objectives

The overall objective of this project is to promote the recovery of injured harbor seal populations and subsistence uses of natural resources through the production of a documentary on subsistence harbor seal hunting in Prince William sound, focusing on the village of Tatitlek. This includes hunting techniques, methods of processing, the distribution of seal products, and the traditional knowledge employed in hunting harbor seals. In FY 97, the documentary will be completed, presented during public screenings in Tatitlek and Anchorage, and distributed.

B. Methods

A documentary video is being produced, through a professional services contract. The video is documenting subsistence harbor seal hunting in Prince William Sound, primarily focusing on the community of Tatitlek. A subcontract within the contract supports community involvement. There will be a public screening of the video in Anchorage (following its debut in Tatitlek, and ideally during the Restoration Workshop), after which the video will be distributed. Funds are being requested in FY 97 to support the attendance of about three Tatitlek residents at the Anchorage screening of the product.

C. Cooperating Agencies, Contracts, and Other Agency Assistance

In FY 96, a contract was awarded through a competitive process to Taylor Productions of Anchorage, Alaska, to produce the documentary. A stipulation in the request for proposals was that the contractor include a $5.0 line item in their budget to fund a subcontract with the Tatitlek IRA Council to support technical, logistical, and consulting services from the community. This item underestimated the level of involvement of community members and the costs of local services. An additional $4.0 is being requested as a supplement to this subcontract. Of this, approximately $1.0 will be for consultant fees and the remainder for boat rentals and other services.

SCHEDULE

A. Measurable Project Tasks for FY 97

October 1996	Complete editing of draft documentary
November 1996	Community review of video (in Tatitlek)
December 1996	Complete final editing
January/February 1997	Public screening of documentary in Tatitlek (first) and Anchorage
February 1997	Completion and distribution of documentary
April 15, 1997	Submission of project final report

B. Project Milestones and Endpoints

Contract Awarded	February 15, 1996
Filming in Progress	April to September 1996
Editing	October 1996
Review of draft documentary	November 1996
Final editing	December 1996
Video Complete	February 1997
Public Screenings	January or February 1997 (Tatitlek and Anchorage)

C. Completion Date

The final version of the documentary will be released and distributed by February 1, 1997. A public screening will take place in Tatitlek (most likely in January 1997) and then Anchorage either during the 1997 Restoration Workshop (January 1997) or in February 1997 (if the product is not complete in time for the Workshop or has not yet been screened in Tatitlek).

PUBLICATIONS AND REPORTS

Documentary Video	February 1, 1997
Final report	April 15, 1997

PROFESSIONAL CONFERENCES

No attendance planned for FY 97.

NORMAL AGENCY MANAGEMENT

The Division of Subsistence of the Alaska Department of Fish and Game has no statutory or regulatory responsibilities for marine mammal management.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

The production of this documentary film complements other harbor seal restoration efforts, including those underway under 96244 (Community-Based Harbor Seal Management and Biological Sampling) and 96052 (Community Involvement and Traditional Knowledge). The project is also consistent with the Trustee Council's goal to facilitate the use of traditional knowledge in the restoration process.

EXPLANATION OF CHANGES IN CONTINUING PROJECTS

Originally, it was anticipated that the contract would be awarded in November 1995, with filming occurring in the spring of 1996, and completion of the video by September 1996. However, awarding the contract was delayed until February 1996 and filming did not get underway until April. The contract with Taylor Productions calls for delivery of the completed documentary by February 1997. Also, the FY 96 included $5.0 to be included as a subcontract

with the Tatitlek IRA Council in the film maker contract to fund support services of community members. The FY 96 budget underestimated the scope of this support, and an additional $4.0 is being requested to fully compensate community residents for their contributions to the production of the film. The $4.0 will be added as a modification to the contract with Taylor Productions. Funding is also being requested to provide travel for three Tatitlek residents to attend the Anchorage public screening of the video.

ENVIRONMENTAL COMPLIANCE

This project is a continuation of Project 96214, which was classified as categorically excluded under NEAP guidelines.

PRINCIPAL INVESTIGATORS

William E. Simeone
Division of Subsistence
Alaska Department of Fish and Game
333 Raspberry Road
Anchorage, Alaska 99518
Phone number : 907-267-2309
FAX number: 907-267-2450

Gary Kompkoff
President, Tatitlek IRA Council
PO Box 171
Tatitlek, Alaska 99677
Phone number: 907-325-2311
FAX number: 907-325-2298

PERSONNEL

Gary Kompkoff is president of the Tatitlek IRA Council. He is involved in each phase of the project, and is administering the subcontract with the IRA Council

William Simeone is a Subsistence Resource Specialist, and is the ADF&G project manager for this project. He will be assigned 1.0 month to this project in FY 97.

Craig Mishler is Subsistence Resource Specialist with the Division of Subsistence, and is presently the division's project manager for the Harbor Seal and Sea Lion Harvest Assessment Project (funded through a contract with the National Marine Fisheries Service). In FY 97, Dr. Mishler will assist in a technical review of the draft documentary. We are not requested any funding support for his involvement.

1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1996 - September 30, 1997

Budget Category:	Authorized FFY 1996	Proposed FFY 1997	LONG RANGE FUNDING REQUIREMENTS					
			Estimated FFY 1998	Estimated FFY 1999	Estimated FFY 2000	Estimated FFY 2001	Estimated FFY 2002	
Personnel	$14.1	$4.4						
Travel	$4.8	$2.8						
Contractual	$50.0	$4.0						
Commodities	$0.0	$0.0						
Equipment	$0.0	$0.0						
Subtotal	$68.9	$11.2						
General Administration	$5.6	$0.9						
Project Total	$74.5	$12.1	$0.0	$0.0	$0.0	$0.0	$0.0	
Full-time Equivalents (FTE)	0.3	0.1						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments:

1997

Prepared: 4/10/96

Project Number: 97214
Project Title: Documentary of Subsistence Harbor Seal Hunting in PWS
Agency: Alaska Department of Fish and Game

FORM 3A
TRUSTEE
AGENCY
SUMMARY

4/15/96

1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1996 - September 30, 1997

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FFY 1997
W. Simeone	Subsistence Resource Specialist II	16B	1.0	4.4		4.4
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		1.0	4.4	0.0	
					Personnel Total	$4.4

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FFY 1997
Anchorage - Tatitlek (Simeone; split 2 charters with film maker)	0.6	2	4	0.1	1.6
Anchorage - Tatitlek (Charter to transport 3 Tatitlek residents to video screening)	0.6	1	6	0.1	1.2
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$2.8

1997

Prepared: 4/10/96

Project Number: 97214
Project Title: Documentary of Subsistence Harbor Seal Hunting in PWS
Agency: Alaska Department of Fish and Game

FORM 3B
Personnel
& Travel
DETAIL

4/15/96

1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1996 - September 30, 1997

Contractual Costs:	Proposed
Description	FFY 1997
Amendment to subcontract with Tatitlek Village (part of professional services contract awarded in FY96) for key respondent honorariums (40hours @ $25/hour = 1.0), boat rentals (3.0)	4.0
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$4.0

Commodities Costs:	Proposed
Description	FFY 1997
Commodities Total	$0.0

1997

Prepared: 4/10/96

Project Number: 97214
Project Title: Documentary of Subsistence Harbor Seal Hunting in PWS
Agency: Alaska Department of Fish and Game

FORM 3B
Contractual & Commodities DETAIL

4/15/96

1997 EXXON VALDEZ TRUS] COUNCIL PROJECT BUDGET
October 1, 1996 - September 30, 1997

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

Existing Equipment Usage: Description	Number of Units	Inventory Agency

1997

Prepared: 4/10/96

4 of 4

Project Number: 97214
Project Title: Documentary of Subsistence Harbor Seal Hunting in PWS
Agency: Alaska Department of Fish and Game

FORM 3B
Equipment
DETAIL

4/15/96

MODELLING TROPHIC WEBS TO ACHIEVE SYNTHESIS IN SEA, NVP, AND APEX ECOSYSTEMS

Project Number: 97215

Restoration Category:

Proposer: University of Tennessee via Stuart L. Pimm

Lead Trustee Agency:

Cooperating Agencies:

Alaska SeaLife Center:

Duration: 1st year, 2-year project

Cost FY 97 (in thousands of dollars): $ 70.7

Cost FY 98 (in thousands of dollars): $ 71.1

Geographic Area: All applicable

Injured Resource/Service: Black oystercatchers, mussels, clams, Kittlitz's murrelets, river otters, common murres, harbor seals, harlequin ducks, marbled murrelets, pacific herring, pigeon guillemots, pink salmon, sea otters, glaucous-winged gulls, surfbirds, black turnstones, as well as commercial fishing and passive uses of habitats.

ABSTRACT

We formulate simple, large-scale trophic models of, and uniting, the communities of the APEX, SEA, and NVP projects. Using the data they gather and data from the literature, we seek a broad synthesis of the larger Prince William Sound and Gulf of Alaska ecosystems and the complex changes within them. We ask how do the changes in species' densities interact to produce the short– to long–term changes in species densities that we observe? To what extent do different components resist changes elsewhere in the food web? How far and how quickly can we expect the effect of a change in one species' density to stretch through the food web?

INTRODUCTION

We propose to formulate simple, large-scale trophic web models to unite the communities of the APEX, SEA, and NVP projects. Integrating previously published information and the data gathered by these projects, we can gain a broad perspective of the larger Prince William Sound and Gulf of Alaska ecosystems and understand the complexity of the changes within them.

The importance of indirect effects.

Previous research has focused on the single species or small groups of trophically similar species and the environmental factors that affect them. The *Ecosystem Synthesis* project recognizes that these essential efforts cannot be sufficient. What Pimm calls the "ocean iron" problem (Pimm 1992) illustrates the need to integrate the various ecosystem components. Consider the singular experiment of fertilizing the southern oceans with iron. Will the consequent increased growth rates of the phytoplankton result in a simple increase in their biomass? Or will the zooplankton consume their productivity and so on up the food chain to lead to a change in biomass only in the system's top predators?

In the aquatic literature, such questions are often couched in terms of the discussion over "top–down" or "bottom up" control. There is an extensive experimental and theoretical literature of where changes in density should be greatest (Carpenter 1988, Carpenter and Kitchell, Kerfoot and Sih 1987, Power 1990, Vanni et al. 1990.)

The general question is how effects propagate throughout the trophic web — or the food web as we shall call it. When and where else in the food web will the consequences of change in one (or more) species be manifested (Vanni 1987a, 1987b)? The complexity of how such effects propagate comes from the consideration of *indirect effects*. Direct effects are those of prey on their predators and vice versa: A on B, B on A. Indirect effects arise because A may also affect C, and C affect B, or A may affect C, C affect D, and D affect B, and so on.

As in the "ocean iron" problem, indirect effects may appear several trophic linkages away from their cause. In the Bering Sea, for example, the large pollock fishery has caused the decline of pollock–eating sea–lions, murres, and kittiwakes, but more distantly, caused an increase in auklets — species that feed on the plankton on which the pollock feed (Springer 1992).

Indirect effects can be completely counter to simple expectation (Abrams 1992). For instance, a reduction in the numbers of predator B can lead to the *decline* of its prey A. Suppose B also feeds on C and both A and C feed on D. Then, A may benefit from its predator, because the predator's decline favors species C, whose increase depletes A's prey, species D.

The catalogue of such possibilities is enormous. Sometimes, there is remarkably little change. The anchovy fishery did not lead to an increase in species that feed on the fish's phytoplankton food: the phytoplankton die in greater numbers and settle

to the benthos (Rowe 1981). There can be circumstance where the decline of a species may not lead to its recovery, at least in the short- to medium-term. From considerations of density-dependence, population ecologists would infer that a population should recover its former numbers following disaster. Everything else in the system has remained unchanged. The insight from considering indirect effects is that the system has not remained the same. The effects of the disaster are still ricocheting through the food web in complex ways. Sometimes the long-term removal of one species, may cause the system to move towards a completely different combination of species. (Aleuts and their otter harvest is the component removed in Simenstad et al.'s (1978) example).

Inspection of every known food web shows that many bizarre outcomes are possible. Are such outcomes large or likely? Food web models predict that they should be ubiquitous (Pimm 1991). Nature agrees. There are reviews of hundreds of predator and competitor removal experiments. They show that unexpected changes — predator removals leading to the decline of some prey species, for example— are as frequent as the changes in expected directions (Pimm 1991).

NEED FOR THE PROJECT

A. Statement of Problem

A problem faced by many resource managers is an incomplete understanding of the interactions between all of the species coexisting in the ecosystems under consideration. Perturbations to multi-species marine communities can be extraordinarily complex (Beddington 1984). When one species' population is perturbed, it is difficult to know how far and in which directions the "domino effect" will go. Given that indirect effects are important and ubiquitous, we may not fully understand the complex changes occurring in the Prince William Sound and Gulf of Alaska ecosystems unless we recognize their consequences.

The complete list of potential questions must come from our working closely with the range of scientists and affected parties. Nonetheless, we can list possibilities where our models might be useful for all the APEX, SEA, and NVP communities.

1. What will be the consequences of loading hatchery raised salmon into the system, given the complex interactions between juvenile salmon, large copepods and pollock?

2. What other components of the ecosystem will the decline of Pacific herring stocks affect? What contribution does this make to the declines of marine bird and mammal populations?

3. In what species groups will the consequences of fishing become apparent? Is there likely a strong connection between fishing, marine bird, and marine mammal populations?

3. What are the consequences of changes in harbor seal populations?

4. Should we expect sea-otters, harlequin ducks, guillemots and other oil–affected near–shore species to recover in the near–term, given the observed ecosystem changes?

5. How should the change from an ecosystem dominated by shrimp to one dominated by pollock and cod affect seabirds, marine mammals, and other species groups?

6. How do changes in one ecosystem — say, the near–shore — affect processes in other ecosystems?

B. Rationale/Link to Restoration

Marine resource managers need an understanding of the interactions between all of the different species, and between the different communities (Parsons 1996). In particular, clues discerning which species contribute most to long-term stability of the communities will aid resource managers in making decisions that affect the development of these communities. The successful and sustainable management of the herring and salmon populations depends on a model of the food webs joining the different communities.

C. Location

Since this project involves modelling and synthesis of existing data, the location of the project will be "on the computer," so to speak. However, the benefits will accrue across the areas of the Gulf of Alaska and Prince William Sound that harbor APEX, SEA, or NVP communities.

COMMUNITY INVOLVEMENT

The Trustee Council newsletter will provide a forum for communication with the local community. As we specify below, this project requires the collective wisdom of many with experience of the area's wildlife, professional and amateur alike.

PROJECT DESIGN

A. Objectives

The objectives of the proposed project are the following:

1. Build a food web model of the interactions of the APEX community members.

2. Build a food web model of the interactions of the NVP community members.

3. Build a food web model of the interactions of the SEA community members.

4. Integrate the three food webs into a single, large-scale model of the interactions of the communities.

5. Examine these models for likely strong, and possibly unexpected connections between different parts of the ecosystem.

B. Methods

Overall philosophy

There are several approaches to modelling food webs. Among them are the strictly theoretical (such as the Lotka-Volterra system explored by May 1972) and explicit simulation models. We take the hybrid approach. Our models differ substantially from simulation models in the normal use of that term. They are near enough to analytical models that we can write down their results algebraically (though no one would want to do the algebra by hand!).

Simulation models typically produce long time series as output. Few empirical studies collect such data and managers need insights now and not hundreds of years from now. Our hybrid models combine the ease of analysis offered by the simple Lotka-Volterra models with the numerical details of simulation models. Our models *do not replace simulation models.* Rather they model large–scale synoptic variables — often grouped under the various meanings of "ecological stability." (See Pimm and Hyman 1987 for applications to fishery contexts.) They may confirm the likelihood of suspected indirect effects, suggested hitherto unexpected connections and effects, or beg the building of more detailed complex models to further refine insights.

Model building

The models we propose are simple ones that parameterize the *growth rates* of a system of trophically connected "species" as functions of their *densities* and necessary environmental variables. In marine systems, the trophic "species" may be different life stages of the same species (Werner and Gilliam 1984) — hence the quotation marks. (Pimm and Rice 1987 develop the extension of food web models to such marine systems.) Once parameterized, the problem becomes one of understanding the consequence of the *change in density* of one species to the *change in density* of other species in the food web. Technically, the issue is one of *resistance* (Pimm 1984, 1991): the extent to which different components resist changes elsewhere in the food web.

The detailed application of dynamical analysis to individual food webs requires a knowledge of the species, their patterns of trophic interaction, and the strengths of those interactions. (Carpenter et al. 1992 provide an experimental test of how food web structure modifies resistance.)

The list of species in the ocean is a very long one. The inevitable compromise is to group species into functional groups. These are sets of species, such as zooplankton, with similar feeding habitats. Determining who eats what in the food web is even more difficult. Generally, we base this information on what we know about the natural history of the functional groups and this can make webs complicated. While some of this information may be in the literature, most will be in the collective wisdom of ecologists, naturalists, hunters, and fisherman of the area. We must listen carefully to what they have to tell us. It has not escaped our notice that we list no references to the ecosystems we propose to study. We have a colloboration to offer, not a stand-alone solution.

Once we have the food web, we must develop a model and specify its parameters. To obtain interaction terms, we follow a recipe described by deRuiter et al. (1995). There are similar, related aproaches, for example, Carpenter et al. 1992, Yodzis and Innes 1992). The interaction terms require several kinds of information. We will first take the biomass of a species to be the average annual population size of the species; call this X_i^*. The feeding rate, F_{ij}, of a predator of density X_j on a prey of density X_i is modelled in a way analogous to the mass-action dynamics chemists use for the random collisions of reactive molecules. (The models similarly assume random encounters of predators and prey.) This assumption leads us to equate the feeding rate F_{ij} with $c_{ij}X_i^*X_j^*$, where c is a constant particular to the two species involved. We will estimate each feeding rate directly, then estimate the per unit effect of predator X_j on prey X_i as F_{ij}/X_j or $c_{ij}X_i^*$.

While the prey species loses F_{ij} to the predator per year, the predator's gain is much smaller. (When the juvenile salmon is swimming for its life, the pollock chasing it is merely running for its supper.) The predator's gain must be reduced by the fraction of the prey's tissues that it can assimilate (the assimilation efficiency) and the fraction of the assimilated tissue that it can convert into new biomass (the production efficiency). We know these efficiencies reasonably well for many groups of species (Pauly and Christensen 1995).

Model simplicity and uncertainty

These models are extremely simple and yet they are riddled with uncertainties. One solution has been to build more complex, detailed models, and to demand more data to parameterize them. We are repelled, rather than seduced by this process. As field ecologists we know that the simplest model parameter may be enormously difficult to obtain. As theoreticians, we see a more practicable alternative.

