

99090

## Monitoring of Oiled Mussel Beds in Prince William Sound

Project Number: 99090

Restoration Category: Monitoring

Proposer: Patricia M. Harris and Christine C. Brodersen  
NMFS, Auke Bay Laboratory  
ABL Program Manager: Dr. Stan Rice  
NOAA Program Manager: Bruce Wright

Lead Trustee Agency: NOAA

Cooperating Agency: None

Alaska Sea Life Center: No

Duration: One year, plus closeout

Cost FY 99 180K

Cost FY 00: 50K

Geographic Area: Oil spill impacted areas of Prince William Sound

Injured Resource/Service: Mussels, Intertidal Communities, Subsistence use

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APR 14 1998

EXXON VALDEZ OIL SPILL  
TRUSTEE COUNCIL

### ABSTRACT

We propose to monitor mussel densities and hydrocarbon concentrations in mussels and sediments in 28 mussel beds impacted by EVOS in Prince William Sound. Twelve of these beds were restored in 1994; mussel hydrocarbon concentrations decreased significantly and replaced sediments remained clean through 1995. 1996 samples, however, indicated recontamination of the replaced sediments and the potential for recontamination of mussels in some restored beds. To compare the efficacy of restoration efforts to long-term natural recovery, we propose to monitor an additional 16 beds that were untreated and remained oiled when they were last sampled (1995). To complete the design, two unoiled reference beds will also be re-sampled

## INTRODUCTION

Many blue mussel (*Mytilus trossulus*) beds impacted by the *Exxon Valdez* oil spill (EVOS) were not cleaned by the EVOS Interagency Shoreline Cleanup Committee to minimize damage to the beds. Natural processes did not quickly reduce the substantial amounts of *Exxon Valdez* oil (EVO) remaining in mussels and sediments underlying mussel beds. In 1992, the Auke Bay Laboratory and National Park Service (Restoration Project R103) documented 50 mussel beds in Prince William Sound (PWS) and 9 on the Kenai and Alaska Peninsulas with underlying sediment concentrations greater than 1700  $\mu\text{g/g}$  total petroleum hydrocarbons (TPH) wet weight; 25 of the beds in PWS had concentrations in excess of 10,000  $\mu\text{g/g}$  TPH. The highest oil concentrations found in animals or sediments in 1991 and 1992 by any researchers in the *Exxon Valdez* spill area were in mussel beds and underlying sediments in PWS. Persistent high concentrations of hydrocarbons in mussels were identified as a possible source of impacts in several consumer species and could also impact human subsistence users.

Attempts to manipulate mussel beds to reduce hydrocarbon levels in 1992 and 1993 (projects R103-1 and 93036) were minimally intrusive and minimally effective. Small scale removal of strips of mussels to increase water circulation through the beds and thereby reduce hydrocarbon levels was effective only in the sediments of the strips themselves. Transplanting small patches of oiled mussels to nearby clean sediments reduced hydrocarbons in those mussels, but mussel mortality was high. (Babcock et al. in prep.). Overall hydrocarbon concentrations in the five manipulated beds remained high in 1993 (Babcock et al. 1996).

The scale of restoration was increased therefore in 1994 (project 94090) at the request of Chenega Bay residents. We manually removed oiled mussels, replaced oiled sediments underlying the mussels with clean sediments, and replaced mussels onto the clean sediments in 12 of the most impacted mussel beds. Hydrocarbon levels in the clean replaced sediments remained low from late summer 1994 through early summer 1995, and total polyaromatic hydrocarbons (TPAH) in mussels were greatly reduced by 1995. However, in 1996 when restored beds were last sampled, TPH concentrations in sediments directly under the mussels ranged from 340 to 9000  $\mu\text{g/g}$ , indicating recontamination in 6 of the 12 beds. Mussel densities showed overall decline in most restored beds from the fall of 1994 to summer 1995. Declines were also observed in reference beds and therefore were not necessarily linked to restoration (Babcock et al. in prep.).

In most untreated beds, hydrocarbon concentrations in mussels and underlying sediments declined at variable rates. Environmental differences between sites as well as differences in the distribution and amount of subsurface oil affected the rate of decrease. In 1995, 16 sampled mussel beds in PWS remained oiled; TPH in sediments ranged up to 20,000  $\mu\text{g/g}$  wet weight and TPAH in mussels ranged up to 4.5  $\mu\text{g/g}$  dry weight. Dates of return to pre-spill concentrations in sediments in those beds, estimated by regression analysis of 1992-1995 data, ranged from 1996 to 2003. (Pre-spill concentrations are defined as 50  $\mu\text{g/g}$  TPH wet weight in sediments and 0.09  $\mu\text{g/g}$  TPAH dry weight in mussels, based on minimum detection limits of analytical instruments and historical data from unoiled sites). The 16 untreated beds have not been sampled since 1995; 3 of them were still visibly oiled in the spring of 1997.

Further sampling is needed to measure hydrocarbon concentrations and estimate mussel densities to 1) evaluate the effectiveness of restoration techniques, 2) evaluate natural recovery rates with respect to expected rates of recovery predicted by regression analysis, 3) examine the degree and pattern of weathering of oil in both restored and untreated beds, and 4) assess mussel bed health. The final report should provide a comprehensive picture of recovery in both restored and naturally recovering mussel beds.

## **NEED FOR THE PROJECT**

### **A. Statement of Problem**

Mussels remain an important food source in PWS intertidal communities, particularly for some predators (e.g. harlequin ducks, sea otters, and black oystercatchers) whose recovery is not yet certain. Additionally, mussel beds provide habitat for many other invertebrate species. Continued monitoring of hydrocarbons in mussel beds is warranted until this contaminated habitat has fully recovered. Human subsistence users need to know whether mussels and other species trophically linked to the beds are oil free. Untreated mussel beds have not been sampled since 1995, so their hydrocarbon levels are unknown. The patterns of concentration decline from 1991 to 1995, and observations of visible oiling in some mussel beds in early 1997, indicate that many beds have not returned to pre-spill concentrations. Sediment recontamination in half of the restored beds necessitates further monitoring of these beds.

### **B. Rationale/ Link to Restoration**

Human subsistence harvesters and researchers studying mussel predators need to know if petroleum hydrocarbons still persist in mussel beds. Although the areal extent of contaminated mussel beds is small in proportion to the total area of beds in PWS, the oiled beds are the worst remaining known source of *Exxon Valdez* Oil (EVO) contamination. Monitoring the gradual return to pre-spill conditions of these beds is basic to all other *Exxon Valdez* Oil Spill (EVOS) studies.

The long term effectiveness of natural recovery and restoration techniques should be assessed to provide guidance in the event of other spills. Oiled beaches remain a problem for PWS residents, prompting this study and other chemical restoration activities.

### **C. Location**

The mussel beds to be evaluated are in the oil-impacted areas of PWS (Knight Island, Disk Island, Eleanor Island, Chenega Island, Latouche Island, Squirrel Island, and Applegate Island) and two not impacted areas, Olsen Bay in eastern PWS and Drier Bay on Knight Island. Residents of Chenega Bay use the beaches near several of the oiled mussel beds.

## COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE

The results will be reported in non-technical terms to the Chenega Bay Village Council in writing, and if the Council so requests, at a public meeting in Chenega Bay as well. Students from the Youth Area Watch Program, especially those from Chenega Bay will be invited to participate in sampling.

### PROJECT DESIGN

#### A. Objectives

1. Measure hydrocarbon concentrations in mussels and underlying sediments, and mussel densities, in beds that were restored in 1994 to evaluate degree of recontamination and to assess mussel bed health. Similar measures will be taken in uncleaned control beds for comparison.
2. Measure the hydrocarbon concentrations in mussels and underlying sediments and mussel densities in untreated mussel beds that remained contaminated with EVO in 1995. Similar measures will be taken in uncleaned control beds for comparison.

#### B. Methods

Our working hypotheses are 1) that the beds restored in 1994 have remained clean and intact and 2) that sediment and tissue hydrocarbon concentrations in untreated oiled PWS mussel beds have returned to pre-spill levels. Data to be collected are TPH (sediments) and TPAH (mussels) concentrations and mussel densities (mussels/m<sup>2</sup>).

#### Objective 1

##### Site Selection

Sites to be sampled include those restored in 1994 and adjacent uncleaned beds that represent natural restoration.

Restored Mussel Beds Proposed for sampling in 1999

| Beach Segment* | Geographic Name | Notes                                               |
|----------------|-----------------|-----------------------------------------------------|
| CH10B-2A       | Chenega Island  | originally sampled as 2 beds, now as 1 with 3 zones |
| CH10B-2B       | Chenega Island  |                                                     |
| CH10B-2C       | Chenega Island  |                                                     |
| CH10B-2D       | Chenega Island  | uncleaned reference bed                             |
| DI067A-1       | Disk Island     |                                                     |
| DI067A-2AL     | Disk Island     |                                                     |
| DI067A-2AR     | Disk Island     |                                                     |

|           |                 |                                   |
|-----------|-----------------|-----------------------------------|
| DI067A-2B | Disk Island     |                                   |
| DI067A-2C | Disk Island     | uncleaned reference bed           |
| EL011A-B  | Eleanor Island  |                                   |
| EL011A-C  | Eleanor Island  |                                   |
| EL011A-D  | Eleanor Island  | uncleaned reference bed           |
| KN113B-2  | Herring Bay     | sample 2 depths and up slope area |
| SL001D-2  | Squirrel Island |                                   |

\* nomenclature follows the interagency Shoreline Cleanup Assessment Team (SCAT) shoreline assessment segment designations. Where we sampled multiple oiled mussel beds within one segment, they are designated with a number following the segment number.

### Sampling

Within each of these beds, triplicate pooled samples of mussels and of sediments will be collected at 8 random spots and placed in hydrocarbon-free glass jars. Approximately 20 mussels, will be collected by hand; the sediments will be collected with a hydrocarbon-free spoon. In 1992, intensive sampling indicated 3 distinct zones of oiling at CH010B-2A (Harris et al. 1996). These zones were obscured when the bed was cleaned, at least to a depth of 12 cm, but the recontamination pattern shown in 1996 samples indicates the re-formation of zones. Therefore, at CH010B-2A the initial zones will be re-sampled, so that triplicate pooled samples will be collected from each zone. At most cleaned beds and at the 3 uncleaned reference beds, sediments will be sampled at 3 depths: surface (0-2 cm), deep (4-6 cm), and below replaced sediment depth (>12 cm) to enable us to determine if oil below the replaced layer has recontaminated surficial sediments. Sediments will be sampled at only two depths, surface and deep, at the Herring Bay restored bed (KN113B-2) because oiled sediments were removed down to bedrock. In that bed, the recontamination source in 1996 appeared to be oiled sediments up slope of the restored area so the up slope area will be re-sampled.

All samples will be immediately cooled, and frozen within 6 h. Samples will be given a unique number in the field to facilitate sample tracking through chemical and data analysis and inclusion in a restoration hydrocarbon data base. Mussel densities will be estimated by counting mussels in 2 of the 4 frames within a 0.25 m x 0.25 m sampling quadrat in at least 8 subsites along the transect and will be expressed as mussels/m<sup>2</sup>.

### Chemical Analysis

Sediment samples will be analyzed by ultraviolet fluorescence as adapted from Krahn et al. (1991) and used successfully at Auke Bay Laboratory since 1992. Concentrations will be reported in µg total hydrocarbons /g wet weight of sediment (TPH). All mussel samples and selected sediments will be analyzed by gas chromatography/mass spectroscopy (GC/MS) for quantitative measurements of individual polynuclear aromatic hydrocarbons (PAH) (Larsen et al., 1992); concentrations will be reported in µg total PAH / g dry weight of mussel or sediment (TPAH). Perylene, which is produced naturally, will not be included in TPAH. At least one sediment sample from each bed will be analyzed by GC/MS to examine the degree and pattern of weathering of EVO if TPH levels in that bed are above pre-spill levels (50 µg/g).

### Data Analysis

Hydrocarbon data will be tested for normality and log transformed if necessary to carry out ANOVA to examine differences between sites (1999 data) and sampling times at each site (using 1992-1999 data). A longer time series will be possible for some sites where hydrocarbon samples have been collected since the mid 1970's. Assuming triplicate sampling as proposed, statistical power will be 80% ( $\alpha = 0.05$ ) to detect a change or difference of 60% at two sites or two sampling times at the same station (Kinetic Laboratories, 1993). Weathering of EVO will be examined using first-order kinetic loss rate modeling (Short and Heintz 1997) and by change in percent phenanthrenes (Babcock et al. in prep) in mussels and sediments analyzed by GC/MS.

## **Objective 2**

### Site Selection:

The 14 oiled mussel beds selected for sampling still contained  $> 0.09 \mu\text{g/g}$  TPAH in mussel tissues and/or  $> 200 \mu\text{g/g}$  TPH in underlying sediments in 1995. KN004-2 was not sampled in 1995, but was selected because TPAH in mussels was  $0.6 \mu\text{g/g}$  in 1994. Olsen Bay and Barnes Cove, two unoiled reference beds monitored since 1991, will be also be sampled.

Unrestored Mussels Beds Proposed for Sampling in 1999:

| Beach Segment* | Geographic Name  | Notes                                  |
|----------------|------------------|----------------------------------------|
| AE005A-2       | Applegate Island |                                        |
| CH009A-3       | Chenega Island   |                                        |
| DI067A-6       | Disk Island      | sampling 2 sediment depths             |
| EL013A         | Eleanor Island   | sampling of 2 zones, 2 sediment depths |
| EL015A-3       | Eleanor Island   |                                        |
| EV036A         | Evans Island     |                                        |
| KN004-2        | Bay of Isles     |                                        |
| KN119A         | Herring Bay      |                                        |
| KN133A-1       | Herring Bay      | sampling of 3 zones, 2 sediment depths |
| KN136A-1       | Bay of Isles     |                                        |
| KN136A-3       | Bay of Isles     | sampling 2 sediment depths             |
| KN505A         | Herring Point    |                                        |
| KN575A         | Barnes Cove      | unoiled reference                      |
| LA015E-2       | Latouche Island  | sampling 2 sediment depths             |
| MA002C         | Foul Bay         |                                        |
| OLSEN          | Olsen Bay        | unoiled reference                      |

Three additional small untreated beds will be sampled, but because these will be sampled similarly to the restored beds they are included under objective 1.

### Sampling:

In the untreated beds, mussel and sediment sampling will follow methods developed by this project in previous years (Babcock et al. 1996). In most of the above beds, a transect, generally 30 m long and parallel to the water line (as topography allows), will be established through the

middle of a mussel bed. Triplicate pooled samples of 20-25 mussels each will be collected approximately every 3 m along the transect and within 1 m above and below the transect and placed in 3 HC-free jars. Three pooled subsamples of surficial sediment (0-2 cm deep) under the mussels will be collected with a HC-free stainless steel spoon into each of three HC-free glass jars. A sample of sediments 4-6 cm below the surface will be taken in 5 beds where samples at that depth have been collected since 1992 to see if initial patterns of oiling related to depth still persist (see table above).

Two beds, KN133A and EL013B, had zones of significantly different concentrations of oil in 1992 (Harris et al., 1996). These beds will be re-sampled by the zones observed in 1992 (rather than by transect) to see if the initial within-bed oiling pattern persists as concentrations have declined. In each zone, three pooled replicate samples of sediments at depths 0-2 cm, 3 pooled replicate sediment samples at depths 4-6 cm, and three replicate samples of mussels will be collected. Sample handling, chemical analysis, and data analysis will follow the procedures discussed under objective 1.