Nature is uncertain: a parameter value, here, this week will not be the same as there, next week. Any model that aims to yield insight of use to managers must be robust to these uncertainties (Ludwig et al. 1993). There need not be a single, acceptable web: we may well build several webs to see how sensitive are our

conclusions to these alternatives. And we will choose parameters not once, but repeatedly and randomly over ranges that reflect our uncertainty (and probably the natural variability) of their true values.

Food webs may vary spatially (in which case, we can build different webs). Food webs are connected spatially (Winemiller 1996) and flows of matter and nutrients between them must be coupled (Schindler et al. 1996). Food webs change temporally: changing physical factors may greatly alter marine food webs (Barber and Chavez 1983, Roemmich and McGowan 1995, Barry et al. 1995). We expect to build many models: this is easy with simple models, less so with large, complex ones.

What the models will tell us.

Our simple models allow calculation of simple effects. How will the change in, say, fishing effort affect the abundance of different species of seabird, or which species will be most affected by the change in seal or otter numbers? The technical aspects of this process are familiar (Pimm 1991). For a given parameterization of a particular food web, we can "tweak" the species known to have declined and look where (and, importantly how quickly) the consequent changes will be manifest.

The simplicity of our models makes this a rapid and so highly repeatable process. It can be done hundreds to thousands of times with each food web formulation. Each time, we select the exact parameters over the statistical ranges that reflect our uncertainties. How certain will be the results? This is a statistical process and so the results will be distributions of effects. It is quite possible that given the uncertainties in parameters we may not be able to specify whether a decline in species A will harm or benefit species B, let alone by how much. On the other hand, as field ecologists, we prefer to have a model tell us a process has a wide range of possible outcomes than see one, precise outcome that we cannot possibly believe (Ludwig et al. 1993).

Model testing

The simplicity of our models and of their results suggests simple tests. We expect to find at least a few, simple, strong, indirect effects. These should correlate with the data already collected or with the often unwritten experience of those that know nature best. We can only justify the utility of our approach if we can draw attention to likely, perhaps observable and possibly hitherto unexpected linkages between different ecosystem components.

C. Cooperating Agencies, Contracts, and Other Agency Assistance

There are no subcontracts involved.

SCHEDULE

A. Measurable Project Tasks for FY 97 (October 1, 1996 - September 30, 1997)

Oct. 1-Dec. 31: We will first conduct an extensive literature search; we need to gain a broad understanding of the naturally occurring marine food webs. We will be gathering data on biomasses, feeding rates, and other parameters from published food webs, so that we have an idea of what ranges of values are acceptable for these models. We will also be investigating the structural patterns of related published food webs.

Jan. 22–25: Pimm attends the Annual Restoration workshop. At that meeting, he will meet the scientists of the APEX, SEA, and NVP projects. We need to learn what data the projects have gathered, what parameters we will need to estimate from our literature base, and whom we should consult for aid in this parameter estimation. The knowledge and insights of the APEX, SEA, and NVP scientists will be crucial.

Spring: We will need to assemble data from local sources and available reports. By this stage, will should have a broad idea of the food web structures and the approximate parameter values necessary in formulating the models.

Summer 1997: This will be a critical time in the project. We need to work closely with the scientists from APEX, SEA, and NVP and the many others with experience of the ecosystems. We are sure that there will be gaps in our knowledge that they can clarify. They are the ones with the working knowledge of the ecosystems that we will be modelling: they have spent the time in the field with those systems. We also want to present preliminary modelling ideas to them, hear their responses, and solicit questions. We will need their expertise at every step, but it will be crucial at this stage.

B. Project Milestones and Endpoints

FY 1997 Assemble knowledge and data.

Fall, 1997 Build models.

Spring, 1998	Model completion: synthesis into one large-scale model of the three communities.
Summer, 1998	Write-up of results, submit manuscript(s), present work to the annual meeting of the Ecological Society of America (ESA), 1998.

C. Completion Date

We will complete the work in FY 98.

PUBLICATIONS AND REPORTS

We expect to submit at least one substantial manuscript to a major international journal, tentatively titled "Food Web Dynamics of Prince William Sound and the Gulf of Alaska," by the close of FY 98. The Principal Investigator has various editorial roles for *Science, Oecologia, Journal of Animal Ecology,* and *Oikos.* He will use that experience plus consultation with his editorial colleagues to decide the appropriate outlet for this and other manuscripts.

PROFESSIONAL CONFERENCES

We plan to present our work at the annual meeting of the ESA, in August 1998.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

The proposed project is inherently a coordination and integration of the APEX, SEA, and NVP projects and will need the goodwill and patience of those involved.

The proposed budget asks for only the most modest amount of equipment. We will meet from other sources all other computers, the equipment used on field trips, supplies, software, and other needs. Pimm's laboratory has been renovated and equipped through his Pew Scholarship in Conservation and the Environment.

PROPOSED PRINCIPAL INVESTIGATOR

Name:	Dr. Stuart L. Pimm
Affiliation:	University of Tennessee
Mailing address:	569 Dabney Hall, University of Tennessee, Knoxville, TN 37996-1610
Phone number:	423-974-1981
Fax number:	423-974-0978
E-mail address:	stuartpimm@aol.com

PERSONNEL

STUART L. PIMM

Personal Birthdate, place: 1949, Derby, England. Naturalized US citizen.
Married: June 1990 to Julia Killeffer of Knoxville, Tennessee
Children: Stephanie, 1983; Shama, 1985

Degrees B.A. Second Class Honours, Oxford, England, 1971.
Ph.D. New Mexico State University, U.S.A. 1974.

Recent Positions Professor, Department of Ecology and Evolutionary Biology
University of Tennessee, Knoxville, 1986–
1982– 1986 Associate Professor, UTK.

Visiting Appointments Griffith University, Queensland, Australia
Institute for Nonlinear Science, University of California,
Ecosystem Management, University of New England, Australia,
Centre for Population Biology, Imperial College, London.

Grants Total ~$2.5 million from National Park Service, Fish and Wildlife Service, Forest Service, National Biological Service, The Nature Conservancy, The World Wildlife Fund, and others.

Publications Over 100 including three books, for example

S.L. Pimm. **Food Webs**. Chapman and Hall (1982).

S.L. Pimm. The complexity and stability of ecosystems. **Nature** 307:321-326. (1984).

S.L. Pimm and A. Redfearn. The variability of animal populations. **Nature** 334: 613-614 (1988).

S.L Pimm. Communities oceans apart? **Nature** 339:13. (1989)

S.L. Pimm. **The Balance of Nature? Ecological Issues in the Conservation of Species and Communities.** The University of Chicago Press (1991).

S.L. Pimm, J.H. Lawton, and J.E. Cohen. Food webs patterns and their consequences **Nature** 350: 669-674 (1991)

S.L. Pimm and J.L. Gittleman. Biodiversity: where is it? **Science** 255: 940. (1992)

S.L.Pimm, J. Diamond, T.R. Reed G.J. Russell and J. Verner. Times to extinction for small populations of large birds. **Proceedings of the National Academy of Sciences (U.S.A.).** 90: 10871–10875 (1993)

S.L.Pimm. Ecosystem dynamics: Nature's short, sharp, shocks. **Current Biology** 3: 288–290. (1993)

S.L.Pimm and A. M. Sugden. Tropical diversity and global change. **Science** 263: 933–934. (1994)

S.L.Pimm, G. J. Russell, J. L. Gittleman, T. M. Brooks. The future of biodiversity. **Science** 269: 347–350 (1995) .

Addresses and seminars Over 100 in 24 different countries, for example

Plenary address to The International Council for the Exploration of the Seas. France 1991.

Sigma-Xi National Lecturer 1993-1995

Research services

Editorial. Editorial Boards of *Evolutionary Ecology, Journal of Animal Ecology, Oecologia, Science.*

Committees. National Research Council Committee on Preservation of the 'Alala; Scientific Advisory Board, Centre for Conservation Biology, Stanford University; American Institute of Biological Sciences Task force for the 90s. National Research Council Committee on the Value of Biodiversity.

Testimony. To Senate: Committee on the Environment; the re-authorization of the Endangered Species Act; July 13th 1995. House: Committee on Resources; the re-authorization of the Endangered Species Act; September 20th 1995.

LISA MANNE, Research Assistant

Personal	Born October 10, 1969, Cincinnati, Ohio. Never married.
Degrees	BS in mathematics, magna cum laude, Otterbein College, Westerville, Ohio, 1991. MS in mathematics, University of Tennessee, 1995.
Seminars	Presented boundary element method research in Dublin at annual IMACS (International Association for Math and Computers in Simulation) meeting, 1991. Presented same work at SIAM (Society for the advancement of Industrial and Applied Mathematics, Los Angeles, 1992. Is presenting a paper at the annual Ecological Society of America meeting, summer 1996: "MacArthur and Wilson revisited with new data: confirmation of classic theory."

Publication

Manne, Lisa L., and Stuart L. Pimm. (1996) Engineered Food Webs. Current Biology **6**: 29-31.

In this review of a 1995 article, we examine the strengths and arrangement of the interactions between species in an empirically derived food web.

LITERATURE CITED

Abrams. 1992b. Predators that benefit prey and prey that harm predators. Unusual effects of interacting foraging adaptations. *American Naturalist* **140:** 573-600.

Barber, R.T. and F.B. Chavez. 1983. Biological consequences of El Niño. *Science* **222:** 1203-1210.

Barry, J.P., C.H. Baxter, R.D. Sagarin, S.E. Gilman. 1995. *Science* **267:** 672.

Beddington, J.R. 1984. The response of multispecies systems to perturbations. In *Exploitation of Marine Communities,* ed. R.M. May, pp. 209-225. Springer-Verlag, Berlin.

Carpenter, S.R., ed. 1988. *Complex Interactions in Lake Communities.* Springer-Verlag, New York.

Carpenter, S.R. and J.F. Kitchell, eds. 1993. *The Trophic Cascade in Lakes.* Cambridge University Press, Cambridge, U.K.

Carpenter, S.R., C.E. Kraft, R. Wright, X. He, P.A. Soranno, and J.R. Hodgson. 1992. Resilience and resistance of a lake phosphorous cycle before and after food web manipulation. *American Naturalist* **140:** 781-798.

De Ruiter, P.C., A-M Neutel, and J.C. Moore. 1995. Energetics and stability in belowground food webs. In *Food Webs: Integration of Patterns and Dynamics,* eds. G.A. Polis and K.O. Winemiller, pp 201-210. Chapman and Hall, New York.

Kerfoot,W.C. and A. Sih, eds. 1987. *Predation: Direct and indirect impacts on aquatic communities.* University of New England Press, Hanover, NH.

Ludwig, D., R. Hilborn, and C. Walters. 1993. Uncertainty, resource exploitation, and conservation: Lessons from history. *Science* **260:** 17, 36.

May, R.M. 1972. Will a large complex system be stable? *Nature* **238:** 413 - 414.

Parsons, T. 1996. The impact of industrial fisheries on the trophic structure of marine ecosystems. In *Food Webs: Integration of Patterns and Dynamics,* eds. G.A. Polis and K.O. Winemiller, pp 352-357. Chapman and Hall, New York.

Pauly, D. and V. Christensen. 1995. *Nature* **374:** 255-257.

Pimm, S.L., J.H. Lawton, J.E. Cohen 1991. Food web patterns and their consequences. *Nature* **350:** 669 - 674.

Pimm, S.L. 1992. Frog Ponds and Ocean Iron. *Nature* **360:** 298–299.

Pimm, S.L. 1991. *The Balance of Nature? Ecological Issues in the Conservation of Species and Communities.* The University of Chicago Press.

Pimm, S.L. and J.B. Hyman. 1987. Ecological stability in the context of multispecies fisheries. *Canadian Journal of Fisheries and Aquatic Sciences* **44:** 84–94.

Pimm, S.L. and J.A. Rice. 1987. The dynamics of multispecies, multi–life–stage models of aquatic food webs. *Theoretical Population Biology* **32:** 303–325.

Pimm, S.L. 1984. The Complexity and Stability of Ecosystems. *Nature* **307:** 321-326.

Pimm, S.L. 1993. Nature's short, sharp shocks. *Current Biology* **3:** 288-290.

Power, M.E. 1990. Top-down and bottom-up forces in food webs: do plants have primacy? *Ecology* **73:** 733-746.

Roemmich, D. and J. McGowan. 1995. *Science* **267:** 1324.

Rowe, G.T. 1981. The benthic processes of coastal upwelling ecosystems. In *Coastal Upwelling,* ed. F.A. Richards. American Geophysical Union, Washington, DC.

Simenstad, C.A., J.A. Estes, and K.W. Kenyan. 1978. Aleuts, sea otters and alternate stable-state communities. *Science* **200:** 403-411.

Springer, A. 1992. Walleye Pollock: How much difference do they really make? *Fisheries Oceanography* **1:** 80-96.

Vanni, M.J., C. Luecke, J.F. Kitchell, Y. Allen, J. Temte, and J.J. Magnuson. 1990. Effects on lower trophic levels of massive fish mortality. *Nature* **344:** 333-335.

Vanni, M. J. 1987a. Effects of food availability and fish predation on a zooplankton community. *Ecological Monographs* **57;** 67-88.

Vanni, M. J. 1987b. Effects of nutrients and zooplankton size on the structure of a phytoplankton community. *Ecology* **68:** 624-635.

Winemiller, K.O. 1996. Factors driving temporal and spatial variation in aquatic floodplain food webs. In *Food Webs: Integration of Patterns and Dynamics,* eds. G.A. Polis and K.O. Winemiller, pp 298-312. Chapman and Hall, New York.

Schindler, D.E., S.R. Carpenter, K.L. Cottingham, X. He, J.R. Hodgson, J.F. Kitchell, and P.A. Soranno. 1996. Food web structure and littoral zone coupling to pelagic trophic cascades. In *Food Webs: Integration of Patterns and Dynamics,* eds. G.A. Polis and K.O. Winemiller, pp 96-108. Chapman and Hall, New York.

Werner, E.E. and J.F. Gilliam. 1984. The ontogenetic niche and species interactions in size-structured populations. *Annual Review of Ecology and Systematics* **15:** 393-426.

Yodzis, P. and S. Innis. 1992. Body size and consumer-resource dynamics. *American Naturalist* **139:** 1151-1175.

Budget Category:	Authorized FFY 96	Proposed FFY 1997
Personnel		33.4
Travel		8.4
Contractual		11.3
Commodities		
Equipment		6
Subtotal		59.1
Indirect		11.6
Project Total (x 1000)		$70.70
Full-time Equivalents (FTE)		
Other Funds		

LONG RANGE FUNDING REQUIREMENTS

Estimated FFY 1998
71.1

Comments:

Indirect costs = 23% of all costs less equipment

See text of DPD for other funds

1997

Prepared: 4/10/96

Project Number:

Project Title: Modelling Trophic Webs to Achieve Synthesis in SEA, NVP, and APEX Ecosystems

Name: University of Tennessee, Stuart Pimm, P.I.

FORM 4A
Non-Trustee
DETAIL

Personnel costs:			Months	Monthly		Proposed
Name	Position description		Budgeted	Costs	Overtime	FFY 1997
S. Pimm	Principal Investigator		2	8.3		16.6
L. Manne	Assistant researcher		12	1.4		16.8
	Subtotal		14	9.7		
					Personnel total (in thousands of dollars)	$33.40

Travel costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	per Diem	FFY 1997
S. Pimm: travel to Alaska to attend annual restoration meeting	1100	1	4	32	1.2
S. Pimm: travel to Alaska to consult with SEA, APEX, NSVP project staff	1100	1	60	32	3
L. Manne: travel to Alaska to consult with SEA, APEX, NSVP project staff	1100	1	60	32	3
S Pimm: travel to Alaska to attend technical review session	1100	1	2	32	1.2
				Travel total (in thousands of dollars)	$8.40

1997

Prepared: 4/10/96

Project Number:
Project Title: Modelling Trophic Webs to Achieve Synthesis in SEA, NVP, and APEX ecosystems
Name: University of Tennessee, Stuart Pimm, P.I.

FORM 4B
Personnel
& Travel
DETAIL

Contractual Costs:	Proposed
Description	FFY 1997
Accommodation for Pimm, Restoration Meeting (4 days @$80/day)	0.3
Accommodation for Pimm, summer visit (60 days @$80/day)	4.8
Accommodation for Manne, summer visit (60 days @ $80/day)	4.8
Car lease for Pimm & Manne, summer visit (2 months @ $600/month)	1.2
Accommodation for Pimm, Technical Review Session (2 days @ $80/day)	0.2
Contractual Total (in thousands of dollars)	$11.30

Commodities Costs:	Proposed
Description	FFY 1997
Commodities Total (in thousands of dollars)	$0

1997

Project Number:

Project Title: Modelling Trophic Webs to Achieve synthesis in SEA, NVP, and APEX ecosystems

Name: University of Tennessee, Stuart Pimm, P.I.

FORM 4B
Contractual & Commodities DETAIL

Prepared: 4/10/96

New Equipment Purchases:	Number	Unit	Proposed
Description	of Units	Price	FFY 1997
Computer, Macintosh powerbook 5300ce, for the modelling portion of the project	1	6	6
New Equipment Total (in thousands of dollars)			$6

Existing Equipment Usage:	Number	
Description	of Units	

1997

Project Number:

Project Title: Modelling Trophic Webs to Achieve Synthesis in SEA, NVP, and APEX ecosystems

Name: University of Tennessee, Stuart Pimm, P.I.

FORM 4B
Equipment
DETAIL

Prepared: 4/10/96

EASTERN PWS WILDSTOCK SALMON HABITAT RESTORATION

Project Number:	97220
Restoration Category:	General Restoration
Proposer:	Native Village of Eyak, Native Village of Tatitlek, USFS
Lead Trustee Agency:	USFS
Duration:	3 Years
Cost FY 97:	$118,000
Cost FY 98:	$115,000
Cost FY 99:	$20,000
Geographic Area:	Eyak Native Corporation lands in Eastern Prince William Sound Tatitlek Native Corporation lands in Eastern Prince William Sound
Injured Resource/Service:	Replacement of Lost Subsistence Services

ABSTRACT

This project will replace lost subsistence services resulting from the Exxon Valdez oil spill by increasing wild salmon production in eastern Prince William Sound. Instream fisheries habitat improvement techniques, primarily the installation of log structures, will be employed by local subsistence users to increase the capability of selected streams to produce additional salmon.