#### Summary of Sampling and Analytical Methods

| Sample Type         | Objective 1<br>Restored Beds | Objective 2<br>Unrestored Beds | Totals    |
|---------------------|------------------------------|--------------------------------|-----------|
| UV Sediment         | 141                          | 78                             | 219       |
| GC/MS Sediment*     | 6                            | 14                             | 20        |
| <u>GC/MS Tissue</u> | <u>48</u>                    | <u>51</u>                      | <u>99</u> |
| TOTAL               | 189                          | 126                            | 315       |

\* Sediments to be analyzed by GC/MS are subsamples of UV sediment samples and therefore do not affect sample totals for each objective. The maximum number of sediments to be analyzed by GC/MS is 19. Sediments will not be analyzed by GC/MS if TPH concentrations are not above pre-spill levels in a bed.

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

No other agencies are involved, and the only contracts involved will be contract labor for sample processing for chemical analyses if Auke Bay Laboratory employees are not available when the work is done.

#### **SCHEDULE**

##### **A. Measurable Project Tasks for FY 98 (October 1, 1998 - September 30, 1999)**

|                             |                                                     |
|-----------------------------|-----------------------------------------------------|
| March - May (2 months)      | Arrange logistics, sampling and analytical supplies |
| May - June (10 flying days) | Collect samples from PWS sites                      |
| June - October              | Hydrocarbon analyses                                |

## **B. Project Milestones and Endpoints**

Data analysis and reporting for samples collected in summer of 1999 will be completed in winter 2000, with the submission of an Annual Report in April of 2000. A proposal for funding the completion of hydrocarbon analysis, data analysis, attendance at the annual EVOS workshop, and preparation of an annual report will be submitted for FY 2000.

## **C. Completion Date**

If our working hypotheses are shown true (significant amounts of oil are *not* found in PWS mussel beds), our objectives will have been met in April of 2000. If the hypotheses prove false, and significant amounts of oil *are* found, another round of sampling will be proposed for a future year, probably 2002.

## **PUBLICATIONS AND REPORTS**

FY99: none

FY00: final report and 2 manuscripts; Effectiveness of Manual Restoration of Oiled Mussel beds, Natural Recovery of Mussel beds Impacted by EVO

## **PROFESSIONAL CONFERENCES**

FY99: EVOS Symposium

FY00: EVOS workshop

## **NORMAL AGENCY MANAGEMENT**

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

## **COORDINATION AND INTEGRATION OF RESTORATION EFFORT**

Logistics of sampling will be tied as closely as practical to the sampling efforts of the Pristine Monitoring project and the sampling associated with the hydrocarbon monitoring of the Chenega Cleanup project if they continue into 1999. The potential for overlap is great since the same personnel will be involved. Data and results will be shared with other projects, especially those involving mussel predators (Nearshore Vertebrate Predators 99025, Alaska Predator Ecosystem Experiment (99163), and Differentiation/Interchange of Harlequins. Students from the Youth Area Watch (99210) will be invited to participate in sampling.

## **PROPOSED PRINCIPAL INVESTIGATORS**

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## **PRINCIPAL INVESTIGATORS**

### **Patricia M. Harris**

#### **Education:**

New York University  
University of Alaska Fairbanks; B.S. Biological Science 1966  
Graduate courses at U of A Fairbanks, U of A Southeast, University of British Columbia,  
U. of Washington

#### **Relevant Experience:**

1989-1992: Co-principal investigator of NRDA study Subtidal 3, was responsible for field logistics and sample collection and assisted in data analysis and report preparation; also assisted other NRDA projects in field collections.

1992 -1998: Participated in study design, field work, proposal preparation, data analysis, and report preparation for mussel bed monitoring and restoration (R103-96090).

1994-1998: Participated in logistical planning, sampling, community involvement coordination, sample tracking, chemical and data analysis, proposal and report preparation for the pristane monitoring in mussels project ( 96195-98195)

1996: Participated in mussel population surveys in PWS with Near shore Vertebrate Predator Project (96025)

1997 & 1998: Assisted in chemical sampling associated with the Chenega Cleanup project (97291, 98291)

Relevant publications: Co-author of annual and final reports for NRDA study Subtidal 3 and restoration project Monitoring of Oiled Mussel beds, contributing author to annual reports for Pristane Monitoring project, author of several publications pertaining to distribution of Exxon Valdez oil in mussels and underlying sediments. Several public presentations of oil-related scientific research.

Responsibilities: Study design, sample collection logistics, collect hydrocarbon samples, analyze data, prepare proposals and reports.

### **Christine C. Brodersen**

#### **Education:**

University of Washington; B.S. Zoology 1971

Graduate work at U of A Southeast

#### **Relevant Experience:**

1974 - present: Fisheries Research Biologist at Auke Bay Fisheries Laboratory, including:

1974 - mid-1980s: Conducted laboratory research on the toxicity of Alaskan crude oils to Alaskan marine species, especially larval stages.

1989 - 1991: Conducted training classes in the handling of hydrocarbon-analysis samples for personnel in agencies doing EVOS field work; coordinated legal chain-of-custody procedures for Auke Bay Laboratory EVOS work.

1989 - present: Participated in proposals, data analysis and reporting for mussel bed monitoring and restoration work (R103 - 96090) and conducted associated laboratory experiments on measures of potentially oil-related stress in mussels.

1994 - 1996; Conducted laboratory experiments on trophic transfer of pristane that helped establish the theories behind the PWS pristane project (96195).

1996: Participated in extensive mussel population surveys in PWS with Nearshore Vertebrate Predator study.

1997 & 1998: Principal investigator of the oil and biology monitoring portion of the Chenega Shoreline Restoration project (97291, 98291).

#### **Relevant publications & presentations:**

More than a dozen papers, reports and presentations on the effects of Alaskan oil, tanker ballast water, and the EVOS.

Responsibilities: Analyze data, prepare proposals, track samples, and collect hydrocarbon samples.

## LITERATURE CITED

- Babcock, M. M., P. M. Rounds, C. C. Brodersen and S. D. Rice. 1994. 1991 and 1992 recovery monitoring and restoration of intertidal oiled mussel (*Mytilus trossulus*) beds in Prince William Sound Impacted by the *Exxon Valdez* oil spill. U.S. Dep. Commer., AFSC Processed Report 94-02. Auke Bay Laboratory. Juneau, Alaska.
- Babcock, M. M., G. V. Irvine, P. M. Harris, J. A. Cusick and S. D. Rice. 1996. Persistence of oiling in mussel beds three and four years after the Exxon Valdez oil spill. In Proceedings of the 1993 *Exxon Valdez* Oil Spill Symposium, Pp. 298-308. Am. Fish. Soc. Bethesda, MD.
- Babcock et al. in prep, Mussel Bed Restoration and Monitoring, an *Exxon Valdez* Oil Spill final report (draft completed 1997).
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- Kinnetic Laboratories Incorporated. 1993. Prince William Sound RCAC long-term monitoring program power analysis report. 35pp.
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- Larsen, M., L. Holland, D. Fremgen, J. Lunasin, M. Wells, and J. Short. 1992. Standard operating procedures for the analysis of petroleum hydrocarbons in seawater, marine sediments, and marine faunal tissue at the Auke Bay Laboratory. Internal document. U.S. Dep. Commer., Natl. Mar. Fish. Serv., Alaska Fish. Sci. Cent., Auke Bay Lab., 11305 Glacier Hwy., Juneau, AK 99801-8626.
- Short, J. W., and R. A. Heintz. 1997. Identification of *Exxon Valdez* oil in sediments and tissues from Prince William Sound and the Northwestern Gulf of Alaska based on a PAH weathering model. Environ. Sci. Technol. 31:2375-2384.