INTRODUCTION

Subsistence use of salmon in Prince William Sound is a service that was injured by the *Exxon Valdez* oil spill. While levels of subsistence harvest have gradually increased throughout the spill area, they continue to remain below pre-spill levels in Prince William Sound. This project will target habitat enhancement of local salmon stocks that are utilized as a subsistence resource by the Native Village of Eyak and the Native Village of Tatitlek. Habitat enhancement or restoration will increase the capability of local streams to produce additional salmon, and therefore provide increased subsistence resources and opportunities. A major focus of the project is the direct involvement and participation of the local subsistence users throughout this process.

Since the 1960's, fisheries biologists have successfully utilized in-stream structures as a technique to improve habitat conditions for salmon spawning and rearing in Alaska. The strategic placement and proper anchoring of logs in stream channels can be an effective method to create additional habitat or improve existing habitat for spawning and rearing salmon. Working with the natural dynamics of the stream channel, log structures can be anchored in various ways to alter stream channels to produce desirable objectives, such as; increase pool habitat, disperse stream energy, prevent erosion, provide cover, enhance spawning habitat, and reduce bedload movement. Individual structures must be designed and installed with specific objectives in mind. These structures should be installed after a thorough analysis of the habitat conditions in the entire stream and requirements of the target salmon species.

This project is a continuation of Project 96220. To date, one month of information compilation and review of existing literature has been accomplished. Over the years, several State and Federal agencies, as well as the regional aquaculture corporation, have conducted surveys and collected fisheries information in streams within the project area. This information is essential in identifying streams with the highest potential for habitat improvement. Local and traditional knowledge from the subsistence users in the area will also be an important factor in identifying potential project streams. Contacts with tribal members have been established, survey methodologies have been chosen, headway has been made concerning the boat contract, and ANILCA hiring forms have been modified to suit the hiring needs. Further results will be compiled after the summer field season.

Following the identification of potential project streams during the winter months, habitat surveys in selected streams will be conducted over the course of the summer. Habitat surveys will be completed by student interns from the Native Village of Eyak under the guidance and direction of a professional fisheries biologist. Standardized fisheries habitat survey techniques used by the USDA Forest Service will be the method of inventory. The surveys will then be analyzed and prescriptions for structural improvement will be developed based upon the desired objectives.

Actual construction and installation of the habitat improvement structures on Eyak Native lands will occur during May and early June, FY 1997. Tatitlek land enhancement work is scheduled for May and June of FY 1998. Work crews consisting of local subsistence users and student interns will construct and install the log structures with hand tools and gas powered winches. No heavy equipment or machinery will be required in the course of this project. Forest Service crews, utilizing

similar techniques in the Montague Island Chum Salmon Restoration Project (94139), demonstrated that a small crew using hand tools can be highly productive and can build effective structures in a creek with substantial flows.

NEED FOR THE PROJECT

A. Statement of Problem

Levels of subsistence harvest have gradually increased in all of the spill area communities. However, subsistence harvests in Prince William Sound remain below pre-spill levels and, in some areas, the composition of the subsistence harvest has changed significantly. Subsistence users also report that the effort necessary to harvest resources has increased, and they continue to voice concerns about food safety.

Subsistence will have recovered when injured subsistence resources are healthy and productive and exist at pre-spill levels and people are confident that the resources are safe to eat. This project will attempt to replace injured subsistence services by enhancing salmon resources important to the Native Village of Eyak and the Native Village of Tatitlek. Production of additional salmon through habitat improvement will reduce harvest effort and contribute to the overall restoration of subsistence resources in Prince William Sound.

B. Rationale

This project will directly contribute to the subsistence recovery objective as identified in the *Exxon Valdez* Oil Spill Restoration Plan. This project will target habitat enhancement of local salmon stocks that are utilized as a subsistence resource by the Native Village of Eyak and the Native Village of Tatitlek. Habitat enhancement or restoration will increase the capability of local streams to produce additional salmon, and therefore provide increased subsistence resources and opportunities.

The policy of the Trustee Council, as stated in the Restoration Plan, is that projects designed to restore or enhance an injured resource: 1) must have a sufficient relationship to an injured resource 2) must benefit the same user group that was injured 3) should be compatible with the character and public uses of the area. This project meets all three portions of the Trustee Council's policy toward restoring or enhancing an injured resource.

C. Location

The initial study area will include all anadromous streams surrounded by Eyak Corporation lands in Port Gravida, Sheep bay, Orca Inlet and the west arm of Simpson bay, Prince William Sound. The second study area will include Tatitlek lands in Port Fidalgo, Galena Bay, Bligh Island, and the Tatitlek Narrows, Prince William Sound. The project benefits will be realized in eastern PWS, and will primarily affect the communities of Cordova and Tatitlek.

COMMUNITY INVOLVEMENT

One of the primary goals in this restoration effort is the direct involvement of the community, specifically the Native Village of Eyak and the Native Village of Tatitlek, in all aspects of the project. Traditional and historic knowledge will be used in the planning process to identify potential project streams important to subsistence users. Student interns from the Native Village of Eyak and the Native Village of Tatitlek, under the guidance of a professional fisheries biologist, will carry out stream habitat inventories and surveys. Boat contracts and personnel involved in this restoration effort will also be solicited through the Native Village of Eyak and the Native Village of Tatitlek.

PROJECT DESIGN

A. Objectives

1. Improve salmon spawning and rearing habitat conditions in four eastern PWS streams through the installation of log structures.

2. Educate student interns in the concepts and application of fisheries habitat management.

3. Involve subsistence users from the Native Village of Eyak to the maximum extent possible.

4. Involve subsistence users from the Native Village of Tatitlek to the maximum extent possible.

5. Develop a baseline of information on existing wildstock salmon habitat conditions within the project area.

6. Estimate potential coho populations from habitat calculations of the surveyed streams.

7. Determine juvenile fish distribution within the surveyed streams.

8. Determine fish distribution pre- and post-installation of instream structures to determine the immediate effects of the project.

9. Map the survey findings into GIS for future land management use.

B. Methods

The initial focus of this project will be the compilation and review of all available fisheries information relevant to salmon streams within the project area. Sources of information may include past studies, agency data bases, in-house reports, publications, and personal communication with local subsistence users and agency staff. The collected information will be cataloged by ADF&G stream number in an accessible format. After the information for streams in the study area has been compiled, the data will be evaluated and ten streams with the highest potential for habitat improvement will be identified.

During the summer of FY 1996, a fisheries biologist and two student interns will conduct habitat surveys in the ten selected streams. Habitat surveys will be conducted following the methods described by the USDA Forest Service Region 10 Stream Survey Protocol (Coghill 1996). The habitat types will be classified according to the descriptions in this methodology: rapid, riffle, glide, cascade, falls, backwater pool, dam pool, lateral scour pool, straight scour pool, trench pool, side channel pool, plunge pool and beaver pond. The survey will be conducted using one person to estimate habitat unit areas, one to record data, and another to measure habitat unit areas, depths, and spawning area. Every fifth pool, glide, or riffle will be measured with a 100' tape or stadia rod after the habitat is estimated visually. The measurements will be performed to obtain an accurate measure of the habitat area and to determine the accuracy of the estimator. Spawning area will be defined as sites with substrate 0.5 - 4.0 inches and less than 30% fine material (less than 0.1 inch or fine sand). Additional information that will be collected includes the number and sizes of Large Woody Debris within the channel, disturbances, channel type, harvest history, bank condition, riparian vegetation, substrate, and juvenile fish distribution. Baited minnow traps will be used to obtain species composition, lengths, relative abundance, and distribution of juvenile salmonids within each creek. In addition, coho population estimates will be calculated using habitat information collected during the stream surveys, following the methodology developed by Reeves et al. (1989). Snorkeling procedures (Thurow, 1994) will be used in FY 1997 and 1998 to monitor fish distribution pre- and post-structure installation to evaluate the immediate effects of the project.

After the habitat surveys are completed, the data will need to be analyzed to determine whether the estimates of the observers were reasonably accurate and precise. This will be performed by plotting the area estimates versus the corresponding measured areas on a graph to see how well the two are correlated. To test this relationship with the data, a simple linear regression will be performed for habitat distance estimates vs. their respective measured distances using the statistical package in Lotus 1-2-3. A correction factor will then be calculated by dividing the actual measurement of the habitat by the estimates made by each observer to obtain a better estimate of the true habitat areas (Dolloff et al. 1993, Hankin and Reeves 1988). Once the corrected habitat type areas are determined, the area for each habitat type will be totaled.

During the winter of FY 1997 and 1998, the field survey data will be analyzed to determine the habitat factors limiting the production of pink, chum, and coho salmon in the project streams. Based upon the limiting factors analysis and target salmon species, prescriptions will be developed for log structural habitat improvements in up to four of the project streams. These four streams will be representative of streams within the study area that offer the greatest opportunity for habitat improvement and the greatest likelihood of success. Work will occur in these representative streams in FY 1997 and FY 1998.

The actual instream work will take place in early summer, FY 1997 and 1998, to take advantage of lower flows in the creeks and to avoid working in streams when salmon are present. Work will be performed by two boat-based crews of four or five people using hand tools and small power tools such as chain saws, gas-powered drills, and a gas-powered winch. No vehicles or heavy equipment will be used. Work crews will construct and install various combinations of six structure types: diagonal log weir, wing deflector, log barb, tree top, erosion control structure, and upstream V check dam. These structures are designed to perform some or all of the following functions: reduce the

energy of the stream flows, reduce bedload movement, reduce erosion, stabilize the channel, create pools, or improve spawning habitat. The type of structure prescribed will depend upon the shape of the existing channel, type of fish habitat available, bank stability, stream flow, and substrate. At each site, the effects of the proposed structures will be considered to ensure that the structure will not cause erosion or other problems at either high or low flows.

Immediately following the installation of the structures, their locations will be mapped with GPS, and affected habitats will be measured for future monitoring. Pre-project habitat surveys will be compared to post-project habitat measurements to determine whether the desired objectives were achieved.
If results from FY 1996 indicate that there are few restoration needs on the surveyed streams, we propose to expand our habitat inventory along the coast to include Tatitlek Native lands. Project objectives will be the same as those listed for the Native Eyak lands.

During FY 1998, a final monitoring survey will be conducted on Eyak Native land structures to evaluate the effectiveness of the structures after being subjected to annual peak stream flows. Tatitlek Native land enhancement projects will be evaluated in FY 1999. Final report writing and data base management will also occur during FY 1999.

C. Contracts and Other Agency Assistance

This project will require a service contract with the private sector for a boat and operator to transport a four person field crew from Cordova to the project sites during FY 1997. This contract will involve approximately 30 field days of transportation for the work crew, and will also include providing meals and quarters for the crew. A similar contract will be required to transport the work crew during FY 1998.

Technical assistance from the Cordova Ranger District of the USDA Forest Service will be required for several aspects of this project. USFS assistance will include: NEPA and other environmental compliance, fisheries habitat technical expertise, habitat survey training, data management and analysis, and report writing.

SCHEDULE

A. Measurable Project Tasks for FY 97

Start-up March 16:	Compilation and review of existing information
March 16 - April 14:	Identify study streams
	Recruit student interns
March 15 - May 14:	Arrange logistics (boats, equipment, contracts, etc.)
May 27 - August 1:	Install restoration log structures on Eyak Native lands
	Conduct fisheries habitat surveys on Tatitlek Native lands
August - September:	Analysis of field data
April 1998:	Annual report on FY 97 work

B. Project Milestones and Endpoints

July 15, 1997	Improve salmon spawning and rearing habitat conditions through the installation of log structures in four eastern PWS streams on Eyak Native lands.
July 31, 1998	Improve salmon spawning and rearing habitat conditions through the installation of log structures in four eastern PWS streams on Tatitlek Native lands.
August 15, 1996/1997	Educate student interns in the concepts and application of fisheries habitat management.
April 15, 1998	Involve subsistence users from the Native Village of Eyak to the maximum extent possible.
April 15, 1999	Involve subsistence users from the Native Village of Tatitlek to the maximum extent possible.
September 30, 1996	Develop a baseline of information on existing wildstock salmon habitat conditions within the project area.
September 30, 1996/1997	Estimate potential coho populations from habitat calculations of the surveyed streams.
September 30, 1996/1997	Determine juvenile fish distribution within the surveyed streams.
September 30, 1997/1998	Determine fish distribution pre- and post-installation of instream structures to determine the immediate effects of the project.
April 15, 1999	Map the survey findings into GIS for future land management use.

C. Completion Dates

April 15, 1997	Annual progress report for streams surveyed on Eyak Native lands. (address field habitat surveys, analysis, and habitat improvement prescriptions)
April 15, 1998	Final report for Eyak Native lands. Annual progress report for streams surveyed on Tatitlek Native lands.
April 15, 1999	Final report for Tatitlek Native lands. (include GIS results of habitat information on all surveyed streams)

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

This project proposal has been closely coordinated with the fisheries staff of the Cordova Ranger District, USDA Forest Service. The Native Village of Eyak and Native Village of Tatitlek will apply similar restoration techniques that were used effectively by the Forest Service with the Montague Island Chum Salmon Restoration project (94139). Results from the Forest Service monitoring efforts on Montague Island will be incorporated into the habitat improvement prescriptions.

As indicated in the proposal for FY 1996, coordination and integration of restoration efforts is occurring among the Native Village of Eyak and the Native Village of Tatitlek for proposed work in FY 1997. Shared equipment, boats, and personnel are all options that are being explored for the FY 1997 and FY 1998 field work.

EXPLANATION OF CHANGES IN CONTINUING PROJECTS

1. The number of objectives has increased. Objectives that were added include the following:
   4. Involve subsistence users from the Native Village of Tatitlek to the maximum extent possible.

   6. Estimate potential coho populations from habitat calculations of the surveyed streams.

   7. Determine juvenile fish distribution within the surveyed streams.

   8. Determine fish distribution pre- and post-installation of instream structures to determine the immediate effects of the project.

   9. Map the survey findings into GIS for future land management use.

2. Due to the addition of habitat surveys on Tatitlek Native lands, the project will continue for one more year.

3. Methods have been modified to include Region 10 USDA Forest Service Stream Survey Protocol. These methods are similar to the methods that are proposed, however the Region 10 protocol provides a standard method of information collection that will allow information to be shared among Districts of the Forest Service. Additional methods will include collection of specific habitat data to calculate the potential coho populations for the surveyed streams (Reeves et al. 1989), the use of baited minnow traps to obtain juvenile fish distribution information, and snorkeling with an underwater camera to obtain photos of fish distribution pre- and post- installation of instream structures to determine the immediate effects of the project (Thurow 1994).

4. Increased costs. The improvement of salmon spawning and rearing habitat conditions through the installation of log structures on Native Village of Tatitlek lands (Objective 4) will add one more year of enhancement project costs which is estimated at $115,000. Objective 9, the mapping of survey

findings into GIS for future land management use will cost another $8000 of Personnel time for FY 1999.

PROPOSED PRINCIPAL INVESTIGATOR

David Schmid
USDA Forest Service, Cordova Ranger District
P.O. Box 280, Cordova, AK 99574
(907) 424-7661 (telephone)
(907) 424-7214 (Fax)

1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1996 - September 30, 1997

Budget Category:	Authorized FFY 1996	Proposed FFY 1997	LONG RANGE FUNDING REQUIREMENTS					
Personnel	$37.4	$50.5						
Travel	$0.0	$1.4						
Contractual	$45.0	$45.0						
Commodities	$0.8	$4.0						
Equipment	$0.0	$6.4						
Subtotal	$83.2	$107.3	Estimated FFY 1998	Estimated FFY 1999	Estimated FFY 2000	Estimated FFY 2001	Estimated FFY 2002	
General Administration	$8.8	$10.7						
Project Total	$92.0	$118.0	$115.0	$20.0				
Full-time Equivalents (FTE)		1.6						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments: Continuation of 96220.

1997

Prepared:4/10/96

Project Number: 97220
Project Title: Eastern PWS Wildstock Salmon Habitat Enhancement
Agency: USDA Foresat Service

FORM 3A
TRUSTEE
AGENCY
SUMMARY

4/15/96

1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1996 - September 30, 1997

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FFY 1997
Schmid	Project Leader	GS-11	0.7	5.0		3.5
Hodges	Asst. Project Leader	GS-9	1.5	3.5		5.3
C. Pearson	Crew Leader	GS-7	9.0	3.0		27.0
Seasonal	Fish Tech	GS-5	2.5	1.7		4.3
Seasonal	Fish Tech	GS-6	2.5	1.7		4.3
Seasonal	Fish Tech	GS-7	2.4	1.7		4.1
						0.0
						0.0
S. Maiyo			0.4	5.0		2.0
						0.0
						0.0
						0.0
	Subtotal		19.0	21.6	0.0	
					Personnel Total	$50.5

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FFY 1997
Evos conference RT, Cordova to Anchorage	200.0	1	2	225.0	650.0
RT Portland to Cordova	500.0	1	1	225.0	725.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$1,375.0

1997

Prepared:

Project Number: 97220
Project Title: Eastern PWS Wildstock Salmon Habitat Enhancement
Agency: USDA Foresat Service

FORM 3B
Personnel
& Travel
DETAIL

4/15/96

1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1996 - September 30, 1997

Contractual Costs:	Proposed
Description	FFY 1997
Boat contract, 30 days@ $1,500/day	45.0
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$45.0

Commodities Costs:	Proposed
Description	FFY 1997
construction supplies	0.9
Maintenance supplies	0.5
safety supplies	0.4
camp supplies	0.8
epoxy	1.0
fuel	0.4
Commodities Total	$4.0

1997

Prepared:

Project Number: 97220
Project Title: Eastern PWS Wildstock Salmon Habitat Enhancement
Agency: USDA Foresat Service

FORM 3B
Contractual & Commodities DETAIL

4/15/96

1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1996 - September 30, 1997

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FFY 1997
Husky data logger	1	2.5	2.5
grip hoist	1	1.3	1.3
come-along	2	0.2	0.4
hand tools	1	0.6	0.6
power jack	1	0.6	0.6
camp equip	1	1.0	1.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
Those purchases associated with replacement equipment should be indicated by placement of an R.		**New Equipment Total**	$6.4

Existing Equipment Usage: Description	Number of Units	Inventory Agency
computer, office equip, radios,boats,		

1997

Project Number: 97220
Project Title: Eastern PWS Wildstock Salmon Habitat Enhancement
Agency: USDA Foresat Service

FORM 3B
Equipment
DETAIL

Prepared:

4/15/96

DEVELOPING A TRUSTEE COUNCIL INFORMATION INFRASTRUCTURE SUBMITTED UNDER THE BAA

Project Number: 97221

Restoration Category:

Proposer: Mitretek Systems, McLean, Virginia

Lead Trustee Agency:
Cooperating Agencies:

Alaska SeaLife Center:

Duration: 1st year, 1-year task, multiyear project

Cost FY97: $199,975

Cost FY98:

Cost FY99:

Cost FY00:

Cost FY01:

Cost FY02:

Geographic Area:

Injured Resource/Service:

ABSTRACT

Mitretek Systems, proposes to assist the Exxon Valdez Oil Spill Trustee Council to develop an information framework and infrastructure that will serve the needs of the community of researchers, resource managers, educators, and local citizens involved in and affected by the restoration effort resulting from the *Exxon Valdez* oil spill. The purpose of this information infrastructure is to help maximize the benefit from the Trustee Council's investment in research, monitoring, restoration, and public education directed at understanding and restoring the northern Gulf of Alaska and Prince William Sound region affected by the oil spill.

INTRODUCTION

Mitretek Systems, proposes to assist in developing an information framework and infrastructure for the Exxon Valdez Oil Spill Trustee Council that will serve the needs of the community of resource managers, researchers, educators, and local citizens involved in and affected by the restoration effort resulting from the *Exxon Valdez* oil spill. The purpose of this information infrastructure is to help maximize the benefit from the Trustee Council's investment in research, monitoring, restoration, and public education directed at understanding and restoring the northern Gulf of Alaska and Prince William Sound region affected by the oil spill.

An effective information infrastructure is important in gaining understanding of the affected resources at the ecosystem level. These tools will help make maximum use of available data and information and will enhance the synergy of ideas among disciplines needed to understand the structure and function of the regional ecosystem and to achieve the Trustee Council goal of "restoring, replacing, enhancing or acquiring the equivalent of natural resources injured as a result of the oil spill."

Establishing an information infrastructure that is appropriate to the needs of research, education, and public outreach is an incremental process that builds on the analysis and understanding of each phase of system investigation, analysis and development. The system must be developed through a partnership of the researchers, resource managers and educators with environmental and information technology specialists. This is to assure that the systems implemented are best suited to serving the needs of the users, accomplishing the environmental goals of the Trustees, and incorporate the work environment of the people involved in the activities.

Mitretek Systems presents below a discussion of the value of an effective information framework and infrastructure. We then present a detailed proposal for carrying out the initial assessment and analysis phase in the process of developing and implementing such a system.

Mitretek Systems realizes that our proposed effort falls outside of the specific research clusters described in the *Invitation to Submit Restoration Proposals for Federal Fiscal Year 1997.* However, an effective information infrastructure is critical to maximizing the benefit of this research and helping assure that program and other data are utilized to the fullest to achieve the resource understanding and recovery, education, and public outreach that are the goals of the Trustee Council's efforts. Development of the infrastructure should occur in parallel with the environmental research so that the systems and tools are available for information sharing, improving data quality, enhancing data synthesis, and assuring the ability to meet the information needs of the Trustee Council.

Mitretek Systems is a nonprofit, public interest corporation formed to work with federal, state and local government and with other nonprofit , public interest organizations on technology-based programs. Mitretek Systems was incorporated in December 1995 as a result of a restructuring with The MITRE Corporation. Our principal capabilities include both information technologies and environmental systems.

Because the results of Mitretek Systems work can sometimes affect the welfare of individual companies and entire industries we must assure objectivity on the work performed. To avoid

conflict of interest, our extraordinary policies and controls include the following: we do not compete for contracts against commercial companies; we do not manufacture commercial products; and we do not take contracts from commercial companies. These corporate characteristics assure the Trustee Council that we will help develop an information infrastructure without a vested interest in the components of the system that is proposed or have a conflict of interest with other vendors or contractors involved in system implementation.

NEED FOR THE PROJECT

Statement of Problem

During the first five years of work, the Trustee Council has invested over $100,000,000 on research, monitoring, and general restoration activities, including $25,000,000 for design and construction of the Alaska SeaLife Center. The research has focused primarily on specific biological and other resources of Prince William Sound and the northern Gulf of Alaska. The purpose of this research has been to determine how these species and resources have been affected by the spill and to assess recovery. Recently, the Trustee Council has begun to turn the focus on an integrated ecological approach so that the effects of the spill and the long-term restoration and management of injured resources and services can be understood at the ecosystem level.

As the focus of the Trustee Council moves towards developing an ecosystem-level understanding, the ability to identify, obtain, manipulate, analyze, synthesize, and disseminate data easily across disparate hardware and software systems becomes of great importance. To understand the effects of the spill and the recovery processes occurring at the ecosystem level will require researchers to compare data sets, explore the interactions of the biological and physical components of the region, be able to determine the effects of restoration activities taking place, and build models of the natural and physical interactions occurring in the region. This activity will be data intensive and will require ready access to the information generated by Trustee Council-sponsored projects, to other data on the regional environment, and to data on the effects of oil spilled into similar environments elsewhere in the world. These data sources will be located world-wide.

Trustee Council data are used also to support education and public outreach activities. The purpose of these activities is to inform the public about the natural ecosystem; the sustainable and productive exploitation of the system for subsistence, income, and tourism; the effect of the oil spill on the ecosystem and dependent activities; and how Trustee Council initiatives are helping to understand ecosystem structure and function and to achieve restoration. For example, the Alaska SeaLife Center must be able to use the data in its activities of research and education.

The Trustee Council must make the most of the invested research dollars and be an effective steward of the resources entrusted to its care. An information framework and infrastructure is an important tool to manage data as an institutional asset, maximize information sharing, and meet the needs of the Trustee Council and the research, resource management, and education organizations involved in understanding the regional ecosystem and in restoring the populations and natural environmental goods and services of the affected region.

Considerations for an Information Framework and Infrastructure

A modern information infrastructure supporting the Trustee Council mission should provide easy access to a broad range of information, both research results and raw data. It should facilitate collaboration between researchers, management agencies and local communities; it should function across multiple platforms, geographic distances and time. In addition, this architecture should address a wide range of needs and present the various organizations and individuals with the information they need and in the form most useful to them. The architecture should make it easy for information providers to share their data and research; it should be easily searchable and provide information consumers access to relevant information. While information providers are also a primary user group, there are additional users, such as the local community and policy makers, who can also profit from access to information on restoration activities and research. This information might include research, related environmental and historical information, policy papers, educational material, some basic applications, and a wide range of processed and raw data, both textual and non-textual. The infrastructure must accommodate the varied user needs and content; it must provide an integrated view of the information space; and it must be distributed, flexible and adaptive.

The information framework and infrastructure are overarching components of all Trustee Council and other restoration activities. The infrastructure is an important tool to help attain the required understanding of the big picture of environmental effects and recovery at the ecosystem level. The Alaska SeaLife Center, with its multifaceted mission of research, education, public outreach, and visitor support could be the steward of the information infrastructure because of its cross-boundary mission. However, location of physical elements of the infrastructure may not be crucial if advantage is taken of modern networking and Internet technology. Location of system components would be an element of system formulation and design.

APPROACH

Many different approaches can be used to provide an information infrastructure to support the mission of the Trust. However, for the information infrastructure to successfully meet the needs of the users, the technology must be tailored to the needs of that user group. Following are alternative ways of looking at the problem.

Data Access

The simplest form of inter-project data reuse is to provide access to any project data environments by any other project's data user. This approach enables appropriate personnel on any project to become users of the data systems of other specific projects. Thus, a data user of one project can become aware of the data available in other relevant projects. Such a "remote" user would be limited to the types of uses of the project of interest data as defined by the applications associated with such a project. Unless the project of interest to the "remote" user supported data "export" capabilities, a "remote" user would not be able to incorporate data from other projects in his or her own project's data environment. If "export" capabilities existed, transformation and manipulation of exported data would probably be required on a case-by-case basis in order to import that data into the "remote" user's project data environment.

An information infrastructure supporting this simple inter-project data reuse would only require a metadata database (e.g. metadata repository), research and monitoring data systems, and query and browser. This approach can provide data users on each project with an understanding of what data are available in each of the other projects. It would also document points of contact for each project that could be contacted to arrange for access to data in other projects of interest. It could also document the export file format, if any is available, for each project's data environment so that users in other projects could understand export file formats. Such export file format documentation, in addition to documenting the file format itself, should also document the name, definition, format, and other data representation details necessary for a recipient of an export file to understand semantically and syntactically exactly what data are contained in the export file.

This approach, while providing inter-project access to data among projects, would only provide sharing of data among projects, if the data environments of the projects have data export and import capabilities. Even if they did, laborious case-by-case manipulations of data would be needed to move data among the projects. This information infrastructure could not be reasonably expected to support an integrated data environment necessary to support ecosystem-level projects.

Data Sharing

Another approach to inter-project data reuse builds upon the simple information infrastructure described above by adding standardized project data extract mechanisms to provide for true inter-project data sharing among projects. Data extracted from one project data environment could be loaded into other project data environment. These project data extracts are documented in the metadata repository and could be used on a defined periodic basis to "refresh" the recipient project data environments. Thus, data from any project could be truly shared on in an organized fashion among other relevant projects. The information infrastructure of this approach requires a metadata repository, research and monitoring data systems, project data extracts, and query and browsing users.

While providing inter-project access and sharing of project data, this approach still cannot support an integrated data environment necessary to support ecosystem-level views of data across projects.

Data Integration

A third approach to inter-project data reuse builds upon the information infrastructure just described by adding an information repository (warehouse) and related planning and decision support applications. This approach, rather than providing one-to-one data extracts among the projects, provides for project data extracts to a common data environment, i.e., the data warehouse.

Since the data warehouse would be explicitly designed to support an ecosystem level analysis of all the data received from source data systems (the research and monitoring project systems), applications can be developed to use the data in the data warehouse for systemic inter-project analysis of ecosystem perspective issues and to support Trustee Council level strategic planning

and decision making on resource allocation, monitoring of environmental restoration progress, and selection of restoration alternatives.

In any of these approaches to inter-project data reuse, the information infrastructure elements would be integrated and synchronized through a programmatic approach to enterprise-wide data management (i.e., coordinated data management activities across all Trustee Council activities). Additional information on components and technology that are available to support the development of an information infrastructure are described in the appendix.

INITIAL ASSESSMENT AND ANALYSIS

The initial step in the development of an information framework and infrastructure for the Trustee Council is to describe and analyze current information systems and to understand the goals, objectives and work environment of information users and producers. These data will be used to develop a proposed vision of the information infrastructure to be put in place and a strategy for implementing the proposed system. This task has four subtasks:

1. Determine current goals, objectives, and work environment of the Trustee Council and program participants.

2. Document current information infrastructure.

3. Develop a proposed information framework and infrastructure.

4. Develop a strategy for implementing the proposed information framework and infrastructure.

Subtask 1. Review Current Goals, Objectives and Work Environment of the Trustee Council and Program Participants

Mitretek Systems will review published information and work with appropriate program participants to review current program goals and objectives. These goals and objectives will be determined in the areas of ecosystem understanding and restoration, education, and public outreach. Mitretek Systems will also investigate the current way that research, education and public outreach activities are carried out and the context within which these activities take place. This subtask will define the work context to which any information infrastructure must be adapted to be of maximum effectiveness and define the goals that must be supported by the systems.

Subtask 2. Document Current Information Infrastructure

Mitretek Systems will develop a description of the information infrastructure currently in use by the Trustee Council, researchers, and other program participants. This will include hardware platforms, system and application software, network connectivity, and other features as determined. If useful, a diagram depicting overall system topology and connectivity and data processing flows may be produced. The survey will determine what data analysis and processing

are currently being carried out, where it takes place, and for what purpose. Currently used analysis software packages will be identified, and how they are being used to support the needs of the Trustee Council, researchers and program participants will be determined. This task will result in a baseline of the current capabilities of the systems in use, and their architectural characteristics and constraints, such as adherence to standards, and flexibility to interface with other architectures.

Mitretek Systems will identify the information sources and types of datasets available in the Trustee Council enterprise data environment. This information will be captured in a high level information model that describes the categories of data and the relationships among the categories. Additional information to be captured about the datasets includes metadata such as who owns it, in what database is it stored, what applications access it (update, analysis, query, etc.), and the currency of the data. The specific information to be obtained and recorded will be agreed to at the initiation of the project.

In addition, an "inventory" of the current technology base supporting the multiple data sets will be prepared. The information of interest includes data structure; data model type, database management system; platform and operating system; system, application, or database interfaces; and database size.

Mitretek Systems will assess the degrees of data redundancies, discrepancies, and deficiencies existing among the various databases and the effectiveness of the semantic and syntactic metadata documentation for the data for project data systems.

Information sources for this subtasks include documentation such as data dictionaries, repositories, data models, DDL, source codes, as well as discussions with the database owners or maintainers.

Based on its interviews and interaction with Trustee Council information systems staff and researchers, Mitretek Systems will develop a consolidated description of users of data in the Trustee Council sponsored enterprise. This assessment will include a discussion of what data analysis and processing are currently being done, where, and for what purpose. It will also identify what analysis software packages are currently being used and how they are used to support the needs of the Trust and its researchers.

Subtask 3. Develop a Proposed Information Framework and Infrastructure

The results of subtasks 1 and 2 and other data collected during this effort will be analyzed and the results used to develop a vision of a proposed framework and infrastructure that meets the needs of the Trustee Council and program participants.

Subtask 4. Develop Strategy for Implementing the Proposed Information Framework and Infrastructure

Working in close coordination with the Trustee Council, Mitretek Systems will develop a strategy for implementing the proposed framework and infrastructure. The strategy will identify those actions that can be implemented immediately, issues needing resolution phasing of the

effort, and Trustee Council decision points during the period of development, acquisition, and implementation.

Implementation of Subtasks

The Mitretek Systems team for this task will comprise domains of both information technology and environmental science and management. This team composition is important to assure that the proposed infrastructure is based on the needs of environmental researchers and educators and that the Trustee Council goals of ecosystem understanding and restoration remain paramount.

Data will be gathered by reviewing published information, by close personal interactions with Trustee Council members, state and federal resource managers, researchers funded by the Trustee Council, personnel with education and public outreach missions, and local community officials in the area affected by the spill.

Project Products

The final products of this analysis will be a briefing presenting the results of the analysis and a report documenting the results. These products will describe the current state of the information technology currently in use, the current data environment, current users of the Trustee Council sponsored enterprise, a proposed information framework and infrastructure, and a strategy for implementing the proposed system.

Schedule

Briefing of Findings	16 weeks after notice to proceed
Draft Final Report	4 weeks after briefing of results
Final Report	4 weeks after receipt of comments on draft report

PROFESSIONAL CONFERENCES

Mitretek Systems will work with the Trustee Council to determine if it is useful and appropriate to present the results and findings of the initial assessment phase at appropriate conferences. If presenting such information is determined to be in the best interests of the Trustee Council, Mitretek Systems will select appropriate conferences in consultation with the Trustee Council.

CAPABILITIES OF MITRETEK SYSTEMS

Information Systems and Technologies

Data Warehouse

Our specific Metadata Management consulting services include the following:

- Assure completeness of requirements
- Assess state of source operational systems
- Identify existing technological constraints and potential barriers
- Plan for incorporation of emerging technologies (e.g., data mining,
- Internet access)
- Select specific components based on meeting user requirements, not on vendor partnerships

Our data management client support activities have resulted in significant cost and performance improvements for our customers. In addition to our experiences with complex architectures, we have the following areas of expertise.

- Developed decision support applications
- Reengineered legacy databases
- Created heterogeneous data access
- Generated Strategic Research Plans
- Assessed Information Management Architectures

Metadata Repository

Our specific Metadata Management consulting services include the following:

- Metadata Management Scope Definition
- Metadata Users Identification
- Metadata Repository Implementation Alternatives Assessment
- Metadata Requirements Definition
- Metadata Repository Selection
- Metadata Utilization Process Definition
- Metadata Management Roles and Responsibilities Identification
- Metadata Repository Concept of Operations Definition

In addition to experience in all of these activities, we have the following areas of expertise:

- Reconciliation & Management of Disparate and Evolving Data
- Data Management Capability Assessment Model
- Metadata for Reconciliation
- Intranet-based Repository
- Metadata for Biological Databases
- Repository Vendor Product Knowledge
- National and International Data Management Standards

We actively participate in a number of key national and international data management related standards committees as well as data management related industry coalitions. This participation include the following:

- X3H4 "Open Repository Systems"
- X3L8 "Data Representation" standards committees
- "CASE Data Interchange Format" (CDIF) standards committee
- ISO/IEC SC14/WG 4 "Coordination of Data Element Standardization"
- Metadata User Council sponsored by the Data Warehouse Institute

Data Management Process

Our specific Data Management Process consulting services include:

- Data Management Maturity Assessment
- Comprehensive Data Management Program Design
- Data Management Organizational Design
- Specific Data Management Task Training
- Specific Data Management Process Definition

In supporting an enterprise in redefining its data management processes, we have applied some subset of the following activities, depending on the enterprises current state of data management:

- Data Management Capability Assessment
- Comprehensive Data Management Program Design
- Data Management Organizational Design
- Specific Data Management Task Training
- Specific Data Management Process Definition

In addition to experience in all of these activities, we have the following areas of expertise:

- Definition of Key Data Management Processes
- Industry State of Practice Database
- Data Management Process Improvement
- Data Management Organization Definition

Internet Network Environments

Our specific Internet network consulting services include:

- Distributed Object Interface Specification
- Training in Distributed Infrastructures
- Distributed Object Design and Development
- Security of Distributed Object Systems
- Defining a Distributed Infrastructure Architecture
- Establishing a Distributed Infrastructure
- Web Objects Internet Design and Development

In addition to the experience in all these activities, we have the following areas of expertise:

- IDL Framework
- Distributed Object Developer Oversight
- IDL Development and Prototype
- WWW and Distributed Objects Prototype
- EOSDIS Distributed Object Oriented Architecture
- CORBA Security
- Distributed Architectures Training

In addition to the capabilities summarized above, we also have extensive knowledge, capabilities, and experience in the following areas:

- Client-server Applications
- Decision Support
- Information Security
- Contractor Technical Oversight

Environmental Analysis and Systems

Mitretek Systems has been providing fovernment agencies with scientific research and technical analysis in the areas of environment, energy and space since 1969. Our current principal work areas in this Center are the following:

- Environmental analysis
- Waste remediation and minimization
- Risk assessment
- Environmental information analysis and management
- Energy systems analysis

Brief overviews of some examples of our experience in each of these areas is given below.

Environmental Analysis

Mitretek Systems has extensive experience with environmental impact analysis of activities and pollutants in the environment. A wide variety of impact causing activities have been studied. A number of these analyses have involved estuarine and nearshore coastal environments. These include onshore and offshore oil and gas exploration and production, petroleum pipeline construction and operation, nuclear and fossil fuel electric generating stations, wastewater discharges, drinking water processing systems, dredging and dredged material disposal, recreational and commercial boat marinas, coastal zone recreational developments, and military installation realignments and closures.