# 1998 EXXON VALDEZ TRUST COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

| Budget Category:                                                                                                                              | Authorized<br>FY 1998 | Proposed<br>FY 1999 |                                 |                      |                      |                      |                      |  |
|-----------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|---------------------|---------------------------------|----------------------|----------------------|----------------------|----------------------|--|
| Personnel                                                                                                                                     |                       | \$120.5             |                                 |                      |                      |                      |                      |  |
| Travel                                                                                                                                        |                       | \$15.2              |                                 |                      |                      |                      |                      |  |
| Contractual                                                                                                                                   |                       | \$13.8              |                                 |                      |                      |                      |                      |  |
| Commodities                                                                                                                                   |                       | \$11.5              |                                 |                      |                      |                      |                      |  |
| Equipment                                                                                                                                     |                       | \$0.0               | LONG RANGE FUNDING REQUIREMENTS |                      |                      |                      |                      |  |
| Subtotal                                                                                                                                      | \$0.0                 | \$161.0             |                                 | Estimated<br>FY 2000 | Estimated<br>FY 2001 | Estimated<br>FY 2002 | Estimated<br>FY 2003 |  |
| General Administration                                                                                                                        |                       | \$19.0              |                                 |                      |                      |                      |                      |  |
| Project Total                                                                                                                                 | \$0.0                 | \$180.0             |                                 | \$58.0               |                      |                      |                      |  |
| Full-time Equivalents (FTE)                                                                                                                   |                       | 1.8                 |                                 |                      |                      |                      |                      |  |
| Dollar amounts are shown in thousands of dollars.                                                                                             |                       |                     |                                 |                      |                      |                      |                      |  |
| Other Resources                                                                                                                               |                       | \$42.5              |                                 |                      |                      |                      |                      |  |
| Comments:                                                                                                                                     |                       |                     |                                 |                      |                      |                      |                      |  |
| NOAA's Contribution:                                                                                                                          |                       |                     |                                 |                      |                      |                      |                      |  |
| Habitat Program Manager, S. Rice 1 mo. @1 1.3mo, J.W. Short 1 mo @8.4mo, Co- PI Biologist C. Brodersen 1 mo @ 6.2K, Co-PI, P Harris 2 mo @9.6 |                       |                     |                                 |                      |                      |                      |                      |  |
| NOAA also contributed the cost of analysis of 1996 sediment samples from restored beds 7K for total NOAA contribution of 42.5K.               |                       |                     |                                 |                      |                      |                      |                      |  |

**1999**

Project Number: 99090  
 Project Title: Mussel Bed Monitoring  
 Agency: NMFS, Auke Bay Laboratory

FORM 3A  
 TRUSTEE  
 AGENCY  
 SUMMARY

# 1998 EXXON VALDEZ TRUSTE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

| Personnel Costs:                           |                              | GS/Range/<br>Step | Months<br>Budgeted | Monthly<br>Costs | Overtime          | Proposed<br>FY 1999 |
|--------------------------------------------|------------------------------|-------------------|--------------------|------------------|-------------------|---------------------|
| Name                                       | Position Description         |                   |                    |                  |                   |                     |
| Harris                                     | Zoologist                    | GS-9/6            | 5.0                | 4.9              |                   | 24.5                |
| Brodersen                                  | Fisheries Research Biologist | GS-11/7           | 3.0                | 6.2              |                   | 18.6                |
|                                            |                              |                   |                    |                  |                   | 0.0                 |
| Chem Lab personnel for analyses:           |                              |                   |                    |                  |                   | 0.0                 |
| Holland                                    |                              | GS-11/6           | 4.0                | 6.0              |                   | 24.0                |
| Larsen                                     |                              | GS-11/6           | 4.0                | 6.0              |                   | 24.0                |
| Lunasin                                    |                              | GS-9/6            | 6.0                | 4.9              |                   | 29.4                |
|                                            |                              |                   |                    |                  |                   | 0.0                 |
|                                            |                              |                   |                    |                  |                   | 0.0                 |
|                                            |                              |                   |                    |                  |                   | 0.0                 |
|                                            |                              |                   |                    |                  |                   | 0.0                 |
|                                            |                              |                   |                    |                  |                   | 0.0                 |
| Subtotal                                   |                              |                   | 22.0               | 28.0             | 0.0               |                     |
| Personnel Total                            |                              |                   |                    |                  |                   | \$120.5             |
| Travel Costs:                              |                              | Ticket<br>Price   | Round<br>Trips     | Total<br>Days    | Daily<br>Per Diem | Proposed<br>FY 1999 |
| Description                                |                              |                   |                    |                  |                   |                     |
| 2 trips for 2 perosons Juneau to Cordova   |                              | 0.4               | 4                  | 18               | 0.2               | 5.2                 |
|                                            |                              |                   |                    |                  |                   | 0.0                 |
| aircraft charter, @\$1K/day                |                              | 1.0               | 9                  |                  |                   | 9.0                 |
|                                            |                              |                   |                    |                  |                   | 0.0                 |
| travel costs 1999 EVOS symposium, 1 person |                              | 0.4               | 1                  | 3                | 0.2               | 1.0                 |
|                                            |                              |                   |                    |                  |                   | 0.0                 |
|                                            |                              |                   |                    |                  |                   | 0.0                 |
|                                            |                              |                   |                    |                  |                   | 0.0                 |
|                                            |                              |                   |                    |                  |                   | 0.0                 |
|                                            |                              |                   |                    |                  |                   | 0.0                 |
|                                            |                              |                   |                    |                  |                   | 0.0                 |
| Travel Total                               |                              |                   |                    |                  |                   | \$15.2              |

1999

Project Number: 99090  
Project Title: Mussel Bed Monitoring  
Agency: NMFS, Auke Bay Laboratory

FORM 3B  
Personnel  
& Travel  
DETAIL

**1998 EXXON VALDEZ TRUSTEES COUNCIL PROJECT BUDGET**

October 1, 1998 - September 30, 1999

| <b>Contractual Costs:</b>                                                                   |  | Proposed      |
|---------------------------------------------------------------------------------------------|--|---------------|
| Description                                                                                 |  | FY 1999       |
| TAG contract labor in chem lab for analyses, and field work 2.5 mo. at \$34.50/hr, 5.5 K/mo |  | 13.8          |
| When a non-trustee organization is used, the form 4A is required.                           |  |               |
| <b>Contractual Total</b>                                                                    |  | <b>\$13.8</b> |
| <b>Commodities Costs:</b>                                                                   |  | Proposed      |
| Description                                                                                 |  | FY 1999       |
| HC-clean sample jars                                                                        |  | 0.9           |
| Chem Lab supplies for analyses (solvents , glassware, gasses)                               |  | 10.6          |
| <b>Commodities Total</b>                                                                    |  | <b>\$11.5</b> |

**1999**

Project Number: 99090  
 Project Title: Mussel Bed Monitoring  
 Agency: NMFS, Auke Bay Laboratory