A specific example is Mitretek Systems support to the Department of Justice to determine the type and extent of mercury contamination released by an industrial facility to ground water and the surface water and sediments of Lavaca Bay, Texas.

Mitretek Systems is currently supporting the CIA and NOAA in investigations to determine the ability of classified remote sensing asset to provide environmental data to federal civil agencies with environmental missions and mandates. In this effort, we have supported the Government Applications Task Force established to determine these capabilities and a NOAA pilot project to demonstrate the utility of classified systems to provide data useful to managers of coastal resources.

Waste Remediation and Minimization

Mitretek Systems has been extensively involved in hazardous waste site remediation. This work has required a broad spectrum of skills in all aspects of the biological and physical environments and in human health issues.

We have supported several Department of Defense organizations. For the U.S. Air Force Center for Environmental Excellence remediation program for contaminated sites on Air Force bases, Mitretek Systems has contributed to project and program definition, decision and acquisition support, independent oversight and quality assurance of contractor work products, and project and program integration. We have supported the U.S. Navy in audits of contract laboratories performing sample analysis from contaminated sites. For the Army Corps of Engineers, we have performed design reviews for thermal treatment systems for contaminated soil.

Mitretek Systems has been active in pollution prevention activities. Mitretek Systems developed a systematic process for identifying, evaluating, and mitigating the use of hazardous materials for military weapons systems maintenance. This work was extended to system acquisition of aircraft weapons systems. Mitretek Systems also investigated specific pollution prevention opportunities, such as alternatives to chrome plating requirements.

Risk Assessment

Mitretek Systems has expertise in both human health and ecological risk assessment. Mitretek Systems personnel served on the ASTM committee developing ecological risk assessment standards. We have served our Defense Department clients as an independent reviewer of ecological and human health risk assessments prepared by contractors as part of contaminated site characterizations.

Mitretek Systems has supported the Food and Drug Administration in the review of toxicological information used in developing regulations for food and cosmetic ingredients, additives and contaminants. Mitretek Systems also has conducted new drug application reviews, the only nongovernmental organization to carry out such review.

Environmental Information Analysis and Management

Mitretek Systems has developed and implemented systems for the effective management and use of environmental information. An example of this is the technical information system that we developed for McClellan Air Force Base. This system integrated commercially available hardware and software, such as geographic information systems and data visualization software, with a user friendly interface to allow the effective analysis of the vast quantity of ground water

and soil contamination data that was being gathered during investigations of contaminated sites on the base.

Energy Systems Analysis

Mitretek Systems has extensive experience with technology assessments of conventional and alternative energy systems. Mitretek Systems has worked with almost all types of energy systems over the years. Our most recent work has been focused on coal liquifaction and the production of liquid fuels from natural gas. We are also developing methodologies for estimating world energy demand.

APPENDIX

Elements of an Information Infrastructure

A variety of information infrastructure components and technologies are available that can be combined to provide varying degrees of service in executing the capabilities described above. These include the following:

- Information warehouse
- Metadata repository
- Existing data systems
- Data extracts from existing data systems
- External data sources
- Strategic planning and decision support applications
- Data query and browsing tools
- Internet-based communications and information access applications
- Enterprise wide concepts for data management

Figure 1 is an example of what could be developed as an information infrastructure using these elements. While information infrastructure needs of the Trustee Council-sponsored research, monitoring, and restoration enterprise remain to be determined, Figure 1 is presented here for purposes of providing a map of the possible elements of such an infrastructure. Each of these elements is briefly explained in terms of their information technology purposes as well as their benefit to the Trustee Council-sponsored enterprise. Following the explanation of the elements of an information infrastructure, three of many options for an information infrastructure architecture are described in terms of their component elements and the data reuse capabilities each provides to researchers and other Trustee Council enterprise participants.

Information Warehouse. The information warehouse provides a coherent, integrated data environment within which to store the data from the disparate research and monitoring projects' data systems that is necessary to construct the comprehensive ecosystem view of the various sets of project data. It provides a consistent time synchronized data environment (integrating data from many source systems) that can support strategic planning and decision making, as well as provide the coherent, systemic view of the available data necessary to systemic environmental research and analysis purposes. The information warehouse contents and data structures would be stored in a metadata repository for reuse over time.

Such an information warehouse can provide a new use of available data: an ecosystem view of data available from the various Trustee Council sponsored research, monitoring and restoration projects.

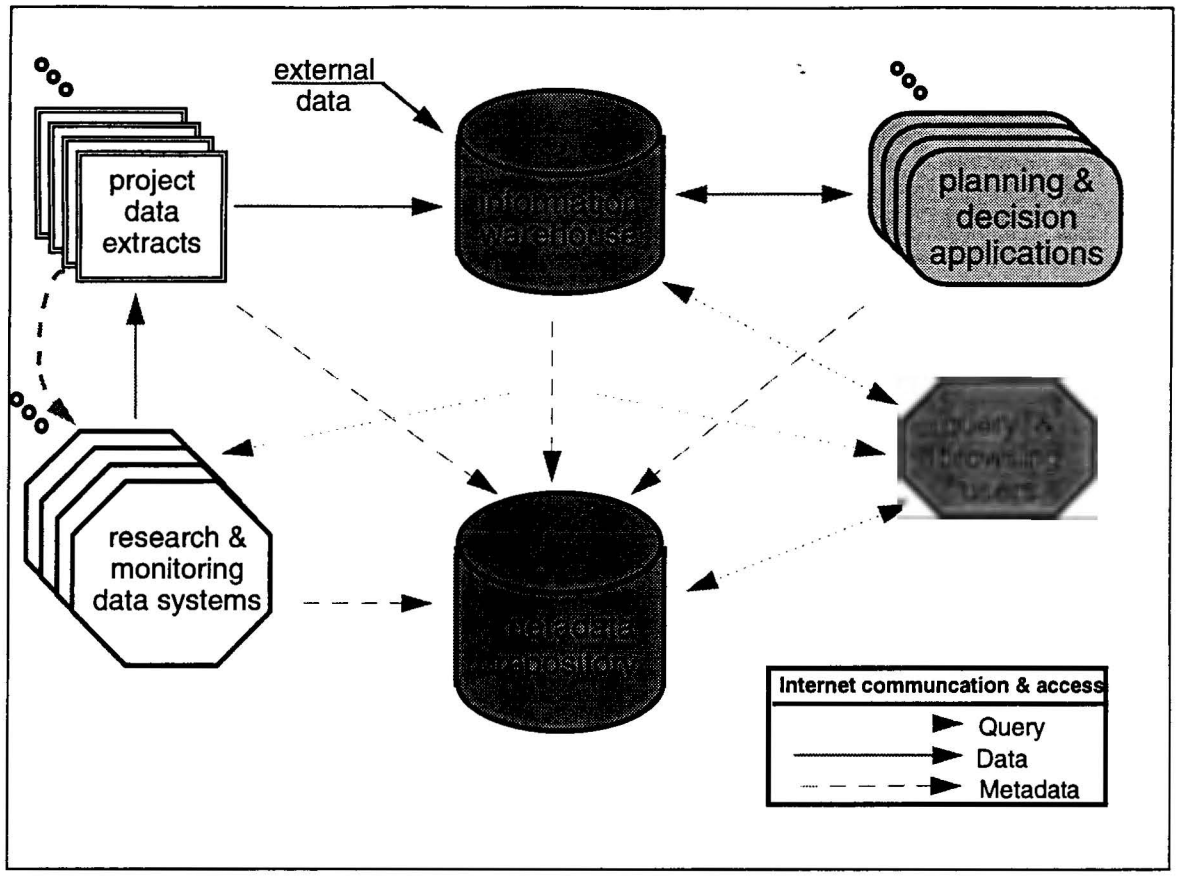


Figure 1 Possible Elements of a Trustee Council Information Infrastructure

Metadata Repository. The metadata repository, at a minimum, provides comprehensive documentation of all data available to an enterprise. This documentation would, over time, record metadata (data about data) for all data elements available in the enterprise, including, names, definitions, formats, sources, 'owners', etc. Such information documents the inventory of all data available to the organization. A minimal metadata repository, called a data registry, records such data element documentation. A robust metadata repository can record many other informational representations of the enterprise, such as database or file locations of data elements; database structures; applications' data models, process models, and source code; organizational structures; goals and objective; plans; and data interfaces between applications and between source data systems and a data warehouse. The metadata repository is the master information 'directory' for the enterprise

A metadata repository (or data registry) could be used by environment researchers and analysts to understand what data is available within the Trustee Council sponsored enterprise and facilitate access to it. It would also be used by developers to facilitate development of analytic, planning, and decision support applications; and a data warehouse.

Existing Data Systems. Existing data systems contain a wealth of data. However, typically, this access to such data is constrained by the native data systems in which it resides. Gaining access to this data, sharing it, or integrating it into a more comprehensive data environment is key to

leveraging the value of the data to the enterprise. Appropriate documentary information about the data of existing systems would be stored in the metadata repository for reuse over time.

The various research and monitoring projects sponsored by the Trustee Council are sources of a wealth of data that can be reused across Trustee Council projects or integrated into an ecosystem view of the evolving environment resulting from the Exxon Valdez spill. Providing access to, sharing, or integrating this data across projects leverages its value in addressing inter-project issues and ecosystem solutions.

Data Extracts from Existing Data Systems. To reuse or share data across existing data systems of an enterprise or integrate it into a more comprehensive data environment (such as a data warehouse) requires development of data extract mechanisms that capture the data from existing source systems, accomplish any required transformations or manipulations required to move it into other systems' data stores or a data warehouse, and electronically move it.

Data appropriate to the ecosystem view of the Exxon Valdez oil spill would be extracted from each of the native research and monitoring projects' data systems. Such extraction would entail manipulation and transformation of the native systems' data into a form suitable for loading into the information warehouse.

External Data Sources. In today's increasingly open systems environment, electronic availability of data from external sources is exploding. As a result, organizations are finding added value in incorporating such electronically available data in their own enterprise data environment.

Other data sources outside of the Trustee Council sponsored Exxon Valdez spill enterprise may prove useful to the Trustee Council's enterprise, e.g., the Environmental Protection Agency' databases. The Environmental Protection Agency has embarked upon a comprehensive program to make their data available to the public via the Internet. Thus, the Trustee Council's Information Infrastructure should be able to acquire such information and incorporate it into their overall ecosystem data set.

Strategic Planning and Decision Support Applications. The data systems of most organizations are oriented to accomplishing day-to-day operational activities. Accessing this data to support enterprise level strategic planning and decision support is difficult due to the many different data formats and different semantics of the operational systems. Much of the data in the operational systems can be useful to strategic needs. Organizations that have brought such data together into a common, integrated environment have been able to develop sophisticated strategic analysis, planning, and decision support applications that help to better allocate resources, monitor progress, and understand strategic issues.

Bringing the data from Trustee Council sponsored research and monitoring projects, and from external data sources, can facilitate routine structured analysis of this data from an ecosystem perspective and improve planning and decision making processes for resource allocation to research, monitoring, and restoration projects.

Data Query and Browsing Tools. Data query and browsing tools are available that permit focused investigation and analysis of specific issues from a variety of data sources. These tools support finding and retrieving data that is constrained by user specified dimensions or domains so that investigators can work with data specifically relevant to their needs.

Data users of every type in the Trustee Council sponsored enterprise should have query and browsing tools available that permit them to accomplish ad hoc queries and browse available data using natural language interfaces provided by query and browsing tools so that they need not be 'computer literate.' Such capability will allow them to obtain information suited to their research, monitoring, or restoration efforts with minimum of effort.

Internet-Based Communications and Information Access Applications. Use of client-server based Internet technology (e.g., Web servers, browser software, web creation tools, local and wide area networking, etc.) can provide a very robust, but relatively low cost, communications and information access capability for an organization. Internet based tools and techniques are expanding at a very swift pace; so fast that 'home grown' network communications services and user interfaces cannot hope to keep pace.

An Internet-based approach to the Trustee Council sponsored Exxon Valdez enterprise communications and information access can provide a low cost, very robust solution for accessing, moving, sharing, and integrating data among the sponsored projects; sharing data with related research efforts; and disseminating information to the public.

Enterprise-Wide Data Management Concepts. Modern data management concepts have evolved from managing data within a data system, or a functionally defined area of endeavor, to managing data across all data systems, functions, and databases of the enterprise. Such an approach to managing data facilitates sharing and integration of data throughout the enterprise and external to the enterprise. New concepts such as data representation standards, data stewardship, data warehousing, enterprise metadata repositories, and enterprise data architectures have been developed to support enterprise-wide data management. Mitretek Systems has synthesized these and many other data management concepts into a programmatic model of the enterprise data management process.

1997 EXXON VALDEZ TRUS COUNCIL PROJECT BUDGET

October 1, 1996 - September 30, 1997

Budget Category:	Authorized FFY 1996	Proposed FFY 1997							
Personnel		$62,538							
Travel		$36,291							
Contractual		$2,686							
Commodities		$0							
Equipment		$0	LONG RANGE FUNDING REQUIREMENTS						
Subtotal	$0.0	$101,515	Estimated FFY 1998	Estimated FFY 1999	Estimated FFY 2000	Estimated FFY 2001	Estimated FFY 2002		
Indirect		$98,463							
Project Total	$0.0	$199,978							
Full-time Equivalents (FTE)		0.0							
	Dollar amounts are shown in thousands of dollars.								
Other Resources									

Comments:

Indirect costs consist of Overhead, General and Administrative, Cost of Money and Fee.
All the above costs and be seen on the submitted proposal in greater breakout detail.

1997

Prepared:

Project Number: 97221
Project Title:
Name:

FORM 4B
Non-Trustee
SUMMARY

Personnel Costs:				Months		Monthly		Proposed
	Name	Position Description		Budgeted		Costs	Overtime	FFY 1997
	Department H050	Technical Staff		6		$9,631		$57,786
	Department H050	Other Exempt		6		$254		$1,524
	Department H050	Non-Exempt Clerical		6		$538		$3,228
		Subtotal		18.0		10,423.0	0.0	
							Personnel Total	$62,538

Travel Costs:		Ticket	Round	Total	Total	Daily	Proposed
	Description	Price	Trips	Staff	Days	Per Diem	FFY 1997
	Washington, DC to Juneau, Alaska	2400	1	3	5	148	$9,714
	Juneau, Alaska to Anchorage, Alaska		1	3	5	138	$2,256
	Anchorage, Alaska to Fairbanks, Alaska		1	3	4	123	$1,620
	Washington, DC to Seattle, WA	827	1	3	6	117	$4,968
	Washington, DC to Seattle, WA	827	1	1	6	117	$1,656
	Washington, DC to Anchorage, Alaska	1637	1	2	6	138	$5,188
	Washington, DC to Anchorage, Alaska	1637	1	4	4	138	$9,024
	Local Travel and Conference fees						$980
	Travel Inflation						$885
						Travel Total	$36,291

1997

Prepared:

Project Number:
Project Title:
Name:

FORM 4B
Personnel
& Travel
DETAIL

1997 EXXON VALDEZ TRU COUNCIL PROJECT BUDGET

October 1, 1996 - September 30, 1997

Contractual Costs:	Proposed
Description	FFY 1997
Publications and Graphics	$1,680
Subcontract and Other Direct	$1,006
Contractual Total	$2,686.0

Commodities Costs:	Proposed
Description	FFY 1997
Commodities Total	$0.0

1997

Prepared:

Project Number:
Project Title:
Name:

FORM 4B
Contractual &
Commodities
DETAIL

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

Existing Equipment Usage: Description	Number of Units	

1997

Prepared:

Project Number:
Project Title:
Name:

FORM 4B
Equipment
DETAIL

Chenega Bay Salmon Habitat Enhancement (Stream 667 Fish Pass).

Project number:	97222
Restoration Category:	General Restoration
Proposer:	USFS
Lead Trustee Agency:	USFS
Cooperating Agencies:	ADF&G
Duration:	2nd year, 2-year project
Cost FY 1997:	$78,800
Cost FY 1998:	$7,500
Cost FY 1999:	
Cost FY 2000:	
Cost FY 2001:	
Cost FY 2002:	
Geographic Area:	Prince William Sound
Injured Resource:	Subsistence

ABSTRACT

Subsistence use of resources in the EVOS area declined following the spill in 1989. Unlike many of the other oil spill communities, subsistence harvest levels in Chenega Bay have not returned to prespill levels. This project seeks to help the recovery of subsistence users in Chenega Bay by installing a fish pass in Stream 667 (known both as Anderson Creek and O"Brien Creek). This creek is flows through the community of Chenega Bay but is inaccessible to salmon because of a waterfall just above the upper intertidal zone. Installation of a fish pass at the waterfall would allow chum and coho salmon access to spawning and rearing habitats in the creek and would increase the number of salmon available for subsistence use.

INTRODUCTION

Subsistence activities for residents of Prince William Sound have been severely disrupted by the Exxon Valdez Oil Spill, and none more so than the subsistence activities for residents of Chenega Bay. While subsistence harvest levels in many of the communities have returned to pre-spill levels, harvest levels at Chenega Bay are still reduced (Seitz and Fall, 1995). Providing subsistence opportunities that are easily accessible to the residents of Chenega Bay would help subsistence users recover from the effects of the oil spill.

ADF&G stream number 667 is located in the village of Chenega Bay, and would provide easy access to subsistence activities. The common name for this creek appears to vary, therefore, this proposal will refer to the creek as Stream 667. This project seeks to increase salmon production in Stream 667 by installing a fish pass over a barrier fall located near the upper intertidal zone. This project began in FY96 with a feasibility study; the field work for the feasibility study is expected to be completed in August of 1996. Although this proposal is written prior to the 1996 field season, it is anticipated that it will be feasible to install a fish pass and improve migration of salmon over the waterfall.

Relatively little information is available on salmon use in this creek because it has not been monitored for escapement by Alaska Department of Fish and Game. However, initial discussions with local residents suggest that chum (*Oncorhynchus keta*) and coho (*Oncorhynchus kisutch*) salmon are occasionally caught in the reaches below the falls and pink salmon (*Oncorhynchus gorbuscha*) are abundant in the intertidal areas (D.Kompkoff, personal communication 1996). Therefore, the feasibility study will consider installing a fish pass that would improve access for chum as well as coho salmon. Stream 667 was identified and recommended as a potential fish pass site in the Prince William Sound-Copper River Comprehensive Salmon Plan, phase II 5-year plan (1986-1991).

This proposal seeks to implement installation of the appropriate fish pass design determined during the feasibility assessment. Because these data are not available at this time, an updated proposal will be provided for review in November, 1996.