**FORM 3B  
 Contractual &  
 Commodities  
 DETAIL**

# 1998 EXXON VALDEZ TRUST COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

| New Equipment Purchases:                                                                        |  | Number<br>of Units         | Unit<br>Price       | Proposed<br>FY 1999 |
|-------------------------------------------------------------------------------------------------|--|----------------------------|---------------------|---------------------|
| Description                                                                                     |  |                            |                     |                     |
|                                                                                                 |  |                            |                     | 0.0                 |
|                                                                                                 |  |                            |                     | 0.0                 |
|                                                                                                 |  |                            |                     | 0.0                 |
|                                                                                                 |  |                            |                     | 0.0                 |
|                                                                                                 |  |                            |                     | 0.0                 |
|                                                                                                 |  |                            |                     | 0.0                 |
|                                                                                                 |  |                            |                     | 0.0                 |
|                                                                                                 |  |                            |                     | 0.0                 |
|                                                                                                 |  |                            |                     | 0.0                 |
|                                                                                                 |  |                            |                     | 0.0                 |
|                                                                                                 |  |                            |                     | 0.0                 |
|                                                                                                 |  |                            |                     | 0.0                 |
| Those purchases associated with replacement equipment should be indicated by placement of an R. |  | <b>New Equipment Total</b> |                     | \$0.0               |
| Existing Equipment Usage:                                                                       |  | Number<br>of Units         | Inventory<br>Agency |                     |
| Description                                                                                     |  |                            |                     |                     |
| computer, printer                                                                               |  | 4                          | NOAA                |                     |
| GC/MS                                                                                           |  | 1                          | NOAA                |                     |
| HPLC                                                                                            |  | 1                          | NOAA                |                     |
| GPS                                                                                             |  | 1                          | NOAA                |                     |
| UVF radio                                                                                       |  | 1                          | NOAA                |                     |
| camera                                                                                          |  | 1                          | NOAA                |                     |
| freezer                                                                                         |  | 1                          | NOAA                |                     |

**1999**

Project Number: 99090  
 Project Title: Mussel Bed Monitoring  
 Agency: NMFS, Auke Bay Laboratory

**FORM 3B  
 Equipment  
 DETAIL**

99126

# 1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

| Budget Category:            | Authorized<br>FY 1998 | Proposed<br>FY 1999 | PROPOSED FY 1999 TRUSTEE AGENCIES TOTALS          |                      |                      |                      |           |         |
|-----------------------------|-----------------------|---------------------|---------------------------------------------------|----------------------|----------------------|----------------------|-----------|---------|
|                             |                       |                     | ADEC                                              | ADF&G                | ADNR                 | USFS                 | DOI/USFWS | DOI/NPS |
|                             |                       |                     |                                                   | \$22.4               | \$249.3              | \$248.6              | \$172.6   | \$10.3  |
| Personnel                   | \$352.8               | \$262.3             |                                                   |                      |                      |                      |           |         |
| Travel                      | \$56.0                | \$39.3              |                                                   |                      |                      |                      |           |         |
| Contractual                 | \$294.3               | \$381.8             |                                                   |                      |                      |                      |           |         |
| Commodities                 | \$4.7                 | \$7.2               |                                                   |                      |                      |                      |           |         |
| Equipment                   | \$0.0                 | \$0.0               | LONG RANGE FUNDING REQUIREMENTS                   |                      |                      |                      |           |         |
| Subtotal                    | \$707.8               | \$690.6             |                                                   | Estimated<br>FY 2000 | Estimated<br>FY 2001 | Estimated<br>FY 2002 |           |         |
| General Administration      | \$73.6                | \$66.1              |                                                   |                      |                      |                      |           |         |
| Project Total               | \$781.4               | \$756.7             |                                                   | \$480.0              | \$0.0                | \$0.0                |           |         |
|                             |                       |                     |                                                   |                      |                      |                      |           |         |
| Full-time Equivalents (FTE) | 4.8                   | 3.9                 |                                                   |                      |                      |                      |           |         |
|                             |                       |                     | Dollar amounts are shown in thousands of dollars. |                      |                      |                      |           |         |
| Other Resources             | \$0.0                 | \$0.0               |                                                   | \$0.0                | \$0.0                | \$0.0                |           |         |

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

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EXXON VALDEZ OIL SPILL  
TRUSTEE COUNCIL

1999

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

FORM 2A  
MULTI-TRUSTEE  
AGENCY  
SUMMARY

Prepared:

1 of 21

4/9/98

**1998 EXXON VALDEZ TRUST COUNCIL PROJECT BUDGET**

October 1, 1998 - September 30, 1999

| Budget Category:                                                                                                                                             | Authorized<br>FY 1998 | Proposed<br>FY 1999 |                                 |                      |                      |                      |  |  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|---------------------|---------------------------------|----------------------|----------------------|----------------------|--|--|
| Personnel                                                                                                                                                    | \$43.2                | \$36.2              |                                 |                      |                      |                      |  |  |
| Travel                                                                                                                                                       | \$3.7                 | \$2.8               |                                 |                      |                      |                      |  |  |
| Contractual                                                                                                                                                  | \$218.6               | \$241.0             |                                 |                      |                      |                      |  |  |
| Commodities                                                                                                                                                  | \$0.5                 | \$0.5               |                                 |                      |                      |                      |  |  |
| Equipment                                                                                                                                                    | \$0.0                 | \$0.0               |                                 |                      |                      |                      |  |  |
| Subtotal                                                                                                                                                     | \$266.0               | \$280.5             | LONG RANGE FUNDING REQUIREMENTS |                      |                      |                      |  |  |
| General Administration                                                                                                                                       | \$21.8                | \$22.3              |                                 | Estimated<br>FY 2000 | Estimated<br>FY 2001 | Estimated<br>FY 2002 |  |  |
| Project Total                                                                                                                                                | \$287.8               | \$302.8             |                                 | \$150.0              |                      |                      |  |  |
| Full-time Equivalents (FTE)                                                                                                                                  |                       | 0.4                 |                                 |                      |                      |                      |  |  |
| Dollar amounts are shown in thousands of dollars.                                                                                                            |                       |                     |                                 |                      |                      |                      |  |  |
| Other Resources                                                                                                                                              |                       |                     |                                 |                      |                      |                      |  |  |
| Comments:<br>Budget reflects continuation of AJV and Eyak large parcel transactions, Old Harbor Exchange, Lesnoi, Blondeau, and several other small parcels. |                       |                     |                                 |                      |                      |                      |  |  |

**1999**

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

FORM 3A  
TRUSTEE  
AGENCY  
SUMMARY

Prepared:

2 of 21

4/9/98

October 1, 1998 - September 30, 1999

| <b>Personnel Costs:</b>                                                                                                                               |                             | <b>GS/Range/<br/>Step</b> | <b>Months<br/>Budgeted</b> | <b>Monthly<br/>Costs</b> | <b>Overtime</b>           | <b>Proposed<br/>FY 1999</b> |
|-------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|---------------------------|----------------------------|--------------------------|---------------------------|-----------------------------|
| TBD                                                                                                                                                   | Natural Resource Manager II | 20                        | 3.0                        | 7.4                      |                           | 22.2                        |
| TBD                                                                                                                                                   | Natural Resource Manager II | 20                        | 2.0                        | 7.0                      |                           | 14.0                        |
|                                                                                                                                                       |                             |                           |                            |                          |                           | 0.0                         |
|                                                                                                                                                       |                             |                           |                            |                          |                           | 0.0                         |
|                                                                                                                                                       |                             |                           |                            |                          |                           | 0.0                         |
|                                                                                                                                                       |                             |                           |                            |                          |                           | 0.0                         |
|                                                                                                                                                       |                             |                           |                            |                          |                           | 0.0                         |
|                                                                                                                                                       |                             |                           |                            |                          |                           | 0.0                         |
|                                                                                                                                                       |                             |                           |                            |                          |                           | 0.0                         |
|                                                                                                                                                       |                             |                           |                            |                          |                           | 0.0                         |
|                                                                                                                                                       |                             |                           |                            |                          |                           | 0.0                         |
|                                                                                                                                                       |                             |                           |                            |                          |                           | 0.0                         |
| <b>Subtotal</b>                                                                                                                                       |                             |                           | 5.0                        | 14.4                     | 0.0                       |                             |
| <b>Personnel Total</b>                                                                                                                                |                             |                           |                            |                          |                           | \$36.2                      |
| <b>Travel Costs:</b>                                                                                                                                  |                             | <b>Ticket<br/>Price</b>   | <b>Round<br/>Trips</b>     | <b>Total<br/>Days</b>    | <b>Daily<br/>Per Diem</b> | <b>Proposed<br/>FY 1999</b> |
|                                                                                                                                                       |                             |                           |                            |                          |                           | 0.0                         |
| Travel to Prince William Sound and Gulf of Alaska for purposes of survey, title verification, and recordation, appraisal review and site inspections. |                             | 0.30                      | 3                          | 7                        | 0.15                      | 2.0                         |
|                                                                                                                                                       |                             |                           |                            |                          |                           | 0.0                         |
|                                                                                                                                                       |                             |                           |                            |                          |                           | 0.0                         |
| Travel to Juneau for Trustee Council briefings, presentations.                                                                                        |                             | 0.50                      | 1                          | 2                        | 0.15                      | 0.8                         |
|                                                                                                                                                       |                             |                           |                            |                          |                           | 0.0                         |
|                                                                                                                                                       |                             |                           |                            |                          |                           | 0.0                         |
|                                                                                                                                                       |                             |                           |                            |                          |                           | 0.0                         |
|                                                                                                                                                       |                             |                           |                            |                          |                           | 0.0                         |
|                                                                                                                                                       |                             |                           |                            |                          |                           | 0.0                         |
| <b>Travel Total</b>                                                                                                                                   |                             |                           |                            |                          |                           | \$2.8                       |