NEED FOR THE PROJECT

A. Statement of Problem

Subsistence use of resources in the EVOS area declined following the spill. Although restoration studies have shown that overall harvest levels have since returned to prespill levels in most oil spill communities, Chenega Bay and Tatitlek are exceptions (Seitz and Fall, 1995; Seitz and Miraglia, 1995). These communities showed reduced harvest levels in 1993/94 and a corresponding increased reliance on salmon harvests (Seitz and Fall, 1995; Seitz and Miraglia, 1995). In addition, the *Exxon Valdez* Restoration Office's Invitation to submit proposals for FY97 stated that subsistence users are traveling greater distances and invest more time in subsistence harvesting than they did prior to the spill. Stream 667 flows through Chenega Bay

and provides for the implementation of a restoration project that would be accessible to all Chenega Bay residents.

B. Rationale/Link to Restoration

The installation of a fish pass on Stream 667 will directly benefit the subsistence users of Chenega Bay by increasing the number of salmon that could be harvested from the creek. The fish pass will allow for chum and coho salmon to access the creek for spawning and rearing. Based on information from the oil spill channel typing data, Stream 667 has approximately 1400 meters of channel types that are considered suitable salmon habitat. Detailed information on the availability of spawning and rearing habitats will be collected during the 1996 feasibility phase of the project.

C. Location

This project is located in ADF&G stream number 667, in Crab Bay on Evans Island, Prince William Sound. The creek flows through the village of Chenega Bay.

COMMUNITY INVOLVEMENT

This project was initiated at the request of the Chenega Bay IRA Council. Community involvement is planned as an integral part of all stages of this project. The 1996 feasibility assessment will involve the residents of Chenega Bay to gain local knowledge of existing escapement levels on the stream. Children from Chenega Bay and other communities will be involved in conducting the stream survey of the creek and we are looking for opportunities to include other residents during the preliminary design and feasibility assessment of the creek.

The Forest Service intends to use ANILCA Local Hire Authority to hire local residents for installation of the fish pass in 1997. After installation, it is anticipated that Chenega Bay residents will be responsible for maintaining and monitoring the fish pass with assistance by the Forest Service. Coordination with the Youth Area Watch Program (96210) was begun in 1996 to explore the possibilities of future involvement with this project. Potential opportunities include conducting escapement counts and monitoring the juvenile salmon populations.

PROJECT DESIGN

A. Objectives

1. Investigate the feasibility of installing a fish pass on Stream 667 to increase salmon availability for subsistence harvest.

2. Install a fish pass on Stream 667 to provide access to additional spawning and rearing habitats.

3. Involve residents of Chenega Bay in the planning, survey, design and implementation of the project.

B. Methods

Feasibility Assessment (FY96): During 1996, residents of Chenega Bay will be interviewed for information on fish runs in Stream 667. This information will be helpful in understanding the historical use of the system. The interviews will be followed by an inventory of spawning and rearing habitat using a modified Hankin and Reeves (1988) procedure which provides quantitative measurements of habitat types. Stream reaches are divided into habitat types based on flow patterns and channel bed shape (pools, riffles, glides etc). Physical parameters of the habitat types would be measured or estimated and descriptions of substrates and available cover will be recorded. This information will also be used to update existing channel typing information for Stream 667.

Live traps will be used to determine the presence, and extent, of fish species already using the creek. There is the potential that Dolly Varden and cutthroat trout are present. These species were injured as a result of the oil spill; therefore, if they are present an evaluation of the effects of this project would need to be considered.

In 1996, a site survey will be conducted at the barrier falls and a preliminary design for a fish pass will be developed.

Fish pass installation: An updated proposal which includes details such as the size of the fish pass and the extent of the work required to install the fish pass will be provided to the Trustee Council after the 1996 field season is completed. This section outlines some of the steps that would be taken to install any type of fish pass.

Forest Service fisheries engineers will develop a formal blue-print design for the fish pass based on surveying data and the preliminary design developed in FY96. Appropriate permits will be obtained (i.e. US Army Corps of Engineers - 404 permit, and the State of Alaska's Coastal Project Questionnaire). The actual installation of the fish pass will be done in the summer of 1997 when stream flows are low and salmon and their eggs are not present. To the extent possible, residents of Chenega Bay will be hired to install the fish pass.

Monitoring and Maintenance: Project monitoring and maintenance of the structure will occur in the years following the installation of the fish pass by residents of Chenega Bay and by the USFS. Increases in salmon production and subsistence use will be documented. The creek will be walked on a yearly schedule to document escapement levels. Subsistence harvest will be documented by the residents of Chenega Bay. Forest Service biologists will work with Chenega Bay residents to develop a schedule and methods for the residents to use when conducting escapement surveys.

C. Cooperating Agencies, Contracts, and Other Agency Assistance

The Alaska Department of Fish and Game will provide assistance during the development of the environmental analysis and escapement monitoring. Coordination with the PWS Regional Planning Team will occur so that this project can be incorporated into their management planning for Prince William Sound.

SCHEDULE

A. Measurable Project Tasks for FY97

Oct.-Nov:	Update project proposal with details from the feasibility assessment and preliminary design developed in FY96.
Dec. - Jan:	Apply for appropriate permits; begin formal engineering project design
Jan. 22-25:	Attend Annual Restoration Workshop
Feb. - May:	Finalize fish pass design; prepare for field season
April 15:	Submit annual report
May - July:	Install fish pass
Aug. - Sept:	Begin escapement survey monitoring program
Sept. 30:	Final Report

B. Project Milestones and Endpoints

Survey, design, and environmental compliance will be completed in 1996 and all construction work on the project would be completed in 1997. Monitoring of the success and maintenance of the structure will be conducted by people from Chenega Bay with assistance from the USFS.

Oct. 15, 1996:	NEPA compliance completed
July 15, 1997:	Installation of the fish pass completed
Sept. 30, 1997:	Final Report

C. Completion Date

The project completion date will be at the end of FY97.

PUBLICATIONS AND REPORTS

Annual reports will be prepared during each year of the project and preliminary reports on the feasibility assessment will be provided to the Trustee Council in late November 1996. NEPA compliance should be completed with the Final EA prepared in September 1996. The final report for the project will be submitted in October 1997.

NORMAL AGENCY MANAGEMENT

This project is on Chenega Bay land which is not managed by the Forest Service. The Forest Service has experience in the design and installation of fish passes in Alaska, but would not generally work on land not managed by the agency.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

Coordination with the Youth Area Watch Program (96210) was begun in 1996 to explore opportunities for future involvement with this project. Through the Chugach School District, children from Chenega Bay and other communities will be involved in conducting the stream survey of the creek in 1996, and the Youth Area Watch Program may be involved in escapement surveys in 1997 and beyond.

EXPLANATION OF CHANGES IN CONTINUING PROJECTS

There are no significant changes in this proposal from the proposal submitted for FY96. Additional information is provided; however, the detailed information needed to evaluate the cost and design of the proposed fish pass will not be available until after the 1996 feasibility assessment is completed. An updated proposal will be provided in November 1996.

PROPOSED PRINCIPAL INVESTIGATOR

The principal investigator of this project will be the Fisheries Biologist at the Glacier Ranger District of the Chugach National Forest. This position is currently vacant and expected to be filled in FY96.

_____ (Fishery Biologist)
Glacier Ranger District
Chugach National Forest
P.O. Box 129
Girdwood, AK. 99587
(907) 783-3242

PERSONNEL

Daniel Gillikin (Fisheries Biological Technician; Glacier Ranger District) will provide technical support and field coordination of the seasonal employees assisting in data collection for the project. Randy Shrank will provide surveying expertise; Vanessa Aloa-Macleod or another Forest Service fisheries engineer will oversee the engineering design; field crews will be seasonal employees and volunteers.

LITERATURE CITED

ADF&G. 1992. An atlas to the catalog of waters important for spawning, rearing or migration of anadromous fishes, South central Region, Resource Management Region II. Alaska Dept. of Fish & Game. Anchorage.

EVOSTC. 1994. *Exxon Valdez* oil spill restoration plan. *Exxon Valdez* Oil Spill Trustee Council. Anchorage.

Hankin, D.G and G.H. Reeves. 1988. Estimating total fish abundance and total habitat area in small streams based on visual estimation methods. Can. J. Fish. Aquat. Sci., Vol. 45: 834-844.

Nickerson, R. 1978. Identification of fish hatcheries, aquaculture sites, habitat & species enhancement projects in Prince William Sound. Alaska Dept. of Fish & Game. Cordova.

PWSRPT. 1983. Prince William Sound - Copper River comprehensive salmon plan, phase I - 20 year plan (1983-2002). Prince William Sound Regional Fish. Plan.Team. Cordova.176 pp

Seitz, J. and J.A. Fall. 1995. Tatitlek. In: Fall, J.A and C.J. Utermohle, (eds). *An investigation of the sociocultural consequences of outer Continental Shelf development in Alaska; II. Prince William Sound.* MMS 95-011; Technical Report No. 160.

Seitz, J. and R.Miraglia. 1995. Chenega Bay. In: Fall, J.A and C.J. Utermohle, (eds). *An investigation of the sociocultural consequences of outer Continental Shelf development in Alaska; II. Prince William Sound.* MMS 95-011; Technical Report No. 160.

1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1996 - September 30, 1997

Budget Category:	Authorized FFY 1996	Proposed FFY 1997	LONG RANGE FUNDING REQUIREMENTS					
			Estimated FFY 1998	Estimated FFY 1999	Estimated FFY 2000	Estimated FFY 2001	Estimated FFY 2002	
Personnel	$10.4	$57.1						
Travel	$0.0	$0.0						
Contractual	$3.2	$6.8						
Commodities	$0.7	$5.9						
Equipment	$0.0	$0.0						
Subtotal	$14.3	$69.8						
General Administration	$1.8	$9.0						
Project Total	$16.1	$78.8	$7.5					
Full-time Equivalents (FTE)	0.2	1.4						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments: Project is a continuation of 96222.

NOTE: **Project costs are estimates and will change once a design is developed.** A final budget will be ready for the August TC meeting.

1997

Prepared:4/10/96, K. Holbrook

Project Number: 97222
Project Title: Chenega Bay Salmon Restoration
Agency: USFS

FORM 3A
TRUSTEE
AGENCY
SUMMARY
4/15/96

1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1996 - September 30, 1997

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FFY 1997
Vacant	Fish Biologist	GS-9	1.0	4.2		4.2
D. Gillikin	Fish Tech	GS-9	4.0	4.2		16.8
Vacant	Engineer	GS-11	2.5	5.1		12.8
Vacant	Engineer Tech	GS-6	1.0	3.0		3.0
Vacant	Construction Foreman	GS-11		7.0		0.0
Seasonal	Labor (local hire)	GS-5	6.0	2.5		15.0
Seasonal	Fish Tech	GS-5	1.5	2.5		3.8
Vacant	Archaeologist	GS-11	0.3	5.1		1.5
	Blaster	GS-11		5.1		0.0
						0.0
						0.0
						0.0
	Subtotal		16.3	38.7	0.0	
					Personnel Total	$57.1

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FFY 1997
RT Sitka to Anchorage	500.0			225.0	0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$0.0

1997

Prepared:

Project Number: 97222
Project Title: Chenega Bay Salmon Restoration
Agency: USFS

FORM 3B
Personnel
& Travel
DETAIL

4/15/96

1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1996 - September 30, 1997

Contractual Costs:	Proposed
Description	FFY 1997
Air charter (12hours @ $400/hr	4.8
Living Quarters (20 days @ 1,000/day	?
Barge	2.0
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$6.8

Commodities Costs:	Proposed
Description	FFY 1997
WCF boat fuel	0.5
WCF truck fuel	0.2
field food	0.2
fishpass	?
construction supplies	?
office supplies (printing, blue prints)	3.0
misc.	2.0
Commodities Total	$5.9

1997

Prepared:

Project Number: 97222
Project Title: Chenega Bay Salmon Restoration
Agency: USFS

FORM 3B
Contractual & Commodities DETAIL

4/15/96

1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1996 - September 30, 1997

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

Existing Equipment Usage: Description	Number of Units	Inventory Agency

1997

Project Number: 97222
Project Title: Chenega Bay Salmon Restoration
Agency: USFS

FORM 3B
Equipment
DETAIL

Prepared: 4/15/96

Integration and Publication of Pre- and Post-Spill Data on Sea Otter Reproduction, Survival, Development, and Health; Submitted Under the BAA No. 52ABNF600073

Project Number: 97223-BAA

Restoration Category: Research and Monitoring

Proposer: Lisa M. Rotterman, Ph.D. and Charles W. Monnett, Ph.D., Enhydra Research

Lead Trustee Agency:

Cooperating Agencies:

Alaska SeaLife Center:

Duration: FY 97, 1st year, 1-year project

Cost FY 97: $73,766

Cost FY 98:

Cost FY 99:

Cost FY 00:

Cost FY 01:

Cost FY 02:

Geographic Area: No Fieldwork

Injured Resource/Service: Sea Otters and the Nearshore Ecological Community

ABSTRACT

This project will result in publication of: a) new analyses, integration, and comparison of unpublished, directly comparable, pre- and post-spill data on the reproduction, development, survival, habitat use, and movements of sea otter females, pups, and weanlings; b) generation of benchmarks against which to gauge sea otter population status relative to recovery; c) new information on habitat acquisition benefits; and d) information key to evaluating response strategies.

INTRODUCTION

Sea otters were severely impacted by the T/V *Exxon Valdez* oil spill (EVOS) and could not yet have recovered fully from the impacts of the spill. Their current status relative to recovery is unclear, and they are listed as "not recovering" in current Trustee Council publications. This project would:

1) Result in significant advances in the level and availability of knowledge concerning the impacts of the EVOS on sea otter reproduction, survival, development, and health.

2) Provide benchmarks for key developmental variables and population parameters against which the current status of the population relative to total recovery can be gauged, including benchmarks on body condition, growth, reproductive rates, and survival rates.

3) Provide information on sea otter habitat use valuable in guiding habitat acquisition.

4) Provide information necessary for formulating future response policy.

No new field work or data acquisition is proposed in this project. Rather, the investigators propose to expand analyses of unpublished post-spill data and to analyze and integrate unpublished pre-spill baseline data in order to achieve the best, most complete understanding of the spill's impacts on sea otters, and to produce the benchmarks and information listed above. Culmination of the project will be the preparation of manuscripts, and the publication in the primary scientific literature of 8 papers, containing many new, and all previously unpublished, data and findings.

Pre-spill and post-spill data are from the investigators' studies between May 1984 and Nov. 30, 1991 in both Eastern Prince William Sound (EPWS) and western Prince William Sound (WPWS).

A. Relevant Background

Dr. C. Monnett and Dr. L. Rotterman, who will undertake this project, began studies of sea otter development, reproduction, survival, population structure, behavior, growth, body condition, and movements in 1984. They pioneered large scale studies, including radio-telemetry studies and growth studies, of sea otter pups and weanlings, conducting studies in both eastern and western PWS. In 1987, they initiated a comprehensive study of adult female reproduction, survival, body condition and movements. When the spill occurred, they were halfway through a study of 59 radio-instrumented sea otter females.

The proposers were the Principal Investigators on key sea otter damage assessment studies. Between 1989 and Nov. 30, 1991, they conducted year-round intensive field studies, including studies

of: 1) female reproduction, health, and survival (PI: C.M.); 2) post-weaning survival (PI: L.M.R.); 3) movement patterns (PI: C.M.); 4) determination of the fate of sea otters released from EVOS treatment centers (PI: C.M.); 5) blood chemistry and hematology of adult females and weanlings (PI: L.M.R.); and 6) pre- and post-spill aerial (and to a lesser extent, boat) marine mammal surveys in Prince William Sound (using funding from the Mineral's Management Service). No funding, beyond data collection, was provided for the survey study, the findings from which the proposers summarized in a draft report in 1989.

These post-spill studies, which were unprecedented in both scope and content, were highly successful resulting in the acquisition of key information on the spill's impacts on sea otters. Dr. Monnett and Dr. Rotterman captured hundreds of sea otters, radio-instrumented 100 adult females and 64 pups, monitored 45 radio-instrumented otters from the treatment centers, and collected samples and carcasses for studies of toxicology, pathology, and clinical blood studies.

A key finding from their post-spill studies was that the post-weaning survival of sea otters born into the spill area more than a year after the spill was very poor, and was significantly lower than their concurrent counterparts in the unoiled eastern Sound. This finding remains, to date, the most definitive evidence of chronic damage to sea otters from EVOS.

Additionally, they demonstrated that female reproductive and survival rates were normal in the spill region in 1990 and 1991, but that adult females in the spill region may have higher rates of liver dysfunction compared with their counterparts in the eastern sound.

Their study of treatment center otters showed that survival and pupping rates of the animals released from the treatment centers was very low and was followed by an increase in mortality in the recipient population.

Their study of movements confirmed that significant interchange was not occurring among oiled (in WPWS) and unoiled (in EPWS) sea otter study populations, a finding crucial to evaluation of all post-spill studies. These movement studies also produced data that provides insight into the recovery process by showing that sea otters from EPWS were not emigrating to the west, and thus, would not be affecting recovery rates.

All funding for these studies, including all professional and technician salaries, ended without notice on Nov. 30, 1991, when invoices for payment were returned. After several months, and the loss of experienced support staff, 3.5 months of salary were provided to cover: preparation of 5 draft and final reports summarizing over two and a half years of continuous, year-round field work and all activities necessary to end this massive effort (e.g., inventory and clearing of warehouses and offices, relocation of staff, etc.). The level of funding restored was less than that originally obligated, resulting in less than full reimbursement of expenses incurred prior to Nov. 30, 1991.

The level of funding provided was insufficient to permit full analysis of all post-spill data, to permit analyses or integration of pre-spill data, and, thus, to develop manuscripts for publication.

The proposers reported the basic results from these studies in unpublished reports in 1992, for which minimal funding was provided to analyze data necessary to address very simple objectives (e.g., to determine whether post-weaning survival in oiled versus non-oiled areas did, or did not, differ).

The population studies were highly praised by key sea otter peer reviewers advising the Chief Scientist. One investigator wrote something to the extent that before the successful completion of these studies, no one would have thought them possible.

This project is relevant to the Nearshore Vertebrate project which seeks to monitor the recovery of sea otters and to determine factors that may be limiting recovery. It provides information on oil spill damage and benchmarks that are necessary for achieving an understanding of sea otter recovery and gauging population status relative to recovery.

NEED FOR THE PROJECT

A. Statement of Problem

Sea otters were one of the species most heavily impacted by the *Exxon Valdez* oil spill. Their current status is unclear. Recent Trustee Council documents list sea otters as "not recovering".

This project will result in the integration and publication of pre- and post-spill data on sea otters.