# 1999

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

FORM 3B  
Personnel  
& Travel  
DETAIL

Prepared:

3 of 21

4/9/98

# 1998 EXXON VALDEZ TRUST COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

| <b>Contractual Costs:</b>                                                                                                                                                                                                                  |  | Proposed       |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|----------------|
| Description                                                                                                                                                                                                                                |  | FY 1999        |
| Map productions, maps and data analysis for negotiators, appraisers, land status verification, data management support.                                                                                                                    |  | 30.0           |
| Aircraft charters to uplands to further refine parcel boundaries (20 hours @ \$400/hour)                                                                                                                                                   |  | 8.0            |
| Services necessary for the Trustee Council to reach closure on purchase agreements for parcels under negotiation. This may include: title reports, litigation reports, appraisal reviews, timber reviews, hazardous materials assessments. |  | 100.0          |
| Advertising                                                                                                                                                                                                                                |  | 1.0            |
| Document production and printing costs                                                                                                                                                                                                     |  | 2.0            |
| Small Parcel Title Insurance                                                                                                                                                                                                               |  | 10.0           |
| Small Parcel Appraisals                                                                                                                                                                                                                    |  | 15.0           |
| Closing and recordation of final title documents, surveys, easements.                                                                                                                                                                      |  | 20.0           |
| Hazardous Materials Review, AJV, Lesnoi, Small parcels.                                                                                                                                                                                    |  | 15.0           |
| Old Harbor Exchange (from 98126 supplemental)                                                                                                                                                                                              |  | 40.0           |
| When a non-trustee organization is used, the form 4A is required.                                                                                                                                                                          |  |                |
| <b>Contractual Total</b>                                                                                                                                                                                                                   |  | <b>\$241.0</b> |
| <b>Commodities Costs:</b>                                                                                                                                                                                                                  |  | Proposed       |
| Description                                                                                                                                                                                                                                |  | FY 1999        |
| Office and field supplies (toner cartridges, data cassettes, etc.)                                                                                                                                                                         |  | 0.5            |
| <b>Commodities Total</b>                                                                                                                                                                                                                   |  | <b>\$0.5</b>   |

**1999**

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

FORM 3B  
Contractual &  
Commodities  
DETAIL

Prepared:

4 of 21

4/9/98

## October 1, 1998 - September 30, 1999

|                    |                                                                                                                                                          |                                                           |
|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|
| <p><b>1999</b></p> | <p>Project Number: 99126<br/>         Project Title: Habitat Protection &amp; Acquisition Support<br/>         Agency: AK Dept. of Natural Resources</p> | <p>FORM 3B<br/>         Equipment<br/>         DETAIL</p> |
|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|

# 1998 EXXON VALDEZ TRUST COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

| Budget Category:                                  | Authorized<br>FY 1998 | Proposed<br>FY 1999 |                                 |                      |                      |                      |  |  |
|---------------------------------------------------|-----------------------|---------------------|---------------------------------|----------------------|----------------------|----------------------|--|--|
| Personnel                                         | \$129.0               | \$132.0             |                                 |                      |                      |                      |  |  |
| Travel                                            | \$16.7                | \$19.0              |                                 |                      |                      |                      |  |  |
| Contractual                                       | \$35.5                | \$68.0              |                                 |                      |                      |                      |  |  |
| Commodities                                       | \$2.5                 | \$5.0               |                                 |                      |                      |                      |  |  |
| Equipment                                         | \$0.0                 | \$0.0               | LONG RANGE FUNDING REQUIREMENTS |                      |                      |                      |  |  |
| Subtotal                                          | \$183.7               | \$224.0             |                                 | Estimated<br>FY 2000 | Estimated<br>FY 2001 | Estimated<br>FY 2002 |  |  |
| General Administration                            | \$21.8                | \$24.6              |                                 |                      |                      |                      |  |  |
| Project Total                                     | \$205.5               | \$248.6             |                                 | \$150.0              |                      |                      |  |  |
| Full-time Equivalents (FTE)                       | 1.7                   | 1.9                 |                                 |                      |                      |                      |  |  |
| Dollar amounts are shown in thousands of dollars. |                       |                     |                                 |                      |                      |                      |  |  |
| Other Resources                                   |                       |                     |                                 |                      |                      |                      |  |  |
| Comments:                                         |                       |                     |                                 |                      |                      |                      |  |  |

1999

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

FORM 3A  
TRUSTEE  
AGENCY  
SUMMARY

Prepared:

6 of 21

4/9/98

**1998 EXXON VALDEZ TRU COUNCIL PROJECT BUDGET**

October 1, 1998 - September 30, 1999

| <b>Personnel Costs:</b>       |                               | GS/Range/ | Months   | Monthly |          | Proposed       |
|-------------------------------|-------------------------------|-----------|----------|---------|----------|----------------|
| Name                          | Position Description          | Step      | Budgeted | Costs   | Overtime | FY 1999        |
| R. Goosens                    | Appraiser                     | 13        | 1.0      | 6.5     |          | 6.5            |
| L. Keeler                     | Lands Specialist              | 12        | 5.0      | 6.0     |          | 30.0           |
| K. Holbrook                   | Realty/Land Parcel Specialist | 13        | 7.0      | 6.5     |          | 45.5           |
| J. Swanson                    | Lands Examiner                | 9         | 3.0      | 4.7     |          | 14.1           |
| D. Kennedy                    | Lands Specialist              | 13        | 3.0      | 6.5     |          | 19.5           |
| R. Schrank                    | Cadastral Engineer            | 12        | 1.5      | 6.0     |          | 9.0            |
| C. Woods                      | Lands Recorder                | 6         | 2.0      | 3.7     |          | 7.4            |
|                               |                               |           |          |         |          | 0.0            |
|                               |                               |           |          |         |          | 0.0            |
|                               |                               |           |          |         |          | 0.0            |
|                               |                               |           |          |         |          | 0.0            |
|                               |                               |           |          |         |          | 0.0            |
| Subtotal                      |                               |           | 22.5     | 39.9    | 0.0      |                |
| <b>Personnel Total</b>        |                               |           |          |         |          | <b>\$132.0</b> |
| <b>Travel Costs:</b>          |                               | Ticket    | Round    | Total   | Daily    | Proposed       |
| Description                   |                               | Price     | Trips    | Days    | Per Diem | FY 1999        |
| RT Anchorage to Cordova       |                               | 0.24      | 6        | 30      | 0.2      | 7.4            |
| RT Anchorage to Juneau        |                               | 0.45      | 4        | 16      | 0.2      | 5.0            |
| RT Anchorage to Washington DC |                               | 2.50      | 2        | 8       | 0.2      | 6.6            |
|                               |                               |           |          |         |          | 0.0            |
|                               |                               |           |          |         |          | 0.0            |
|                               |                               |           |          |         |          | 0.0            |
|                               |                               |           |          |         |          | 0.0            |
|                               |                               |           |          |         |          | 0.0            |
|                               |                               |           |          |         |          | 0.0            |
|                               |                               |           |          |         |          | 0.0            |
| <b>Travel Total</b>           |                               |           |          |         |          | <b>\$19.0</b>  |