None of the data from the Principal Investigator's oil-spill studies are currently available in the primary scientific literature. Lack of full development of existing post-spill and pre-spill data from the principal investigators' studies on sea otter development, health, reproduction, movements, habitat use, and survival in Prince William Sound, AK, has greatly constrained the ability of interested scientists, spill residents, and others to achieve a full understanding of the spill's impacts on sea otters and on the ecosystems in which they play a vital part. It has hampered the interpretation of related findings from other spill-related studies. It has hampered development of meaningful recovery models for sea otters, and resulted in restoration activities proceeding without clear benchmarks against which to gauge current population status relative to recovery. Frustration over such issues has caused some experienced and knowledgeable scientists to stop participating in the restoration process.

Benchmarks of key population and development variables are needed against which to gauge current population status relative to recovery. Lack of funding to develop a 6-year pre-spill database

has, thus, hampered understanding of current population status and researchers have, instead, gauged recovery using relatively inaccurate and biased methods.

This project will aid restoration by providing detailed data on EVOS damage to sea otters, without which restoration planning is hobbled. It will also aid restoration by providing benchmarks useful for assessing population status relative to recovery.

As noted in the background section, funding has never been provided to permit more than the most basic analyses of the relevant post-spill data necessary to address simple litigation-driven objectives. No Trustee Council funding has been provided for these investigators since mid-1992, despite recommendations from key peer reviewers that such funding be provided. For example, in 1991, the key sea otter peer reviewer wrote "A complete analysis of the data from instrumented otters in Prince William Sound would certainly be a worthy objective and hopefully the Fish and Wildlife Service will be able to see that funding is available so that a complete analysis is carried out" (D. Siniff in a letter to C. Gorbics, Nov. 14, 1991).

Funds have also not previously been provided to permit the Principal Investigators to undertake the considerable effort to integrate the 1984-1989 (pre-spill) baseline data with post-spill data. The pre-spill study was interrupted by the grounding of the T/V *Exxon Valdez* on March 24, 1989 and funds were never provided to develop or to publish results of studies initiated in 1987.

Thus, funding is needed to permit the Principal Investigators the time needed to undertake the considerable effort required to finish analyses, integration, and writing required to ensure that the full value of the data and findings from this considerable and unique body of work is realized and available to the public and scientific communities. Peer reviewers to Trustee Council staff have repeatedly recommended that such funding be made available. This proposal seeks funding to undertake some of the necessary analyses, manuscript preparation and publication.

B. Rationale/Link to Restoration

As noted throughout this proposal, information to be published as a result of the proposed work will provide benchmarks against which population status relative to recovery can be gauged. They will provide information about habitat use valuable in guiding habitat acquisition to aid recovery, and to planning future response efforts. They also provide baseline data that can serve as benchmarks of normalcy against which to evaluate whether further damage is occurring.

Moreover, the results of the studies to be published in the papers proposed here form much of the core of the information available on the chronic impacts of oil on sea otters. However, due to lack of support to enable further data summarization and analyses, including the integration of a massive amount of baseline data from studies conducted prior to the spill, the

scientific community and the public have not been able to fully evaluate and to understand the impacts of the spill on sea otters. Some publications have reported that there essentially was little relevant baseline, yet many years of comparable data exist on the key pieces of information necessary to evaluate damage and to monitor recovery. For example, baseline exists on: a) rates of reproduction; b) rates of survival; c) body mass/length ratios; d) growth rates, etc. The data on mortality and reproduction are the most accurate available, being based on intensive, year-round monitoring of radio-instrumented individuals that were followed over time.

Without reliable and detailed data on the population-level impacts of the spill on basic population characteristics, such as birth and death rates of key segments of the population (e.g., females and pups) it is not possible to form conclusions about recovery status or to understand mechanisms impacting recovery.

The proposed data development and publication of papers will make available findings identified by Trustee Council peer reviewers as being part of a body of data critical to the development of meaningful efforts to model the potential recovery of the population(s) of sea otters damaged by the *Exxon Valdez* oil spill.

C. Location

This project will be undertaken from the Principal Investigators' offices in Homer, Alaska. The project's benefits will be realized globally, as information will be published in the primary literature and, thus, will be available to all interested persons.

COMMUNITY INVOLVEMENT

The Principal Investigators strongly support greater involvement of spill-area residents in Trustee Council restoration activities. The Principal Investigators have been residents of the spill area since 1984. This project involves only the development, integration and publication of data from studies already conducted. No new field work is proposed here and no technician aid is requested. Since the primary objectives of the proposal are to develop, integrate and publish results from the Principal Investigators' long-term studies, they will undertake all data analyses and writing required for project completion. Thus, it is unclear how, or if, additional spill area residents, other than the Principal Investigators, could be involved in implementation. However, the Principal Investigators would be willing to coordinate with the Spill Area-Wide Coordinator for the Trustee-sponsored Community Involvement Project to enhance communication of research findings from these projects to local communities.

Both before and after the spill, the Principal Investigators have ensured that interested members of the Native community had access to the findings from their research. For example, in the past, the authors have provided summaries of findings from their

studies orally at meetings of the Alaska Sea Otter Commission, and provided copies of research publications to local Native corporations and to the Alaska Sea Otter Commission. Communication of the results from this project could take similar forms, or could involve non-technical oral presentations to community groups or the dissemination of reprints to local libraries. At present, no funds are requested to permit such enhanced communication. If the project is funded and activities such as community visits or reprint dissemination is requested by the spill Area-Wide Coordinator, the budget will need to be adjusted accordingly.

PROJECT DESIGN

A. Objectives

The objective of this proposal is to produce eight manuscripts for publication based on analysis of data previously summarized in NRDA final reports or based on analysis of related data collected during NRDA studies but not included in previously submitted final reports. Where possible, papers will incorporate additional data from studies conducted in Prince William Sound by the Principal Investigators during 1984-1989. Objectives of the eight manuscripts to publication are given in detail below in the section entitled "publications and reports".

B. Methods

The purpose of this project is to produce eight manuscripts for publication in the primary literature. No field work is proposed.

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

None

SCHEDULE

A. Measurable Project Tasks for FY 97 (October 1, 1996-September 30, 1997)

Manuscripts having the following, or similar titles, will be submitted for publication on, or before, these dates:

November 15: Health, development, and survival of sea otter pups and weanlings in Prince William Sound after the T/V *Exxon Valdez* oil spill

Length-mass relationships in sea otters in Prince William Sound after the T/V *Exxon Valdez* oil spill

December 15: Persistence of beach-cast carcasses of radio-instrumented sea otters in Prince William Sound, AK

February 1: Survival and reproduction of female sea otters in Prince William Sound, AK after the T/V *Exxon Valdez*

oil spill

March 15: Age-specific reproduction of female sea otters in Prince William Sound, AK

May 1: Post-weaning movements of male and female sea otters in Prince William Sound, AK

July 1: Survival and reproduction of sea otters released from treatment centers after the T/V *Exxon Valdez* oil spill

September 1: Use of lagoons, land, and other "unusual" habitats by sea otters in Prince William Sound, AK

B. Project Milestones and Endpoints

The project objectives will be met when each successive manuscript is submitted for publication in the primary literature.

C. Completion Date

The project will be completed when the last manuscript is submitted, on, or before, September 1 1997.

PUBLICATIONS AND REPORTS

Below, information is provided on the manuscripts to be developed and submitted for publication in FY 1997 under this proposal.

1) Title: Health, development, and survival of sea otter pups and weanlings in Prince William Sound after the T/V *Exxon Valdez* oil spill

Targeted Journal: Journal of Mammalogy

When manuscript will be submitted: By November 15, 1996

Subject and Justification:

This paper will make available to the lay and scientific communities the most direct evidence available for a chronic, population-level impact of the *Exxon Valdez* oil spill on the survival of sea otters. A unique, multi-year, data base on the development, health, and survival of sea otter pups and weanlings will be integrated and summarized, including directly comparable data from the spill area both before and after the spill.

In this paper, the authors will:

1) Analyze, incorporate, and interpret data on pup survival following weaning and on factors that may aid in the interpretation of survival findings, such as: a) pup body

condition; b) pup growth rates; c) pup dependency periods; and d) the timing of key milestones such as birth and weaning.

2) Summarize and analyze pre-spill data on post-weaning survival rates and on the aforementioned factors collected by the Principal Investigators between 1984 and 1988.

3) Compare data collected on the development, health, and survival of sea otter pups and weanlings inhabiting oil-impacted areas of PWS with comparable data collected concurrently on sea otters in unoiled areas, and with the pre-spill, multi-year, data.

Data available from studies of radio-instrumented and tagged sea otter pups and weanlings living in oiled portions of western Prince William Sound (WPWS) will be compared with pre-spill data from WPWS and to pre- and concurrent post-spill data on otters inhabiting non-oiled areas in eastern Prince William Sound (EPWS). Parallel development and comparison will be made of all available data sets.

The pre-spill data were collected by the Principal Investigators in non-oil spill studies between 1984 and 1989.

The findings from the resulting data development, analyses, summarization, and publication are crucial to: a) understanding the magnitude, levels, and mechanisms of chronic impacts of the spill on sea otters; b) future monitoring of population status; c) determination of current population status relative to full recovery; d) evaluation of potential courses of recovery of sea otters; and, hence, e) recovery of the nearshore ecosystem of which sea otters are a vital component.

The data to be presented will provide baseline values for key development variables and population parameters that can act as benchmarks against which to evaluate the status of the population relative to recovery.

The proposed data development and paper publication will make available findings identified by Trustee Council peer reviewers as part of a body of data critical to the development of meaningful efforts to model the potential recovery of the population(s) of sea otters damaged by the *Exxon Valdez* oil spill.

2) Title: Length-mass relationships in sea otters in Prince William Sound after the T/V *Exxon Valdez* oil spill

Targeted Journal: Journal of Mammalogy

When Manuscript will be Submitted: By November 15, 1996

Subject and Relevance to Restoration:

The mean mass, adjusted for total body length, of male and female sea otters (Enhydra lutris) inhabiting oiled habitat in Prince William Sound, Alaska (USA), after the wreck of the T/V *Exxon*

Valdez in 1989 will be compared to that of sea otters captured in the same or adjacent habitat in western PWS approximately a decade earlier, and of individuals inhabiting unoiled habitat in eastern PWS between 1984-1990.

This paper will provide baseline data on body condition in sea otters. It will also present new information indicating additional chronic impacts of the spill on sea otters. It provide insight into the overall health of sea otters in PWS both prior to, and a year and a half after, the spill that may be useful in the interpretation of existing and future data on population distribution and abundance, reproduction, and survival.

3) Title: Persistence of beach-cast carcasses of radio-instrumented sea otters in Prince William Sound, AK

Targeted Journal: Marine Mammal Science

When Manuscript will be Submitted: By December 15, 1996

Subject and Relevance to Restoration:

Information obtained about the number and estimated age of sea otters found as beach cast carcasses on selected beaches have been collected over the past 20 years in Prince William Sound and have been used to draw conclusions about the rates of mortality of various age classes of sea otters following the *Exxon Valdez* oil spill. The data to be developed and made available through publication in this paper are directly relevant to the interpretation of carcass counts obtained on annual beach walks of selected beaches, and their use as an indicator of mortality.

Data will be presented on the condition and persistence of beach-cast carcasses of radio-instrumented sea otters as a function of age, sex, location, and time of year. Data from studies conducted in Prince William Sound from the spring of 1984 to the end of Nov. 1991 will be analyzed, integrated, and presented.

4) Title: Survival and reproduction of female sea otters in Prince William Sound, AK after the T/V *Exxon Valdez* oil spill

Targeted Journal: Marine Mammal Science

When manuscript will be submitted: By February 1, 1997

Subject and Relevance to Restoration:

The purpose of this paper is to publish information on the impact of the T/V *Exxon Valdez* oil spill on the survival and the reproduction of female sea otters residing in oiled portions of Prince William Sound. In order to do so, additional data crunching and analyses are required. Comparison will be made of rates of survival and pupping of female sea otters in EVOS-oiled areas and otters inhabiting adjacent unoiled areas in Prince William Sound. Two independent data sets from the unoiled areas will be used for comparison with the EVOS affected area: one from

a concurrent post-spill study, and the other from studies conducted prior to the spill from 1987 through the end of 1989. Additionally, data on pregnancy detection rates and premature fetal loss will be incorporated.

The publication of this paper, based on the observations of approximately 100 radio-instrumented females will make available the best, most reliable existing evidence regarding the chronic impacts of the EVOS on survival and reproduction of sea otters in spill-affected areas. The paper will summarize part of a body of data identified by Trustee peer reviewers as those data necessary for development of meaningful models to predict the recovery of EVOS-affected sea otter populations.

5) Title: Age-specific reproduction of female sea otters in Prince William Sound, AK

Targeted Journal: Journal of Wildlife Management

When manuscript will be submitted: By March 15, 1997

Subject and Relevance to Restoration:

We will develop and publish age-specific reproductive schedules for female sea otters using data from up to 3 years of observation on approximately 150 radio-instrumented individuals studied in Prince William Sound from the spring of 1987 to the end of Nov. 1991.

Other issues to be examined in the paper will include: a) age of first reproduction; b) reproductive senescence; and c) the relationships between age, reproductive history, and reproductive success.

This paper will summarize the least biased, most accurate data available on reproductive parameters for sea otters in PWS.

6) Title: Post-weaning movements of male and female sea otters in Prince William Sound, AK

Targeted Journal: Canadian Journal of Zoology

When manuscript will be submitted: By May 1, 1997

Subject and Relevance to Restoration:

Data on the post-weaning movements of radio-instrumented sea otters studied between 1984 and 1991 in Prince William Sound, Alaska, will be examined. The movements of male and female sea otter weanlings will be compared, including the distance travelled, and the type of habitat resided in, following weaning. Data on the movements of mother-pup pairs prior to weaning will also be summarized and compared to post-weaning movement patterns.

Information that will be published in this paper will provide direct information necessary for evaluating trends in sea otter

distribution and abundance in the oil spill area over time and for understanding population dynamics over the course of recovery. For example, it is directly relevant to the interpretation of mother-pup counts obtained to estimate population or area-wide pupping rates. Since available data indicate that weanlings are probably the age class of sea otters most vulnerable to the chronic impacts of the spill, this information can provide guidance to the design of sampling efforts aimed at assessing the impacts of the spill on the nearshore sea otter (and other predator) prey communities. This paper will also provide information directly relevant determining population structure, knowledge of which is required before meaningful interpretation can be made of trends in distribution and abundance over time. It will also provide a measure of the probable source pool for recruitment of sea otters to the oil spill areas. Conversely, it may provide some insight into the probable magnitude of emigrations from the area.

7) Title: Survival and reproduction of sea otters released from treatment centers after the T/V *Exxon Valdez* oil spill

Targeted Journal: Conservation Biology

When manuscript will be submitted: By July 1, 1997

Subject and Relevance to Restoration:

This paper will present findings on the survival and the reproduction of 45 sea otters that were captured in oiled habitat after the *Exxon Valdez* oil spill, treated at centers established in response to the spill, and released back into unoiled habitat in PWS in the summer of 1989. Data of the survival and reproduction of these animals will be compared to similar data on the recipient population collected concurrently, and prior to the spill. Factors possibly related to survival (e.g., age, condition upon capture, movement after release, center where treated, etc.) will be examined.

The data to be presented in this paper are the only existing data available for evaluating the long-term fate of sea otters released into their natural habitat following a large scale oil spill and subsequent rehabilitation effort. Hence, they are critical for the evaluation of the efficacy of the rehabilitation strategy and for the planning of future response policy. They also provide insight into the probable fate of the other * sea otters released from the EVOS treatment centers back to the wild and so provide heretofore unconsidered information relevant to assessing the total damage to, and, hence, the full recovery of, sea otter populations from the *Exxon Valdez* oil spill.

8) Title: Use of lagoons, land, and other "unusual" habitats by sea otters in Prince William Sound, AK

Targeted Journal: Marine Mammal Science

When the Manuscript will be Submitted: by September 1, 1997

Subject and Relevance to Restoration

Data on the locations of hundreds of radio-instrumented sea otters from studies conducted in PWS between 1984 and 1991 will be analyzed and discussed to evaluate the importance of lagoons, other habitats surrounded by land, streams, and land to different age and sex classes of sea otters in PWS.

Such data will:

a) provide insight into the impact of various land-uses on sea otters in PWS and elsewhere, and, thus, provide insight into the benefits of habitat acquisition and protection to sea otter recovery;

b) aid in the interpretation and design of surveys undertaken to assess sea otter population status relative to recovery;

c) provide information valuable in the formulation of future response and restoration efforts

PROFESSIONAL CONFERENCES

None requested

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

This project is directly relevant to the Nearshore Vertebrate Ecosystem Project. Publication of these papers will provide information crucial for understanding current population status. It will provide benchmarks for key development variables and population parameters that permit unbiased assessments of population status relative to recovery.

PROPOSED PRINCIPAL INVESTIGATORS

Lisa M. Rotterman, Ph.D. and Charles Monnett, Ph.D.
Enhydra Research
P.O. Box 3448, Homer, AK 99603
Telephone: 907-235-6099
Fax: 907-235-6099

PERSONNEL

Dr. Lisa M. Rotterman will be Principal Investigator on this project and Dr. Charles Monnett will be co-Principal Investigator. In addition to having extensive research experience in the spill region, both individuals are spill area residents and have resided in the spill region since 1984.

Working in full collaboration, Dr. Monnett and Dr. Rotterman have conducted original research on sea otter population ecology, behavior, development, and genetics in Alaska since 1984. Their sea otter research has included, but not been limited to, research on sex-, age-, and locality-specific: survival rates and causes; reproductive patterns and rates; movement patterns; morphology; body condition; and growth. They have also conducted studies on sea otter population structure and molecular and population genetics. Their sea otter studies have been multi-year, year-round studies in which hundreds of radio-instrumented individuals are studied intensively. They have developed indices by which to assess and compare sea otter populations status generally, and under different resource regimes, specifically.

Dr. Monnett and Dr. Rotterman pioneered studies on sea otter pups and weanlings. At the time of the spill, and until their studies were taken over by government researchers in 1992, they were the only scientists in the world to have conducted large-scale growth and telemetry studies on these age classes. This work permitted the post-spill studies on weanling survival, which produced the most definitive evidence of chronic damage to sea otter populations from the spill to date.

Dr. Monnett and Dr. Rotterman hold the best, most comparable, and in many cases the only baseline data available on the growth, reproduction, body condition, survival and movements of sea otter females, pups and weanlings in Prince William Sound.

As discussed more below, Dr. Monnett and Dr. Rotterman collaboratively conducted much of the post-spill field research on sea otters until 1992. They conducted pre- and post oiling marine mammal surveys in WPWS in 1989, including surveys initiated on the day of the spill. They captured, instrumented and monitored approximately a hundred and sixty sea otters in order to evaluate the impacts of the spill on adult female and weanling survival, health, and movements, and on female reproduction. They collected hundreds of samples for toxicology, pathology, blood chemistry and other studies. They also successfully undertook studies to evaluate the efficacy of the post-spill sea otter rehabilitation program by monitoring the post-release fate of sea otters from the treatment centers.

Dr. Monnett and Dr. Rotterman have written over 30 reports and publications based on their sea otter research.

Individual information about the qualifications of the two researchers are provided below.

Dr. Rotterman was the Principal Investigator on two major facets of the post-spill sea otter studies: 1) studies aimed at determining the impact of the spill on weanling survival; and 2) the impacts of the spill on the health of adult female and weanling sea otters as assessed through evaluation of blood chemistry and hematology. She has a Ph.D. and a M.S. from the Department of Ecology and Behavioral Biology at the University of Minnesota and a B.S. from the University of Maryland in the field of Conservation and Resource Development, with speciality in Fish and Wildlife. The specialities of her Ph. D. program were population and community ecology, evolution, and behavior. She has a second area of Ph.D.-level expertise in the fields of population, quantitative, and molecular genetics and earned a minor in Genetics as part of her Ph.D. program.

The topic of her Ph.D. dissertation was the impacts of population fragmentation and reduction on genetic variability and structure within and among populations of sea otters, and the implications of current genetic status to long-term viability. The field portions of her doctoral research were undertaken in Alaska, particularly in Prince William Sound. She was twice appointed as a Guest Researcher in the Laboratory of Viral Carcinogenesis in the Genetics Section at the National Cancer Institute, National Institutes of Health where the laboratory portions of her doctoral research was undertaken.

In addition to her research on sea otter ecology and genetics, she has many years of experience conducting research in the fields of avian ecology and non-human primate toxicology and infant development. She has additional research experience on other marine mammals, and caribou.

Dr. Monnett was the Principal Investigator on several key portions of the post-spill sea otter studies: 1) studies aimed at evaluating the impact of the spill on female health, reproduction and survival; 2) studies of the movement patterns of sea otters after the spill; 3) studies aimed at determining the efficacy of the sea otter rehabilitation program; and 4) pre- and post-spill aerial (and to a lesser extent, boat) marine mammal surveys (sea otters, harbor seals, sea lions, and other marine mammals) in oiled and adjacent areas of PWS, which he initiated on the morning of the spill.

Dr. Monnett has a Ph.D. from the Department of Ecology and Behavioral Biology at the University of Minnesota and a B.S. from the University of Washington in Zoology. He also has training in the veterinary sciences and is a certified veterinary technologist. He holds a private pilot's license and is certified as a commercial diver.

The topic of Dr. Monnett's Ph.D. dissertation was "Patterns of Movement, postnatal development and mortality of sea otters in Alaska" in which studies of sea otter pups and weanlings were pioneered.

In addition to his research on sea otters, he has many years of experience conducting research in the fields of avian ecology and

non-human primate toxicology and infant development. He also has additional research experience on other marine mammals.

1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1996 - September 30, 1997

Budget Category:	Authorized FFY 1996	Proposed FFY 1997						
Personnel		$60,000.0						
Travel		$2,060.0						
Contractual		$4,000.0						
Commodities		$1,000.0						
Equipment		$0.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	$0.0	$67,060.0	Estimated FFY 1998	Estimated FFY 1999	Estimated FFY 2000	Estimated FFY 2001	Estimated FFY 2002	
Indirect		$6,706.0						
Project Total	$0.0	$73,766.0						
Full-time Equivalents (FTE)		12.0						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments

Indirect costs = 10% of direct costs

1997

Prepared:

Project Number: 97223-BAA
Project Title: Publication of Sea Otter Data
Name: Lisa M. Rotterman, Ph.D

FORM 4A
Non-Trustee
SUMMARY

1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1996 - September 30, 1997

Personnel Costs:			Months	Monthly		Proposed
	Name	Position Description	Budgeted	Costs	Overtime	FFY 1997
	Rotterman, Lisa	Research Ecologist	6.0	5000.0		30,000.0
	Monnett, Charles	Research Ecologist	6.0	5000.0		30,000.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
		Subtotal	12.0	10000.0	0.0	
					Personnel Total	$60,000.0

Travel Costs:		Ticket	Round	Total	Daily	Proposed
	Description	Price	Trips	Days	Per Diem	FFY 1997
	HOM/ANC/HOM	140.0	4	12	125.0	2,060.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
					Travel Total	$2,060.0

1997

Prepared:

Project Number:
Project Title: Publication of Sea Otter Data
Name: Lisa M. Rotterman, Ph.D.

FORM 4B
Personnel
& Travel
DETAIL

1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1996 - September 30, 1997

Contractual Costs:	Proposed
Description	FFY 1997
Page costs for publication of 8 papers (estimated)	4,000.0
Contractual Total	$4,000.0

Commodities Costs:	Proposed
Description	FFY 1997
Office Supplies	1,000.0
Commodities Total	$1,000.0

1997

Prepared:

Project Number:
Project Title: Publication of Sea Otter Data
Name: Lisa M. Rotterman, Ph.D

FORM 4B
Contractual & Commodities DETAIL

1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1996 - September 30, 1997

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

Existing Equipment Usage:	Number
Description	of Units

1997

Prepared:

Project Number:
Project Title:
Name:

FORM 4B
Equipment
DETAIL

Forage Fish Assessment of the Cook Inlet, Shelikof Strait and Gulf of Alaska Oil and Gas Development Assessment Areas

Project Number:	97224
Restoration Category:	Research
Proposer:	Department of the Interior, Minerals Management Service/National Park Service
Lead Trustee Agency:	DOI
Cooperating Agencies:	
Alaska SeaLife Center:	
Duration:	1st year, 3-year project
Cost FY 97:	$110 K (Requested) (Total FY 97 cost estimate is $315 K.)
Cost FY 98:	$105 K (Requested) (Total FY 98 cost estimate is $184 K.)
Cost FY 99:	$105 K (Requested) (Total FY 99 cost estimate is $184 K.)
Geographic Area:	Cook Inlet, western Gulf of Alaska, Shelikof Strait
Injured Resource/Service:	Pacific herring and other forage fish, various seabirds, harbor seals, and marine mammals/passive uses, recreation and tourism, subsistence and commercial fishing.

ABSTRACT

This project would provide a means for collecting and collating information on the abundance, density, distribution and stock/population status of forage fishes in the nearshore areas of western Gulf of Alaska, Shelikof Strait and Cook Inlet adjacent to National Park Service areas. Additional inventory and monitoring of forage fish biomass and quality would be done to establish a trend index for ecological change and provide a baseline. Subsequent long-term monitoring could enable the differentiation between natural fluctuations of forage fish biomass and nutrient quality and large or abrupt changes that may occur from local human disturbances, such as oil spills.

INTRODUCTION

The inventory and monitoring of forage fish species, as proposed in this study, will provide baseline information about forage fish species and their relationship with their prey species, specifically for nearshore areas associated with Lake Clark, Katmai and Kenai Fjords National Parks. This information will enable the EVOS Trustee Council to better access impacts that resulted from the *Exxon Valdez* oil spill and provide necessary restoration efforts to the recovery of forage fish species and their prey species in Lower Cook Inlet, Shelikof Strait and the western Gulf of Alaska areas.

Information gathered from this study would help with refinement of mitigation measures for effects on forage fishes, marine mammals, particularly pinnipeds, and seabirds, and would help identify other sources of effects on commercial fish. Information gained from this study will supplement the products obtained from EVOS project number 96163 L pertaining to forage fish.

NEED FOR THE PROJECT

A. Statement of Problem

EVOS provides an opportunity to measure oil spill impacts to forage fishes and other resources in this part of Alaska that have not yet been explored and determined. The level of baseline information available on forage fish abundance, composition, diet, biomass and nutrient quality in Cook Inlet, Shelikof Strait and the western Gulf of Alaska is not adequate at this time for the determination of oil spill, offshore oil and gas exploration and post-lease impacts. Therefore, determining impacts that may resulting from oil and gas related activities is not currently based on sound, scientific baseline data.

B. Rationale/Link to Restoration

Forage fish populations are a principle component forming the basic foundation for Alaskan marine ecosystems. Nearshore fish assemblages are extremely vulnerable to petroleum-related environmental impacts. These impacts could adversely impact prey-base forage fish species. Consequently, impacts could be incurred on species that prey and are dependent on forage fish biomass and fish nutrient quality or related food webs, such as various seabird species, endangered whale species (humpback and fin), depleted harbor seal populations and threatened Steller sea lions.

Information gathered from this study would help with the refinement of mitigation measures for nearshore marine mammals (particularly pinnipeds), forage fish, and seabirds. The information would help with assessments of the effects of oil exploration, development and spills by identifying other sources of effects on commercial fish. The status of high-quality forage fish in the Cook Inlet, western Gulf of Alaska and Shelikof Strait areas is very important information

needed to understand the natural variability and man-induced changes that have occurred and may occur in the marine ecosystem environment of Cook Inlet, Shelikof Strait and the western Gulf of Alaska.

C. Location

Sampling would be conducted primarily in the Cook Inlet area, with some sampling being conducted in the western Gulf of Alaska and Shelikof Strait areas, in nearshore areas adjacent to Lake Clark, Kenai Fjords and Katmai National Parks. The project's benefits would be realized throughout these areas and could possibly be applied in other similar ecosystem areas. No communities would be affected by the project and the study information would be available for their usage.

COMMUNITY INVOLVEMENT

The MMS is currently involved with incorporating traditional knowledge and concerns into its oil and gas process. We would support any efforts by the EVOS Trustee Council in the implementation of this project proposal to contact local facilitators in the study area to obtain this knowledge. We would also support efforts to hire and use locally available vessels, technicians, equipment, etc. if possible. A non-technical synopsis of the research findings would be made available to local communities in the study areas.

PROJECT DESIGN

A. Objectives

1. Determine forage fish, particularly high-lipid forage fish, abundance, composition, diet, biomass and nutrient quality at key locations in nutrient rich coastal areas adjacent to national parks.

2. Determine forage fish energy levels/flow and hydrocarbon contamination levels.

B. Methods

A literature search would be conducted for available information on the abundance, density and distribution of herring to determine their past and current stock/population status in Cook Inlet, Shelikof Strait and the western Gulf of Alaska. Sources of information would include the National Marine Fisheries Service, Alaska Department of Fish and Game, and the National Oceanic and Atmospheric Administration Outer Continental Shelf Environmental Assessment Program. A literature search could also be conducted for available information for lipids, energy

analysis and hydrocarbon level studies done on forage fish. Further sampling would be done using side-scan sonar, trawl samples, gillnets, tow nets, puffin burrow collections and scuba methods for herring and other forage fish species, particularly Pacific sandlance and capelin, if necessary. Sampling would be conducted to obtain statistically reliable results. Proposed bi-annual sampling would be conducted in the spring and fall. To optimize sampling results, findings in the NOAA forage fish pertaining to sampling periods, i.e. late summer, early fall for stable forage fish populations, will be considered, as should any other pertinent sampling period data. Forage fish catches would be sorted by species and weighed. Samples obtained at selected sites adjacent to marine mammal concentrations and seabird colonies would be evaluated in the laboratory using lipids, primarily for herring, energy analysis, using Pristane as a tracer, and hydrocarbon levels. Stomach contents would be identified, enumerated and weighed. Paired controls would be randomly selected. Data processing and analysis would use Geographic Information Systems (GIS).

C. Cooperating Agencies, Contracts, and Other Agency Assistance

The MMS and the NPS, Alaska Office, have jointly identified the need for this study. Co-funding may be possible, subject to the availability of funds.

Parts of this project could possibly be contracted to the private sector if the expertise, equipment, etc. is available. However, it is more likely that the project will require contracts for services with governmental agencies, such as the Alaska Department of Fish and Game or the U.S. Fish and Wildlife Service and an interagency agreement with the National Park Service, and/or contracts with universities, such as the University of Alaska Fairbanks or Oregon State University. Details of the necessary contracts would be established by the EVOS Trustee Council as the project's implementing agency.

MMS coordinated this study proposal with Bud Rice (NPS Anchorage), Alan Bennett (NPS Kenai), and Buddy Goatcher (NPS Kodiak). We contacted Paul Anderson (NMFS Kodiak) and Bill Bechtol (ADF&G Homer) about their current ongoing forage fish EVOS study to ensure that efforts would complement each other and provide information to benefit the species. We also spoke with Dr. David Duffy, Alaska Natural Heritage Program regarding the ongoing EVOS forage fish study and the MMS project proposal.

SCHEDULE

A. Measurable Project Tasks for FY 97 (October 1, 1996 - September 30, 1997)

The project's task schedule would be determined by the EVOS Trustee Council as the implementing party. However, the following could be a proposed basic schedule.

Start-up to May 31:	Award contracts, arrange logistics, conduct literature search
Mid-August-September 30:	Conduct sampling
October 1-November 15:	Conduct laboratory analysis
November 16-January 1:	Data processing and analysis, including GIS
January 2-February 15:	Prepare draft report
April 15:	Annual report on FY 97 work

B. Project Milestones and Endpoints

1. Forage fish sampling would continue for three years to ensure that adequate sampling for a statistically reliable data analysis was obtained and to ensure that variability in forage fish populations would be observed.

2. Laboratory analysis of forage fish samples would occur subsequent to the fish sampling. Three years of analysis would provide information about the adverse impacts to forage fish populations due to oil spill stress factors, forage fish energy levels/flow, and the bioaccumulation of hydrocarbons in forage fish.

To these endpoints, we would anticipate that the schedule for the entire life of this project would remain somewhat similar to the FY 97 schedule. However, the data analysis would be more detailed, hypothesis may be developed from the data findings that could require additional research and sampling, and peer-reviewed publications may be produced.

C. Completion Date

We anticipate that three years of sampling data and data analysis would be sufficient to meet this project's objectives. Therefore, them final reports would be completed in FY 00. However, data analysis may determine that additional sampling and analysis is needed to meet the objectives. This could extend this project beyond FY 99.

PUBLICATIONS AND REPORTS

At the present time no publications are planned for submittal in FY 97 due to the fact that sampling and data analysis would be done in the later part of FY 97.

NORMAL AGENCY MANAGEMENT

Neither the MMS nor National Park Service are required to do this project by statute or regulation. We are concerned with the well-being of the resources and their recovery in the western Gulf of Alaska, Cook Inlet and Shelikof Strait in light of the *Exxon Valdez* oil spill. Since forage fish are a vital link in the food web for a variety of species in these areas, it is of

utmost importance that the effects of the oil spill on them be studied so that adequate restoration efforts can be implemented to ensure their recovery. Estimating the current ecological role of forage fish in the Cook Inlet nearshore will provide necessary data for future damage assessment, if needed. Knowing how forage fish are/were affected may assist in explaining the difficulties that other species, such as seabirds and marine mammals that prey and depend on these species to survive, have had in recovering from the oil spill. We have not previously received any funding from the Trustee Council. The result obtained from the funding of this project would complement the forage fish project (No. 96163 L) results currently being done. The resultant baseline of selected forage fish parameters would further assist the Trustee Council in the recovery and management of several injured resources.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

MMS has contacted Paul Anderson, National Marine Fisheries Service in Kodiak and Dr. David Duffy, Alaska Natural Heritage Program regarding the ongoing forage fish study (No. 96163 L) funded by the Trustee Council. We ascertained what their study was encompassing and what data they had collected, so as not to duplicate efforts. We have designed our objectives so that we will be able to correlate the results of these two forage fish studies. This will provide the Trustee Council with a more complete analysis of the forage fish populations and a more thorough understanding of the impacts from the *Exxon Valdez* oil spill. The end result would be that the Trustee Council would be able to effect a more detailed and complete recovery plan for forage fish species and their associated predator species.

EXPLANATION OF CHANGES IN CONTINUING PROJECTS

This project is a new project proposal and was not funded in FY 96.

PROPOSED PRINCIPAL INVESTIGATOR, IF KNOWN

Since MMS would not be this project's implementing agency, the principal investigator is not known at the present time.

1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1996 - September 30, 1997

Budget Category:	Authorized FFY 1996	Proposed FFY 1997						
Personnel		$0.0						
Travel		$0.0						
Contractual		$0.0						
Commodities		$0.0						
Equipment		$0.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	$0.0	$0.0	Estimated FFY 1998	Estimated FFY 1999	Estimated FFY 2000	Estimated FFY 2001	Estimated FFY 2002	
Indirect								
Project Total	$0.0	$0.0						
Full-time Equivalents (FTE)		0.0						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments: Since MMS will not be the implementing agency for this project, we do not have a detailed budget developed for this project. The MMS and the NPS, Alaska Office, have jointly identified the need for this study. Co-funding may be possible, subject to the availability of funds.

1997

Prepared:

Project Number: 97224
Project Title: Forage Fish Assessment of the Cook Inlet, Shelikof Strait and Gulf of AK. Oil and Gas Development Areas
Name: Minerals Management Service (MMS)

FORM 4A
Non-Trustee
SUMMARY

4/15/96

1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1996 - September 30, 1997

Personnel Costs:			Months	Monthly		Proposed
	Name	Position Description	Budgeted	Costs	Overtime	FFY 1997
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
		Subtotal	0.0	0.0	0.0	
					Personnel Total	$0.0

Travel Costs:		Ticket	Round	Total	Daily	Proposed
	Description	Price	Trips	Days	Per Diem	FFY 1997
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
					Travel Total	$0.0

1997

Prepared:

Project Number:
Project Title: Forage Fish Assessment of the Cook Inlet, Shelikof Strait and Gulf of AK. Oil and Gas Development Assessment Areas
Name: MMS

FORM 4B
Personnel
& Travel
DETAIL

4/15/96

1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1996 - September 30, 1997

Contractual Costs:	Proposed FFY 1997
Description	
Contractual Total	$0.0

Commodities Costs:	Proposed FFY 1997
Description	
Commodities Total	$0.0

1997

Prepared:

Project Number:
Project Title: Forage Fish Assessment of the Cook Inlet, Shelikof Strait and Gulf of AK. Oil and Gas Development Assessment Areas
Name: MMS

FORM 4B
Contractual & Commodities DETAIL

4/15/96

1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1996 - September 30, 1997

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

Existing Equipment Usage: Description	Number of Units	

1997

Project Number:
Project Title: Forage Fish Assessment of the Cook Inlet, Shelikof Strait and the Gulf of AK. Oil and Gas Development Assessment Areas
Name: MMS

FORM 4B
Equipment
DETAIL

Prepared:

4/15/96