**1999**

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

**FORM 3B  
 Personnel  
 & Travel  
 DETAIL**

Prepared:

7 of 21

4/9/98

# 1998 EXXON VALDEZ TRUST COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

| <b>Contractual Costs:</b>                                         |  | Proposed      |
|-------------------------------------------------------------------|--|---------------|
| Description                                                       |  | FY 1999       |
| Title documents, title reports, purchase agreements               |  | 10.0          |
| Air Charter, 20 hours @ \$400/hr.                                 |  | 8.0           |
| Appraisals (small parcels)                                        |  | 50.0          |
| When a non-trustee organization is used, the form 4A is required. |  |               |
| <b>Contractual Total</b>                                          |  | <b>\$68.0</b> |
| <b>Commodities Costs:</b>                                         |  | Proposed      |
| Description                                                       |  | FY 1999       |
| supplies                                                          |  | 2.0           |
| Maps                                                              |  | 2.0           |
| Film and development                                              |  | 1.0           |
| <b>Commodities Total</b>                                          |  | <b>\$5.0</b>  |

**1999**

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

FORM 3B  
 Contractual &  
 Commodities  
 DETAIL

Prepared:

8 of 21

4/9/98

October 1, 1998 - September 30, 1999

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# 1999

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

FORM 3B  
Equipment  
DETAIL

Prepared:

9 of 21

4/9/98

# 1998 EXXON VALDEZ TRUST COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

| Budget Category:                                                                                                                                                                                                                                                                                            | Authorized<br>FY 1998 | Proposed<br>FY 1999 |                                 |                      |                      |                      |  |  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|---------------------|---------------------------------|----------------------|----------------------|----------------------|--|--|
| Personnel                                                                                                                                                                                                                                                                                                   | \$155.8               | \$69.9              |                                 |                      |                      |                      |  |  |
| Travel                                                                                                                                                                                                                                                                                                      | \$34.4                | \$16.3              |                                 |                      |                      |                      |  |  |
| Contractual                                                                                                                                                                                                                                                                                                 | \$39.9                | \$69.5              |                                 |                      |                      |                      |  |  |
| Commodities                                                                                                                                                                                                                                                                                                 | \$1.5                 | \$1.5               |                                 |                      |                      |                      |  |  |
| Equipment                                                                                                                                                                                                                                                                                                   | \$0.0                 | \$0.0               |                                 |                      |                      |                      |  |  |
| Subtotal                                                                                                                                                                                                                                                                                                    | \$231.6               | \$157.2             | LONG RANGE FUNDING REQUIREMENTS |                      |                      |                      |  |  |
| General Administration                                                                                                                                                                                                                                                                                      | \$26.2                | \$15.4              |                                 | Estimated<br>FY 2000 | Estimated<br>FY 2001 | Estimated<br>FY 2002 |  |  |
| Project Total                                                                                                                                                                                                                                                                                               | \$257.8               | \$172.6             |                                 | \$150.0              |                      |                      |  |  |
| Full-time Equivalents (FTE)                                                                                                                                                                                                                                                                                 | 3.1                   | 1.2                 |                                 |                      |                      |                      |  |  |
| Dollar amounts are shown in thousands of dollars.                                                                                                                                                                                                                                                           |                       |                     |                                 |                      |                      |                      |  |  |
| Other Resources                                                                                                                                                                                                                                                                                             |                       |                     |                                 |                      |                      |                      |  |  |
| Comments:                                                                                                                                                                                                                                                                                                   |                       |                     |                                 |                      |                      |                      |  |  |
| Budget represents closing costs associated with Koniag, Phase I Final Closing, Koniag Phase II, negotiations, AKI final closing remnants, AKI exchange closing and AJV purchase agreement and closing. Addition small parcel work focuses on KNA closing, 10-acre parcel closings and KIB foreclosed lands. |                       |                     |                                 |                      |                      |                      |  |  |

**1999**

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

FORM 3A  
 TRUSTEE  
 AGENCY  
 SUMMARY

Prepared:

10 of 21

4/9/98

**1998 EXXON VALDEZ TRU . COUNCIL PROJECT BUDGET**

October 1, 1998 - September 30, 1999

| <b>Personnel Costs:</b>                        |                         | GS/Range/<br>Step | Months<br>Budgeted | Monthly<br>Costs | Overtime          | Proposed<br>FY 1999 |
|------------------------------------------------|-------------------------|-------------------|--------------------|------------------|-------------------|---------------------|
| Name                                           | Position Description    |                   |                    |                  |                   |                     |
| C Rasmussen                                    | Review Appraiser        | 13                | 1.0                | 5.6              | 0.0               | 5.6                 |
| S. Shuck                                       | Realty Specialist       | 13                | 4.0                | 6.6              | 0.0               | 26.4                |
| N. Parker                                      | Realty Specialist       | 9                 | 4.0                | 3.9              | 0.0               | 15.6                |
| S. Alexander                                   | Realty Assistant        | 6                 | 2.0                | 3.2              | 0.0               | 6.4                 |
| K. Milton                                      | Cartographic Technician | 7                 | 2.0                | 3.6              | 0.0               | 7.2                 |
| G. Muehlenhardt                                | Biologist               | 12                | 1.5                | 5.8              | 0.0               | 8.7                 |
|                                                |                         |                   |                    |                  |                   | 0.0                 |
|                                                |                         |                   |                    |                  |                   | 0.0                 |
|                                                |                         |                   |                    |                  |                   | 0.0                 |
|                                                |                         |                   |                    |                  |                   | 0.0                 |
|                                                |                         |                   |                    |                  |                   | 0.0                 |
| Subtotal                                       |                         |                   | 14.5               | 28.7             | 0.0               |                     |
| <b>Personnel Total</b>                         |                         |                   |                    |                  |                   | <b>\$69.9</b>       |
| <b>Travel Costs:</b>                           |                         | Ticket<br>Price   | Round<br>Trips     | Total<br>Days    | Daily<br>Per Diem | Proposed<br>FY 1999 |
| Description                                    |                         |                   |                    |                  |                   |                     |
| Travel to Kodiak                               |                         | 0.4               | 8                  | 16               | 0.15              | 5.6                 |
| Travel to Kenai Salamatof and KNA              |                         |                   | 2                  | 4                | 0.15              | 0.6                 |
| Travel for Washington, D.C. and Colorado Staff |                         | 1.5               | 5                  | 17               | 0.15              | 10.1                |
|                                                |                         |                   |                    |                  |                   | 0.0                 |
|                                                |                         |                   |                    |                  |                   | 0.0                 |
|                                                |                         |                   |                    |                  |                   | 0.0                 |
|                                                |                         |                   |                    |                  |                   | 0.0                 |
|                                                |                         |                   |                    |                  |                   | 0.0                 |
|                                                |                         |                   |                    |                  |                   | 0.0                 |
|                                                |                         |                   |                    |                  |                   | 0.0                 |
| <b>Travel Total</b>                            |                         |                   |                    |                  |                   | <b>\$16.3</b>       |

**1999**

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

FORM 3B  
Personnel  
& Travel  
DETAIL

Prepared:

11 of 21

4/9/98

**1998 EXXON VALDEZ TRUST COUNCIL PROJECT BUDGET**

October 1, 1998 - September 30, 1999

| <b>Contractual Costs:</b>                                         |  | Proposed      |
|-------------------------------------------------------------------|--|---------------|
| Description                                                       |  | FY 1999       |
| Air Charter, Kodiak Charter Air Service                           |  | 6.0           |
| Title Insurance and Related Fees                                  |  | 46.0          |
| Survey of 10-acre parcels                                         |  | 7.5           |
| Appraisal - 10-acre parcels                                       |  | 10.0          |
| When a non-trustee organization is used, the form 4A is required. |  |               |
| <b>Contractual Total</b>                                          |  | <b>\$69.5</b> |
| <b>Commodities Costs:</b>                                         |  | Proposed      |
| Description                                                       |  | FY 1999       |
| Office Supplies                                                   |  | 1.5           |
| <b>Commodities Total</b>                                          |  | <b>\$1.5</b>  |

**1999**

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

**FORM 3B  
 Contractual &  
 Commodities  
 DETAIL**

Prepared:

12 of 21

4/9/98

October 1, 1998 - September 30, 1999

|                                                                                                 |  |                    |                            |                     |
|-------------------------------------------------------------------------------------------------|--|--------------------|----------------------------|---------------------|
| <b>New Equipment Purchases:</b>                                                                 |  | Number<br>of Units | Unit<br>Price              | Proposed<br>FY 1999 |
| Description                                                                                     |  |                    |                            |                     |
|                                                                                                 |  |                    |                            | 0.0                 |
|                                                                                                 |  |                    |                            | 0.0                 |
|                                                                                                 |  |                    |                            | 0.0                 |
|                                                                                                 |  |                    |                            | 0.0                 |
|                                                                                                 |  |                    |                            | 0.0                 |
|                                                                                                 |  |                    |                            | 0.0                 |
|                                                                                                 |  |                    |                            | 0.0                 |
|                                                                                                 |  |                    |                            | 0.0                 |
|                                                                                                 |  |                    |                            | 0.0                 |
|                                                                                                 |  |                    |                            | 0.0                 |
|                                                                                                 |  |                    |                            | 0.0                 |
|                                                                                                 |  |                    |                            | 0.0                 |
| Those purchases associated with replacement equipment should be indicated by placement of an R. |  |                    | <b>New Equipment Total</b> | \$0.0               |
| <b>Existing Equipment Usage:</b>                                                                |  |                    | Number<br>of Units         | Inventory<br>Agency |
| Description                                                                                     |  |                    |                            |                     |
|                                                                                                 |  |                    |                            |                     |

# 1999

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

FORM 3B  
Equipment  
DETAIL

**1998 EXXON VALDEZ TRUST COUNCIL PROJECT BUDGET**

October 1, 1998 - September 30, 1999

| Budget Category:                                  | Authorized<br>FY 1998 | Proposed<br>FY 1999 |                                 |                      |                      |                      |  |  |
|---------------------------------------------------|-----------------------|---------------------|---------------------------------|----------------------|----------------------|----------------------|--|--|
| Personnel                                         | \$13.0                | \$18.0              |                                 |                      |                      |                      |  |  |
| Travel                                            | \$1.2                 | \$1.2               |                                 |                      |                      |                      |  |  |
| Contractual                                       | \$0.3                 | \$0.3               |                                 |                      |                      |                      |  |  |
| Commodities                                       | \$0.2                 | \$0.2               |                                 |                      |                      |                      |  |  |
| Equipment                                         | \$0.0                 | \$0.0               |                                 |                      |                      |                      |  |  |
| Subtotal                                          | \$14.7                | \$19.7              | LONG RANGE FUNDING REQUIREMENTS |                      |                      |                      |  |  |
| General Administration                            | \$2.0                 | \$2.7               |                                 | Estimated<br>FY 2000 | Estimated<br>FY 2001 | Estimated<br>FY 2002 |  |  |
| Project Total                                     | \$16.7                | \$22.4              |                                 | \$20.0               |                      |                      |  |  |
| Full-time Equivalents (FTE)                       |                       | 0.3                 |                                 |                      |                      |                      |  |  |
| Dollar amounts are shown in thousands of dollars. |                       |                     |                                 |                      |                      |                      |  |  |
| Other Resources                                   |                       |                     |                                 |                      |                      |                      |  |  |
| Comments:                                         |                       |                     |                                 |                      |                      |                      |  |  |

**1999**

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

**FORM 3A  
 TRUSTEE  
 AGENCY  
 SUMMARY**

Prepared:

14 of 21

4/9/98

October 1, 1998 - September 30, 1999

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

Prepared: 15 of 21

4/9/98

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

| <b>Contractual Costs:</b>                                         |  | Proposed     |
|-------------------------------------------------------------------|--|--------------|
| Description                                                       |  | FY 1999      |
| Document reproduction                                             |  | 0.3          |
| When a non-trustee organization is used, the form 4A is required. |  |              |
| <b>Contractual Total</b>                                          |  | <b>\$0.3</b> |
| <b>Commodities Costs:</b>                                         |  | Proposed     |
| Description                                                       |  | FY 1999      |
| Office Supplies                                                   |  | 0.2          |
| <b>Commodities Total</b>                                          |  | <b>\$0.2</b> |

1999

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

FORM 3B  
Contractual &  
Commodities  
DETAIL

Prepared:

16 of 21

4/9/98

1999

|                                                                                                                     |
|---------------------------------------------------------------------------------------------------------------------|
| Project Number: 99126<br>Project Title: Habitat Protection & Acquisition Support<br>Agency: AK Dept. of Fish & Game |
|---------------------------------------------------------------------------------------------------------------------|

### FORM 3B Equipment DETAIL

**1998 EXXON VALDEZ TRUST COUNCIL PROJECT BUDGET**

October 1, 1998 - September 30, 1999

| Budget Category:                                  | Authorized<br>FY 1998 | Proposed<br>FY 1999 |                                 |                      |                      |                      |  |  |
|---------------------------------------------------|-----------------------|---------------------|---------------------------------|----------------------|----------------------|----------------------|--|--|
| Personnel                                         | \$11.8                | \$6.2               |                                 |                      |                      |                      |  |  |
| Travel                                            | \$0.0                 | \$0.0               |                                 |                      |                      |                      |  |  |
| Contractual                                       | \$0.0                 | \$3.0               |                                 |                      |                      |                      |  |  |
| Commodities                                       | \$0.0                 | \$0.0               |                                 |                      |                      |                      |  |  |
| Equipment                                         | \$0.0                 | \$0.0               | LONG RANGE FUNDING REQUIREMENTS |                      |                      |                      |  |  |
| Subtotal                                          | \$11.8                | \$9.2               |                                 | Estimated<br>FY 2000 | Estimated<br>FY 2001 | Estimated<br>FY 2002 |  |  |
| General Administration                            | \$1.8                 | \$1.1               |                                 |                      |                      |                      |  |  |
| Project Total                                     | \$13.6                | \$10.3              |                                 | \$10.0               |                      |                      |  |  |
|                                                   |                       |                     |                                 |                      |                      |                      |  |  |
| Full-time Equivalents (FTE)                       |                       | 0.1                 |                                 |                      |                      |                      |  |  |
| Dollar amounts are shown in thousands of dollars. |                       |                     |                                 |                      |                      |                      |  |  |
| Other Resources                                   |                       |                     |                                 |                      |                      |                      |  |  |
| Comments:                                         |                       |                     |                                 |                      |                      |                      |  |  |

**1999**

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

FORM 3A  
 TRUSTEE  
 AGENCY  
 SUMMARY

Prepared:

18 of 21

4/9/98

October 1, 1998 - September 30, 1999

|                    |                                                                                                                                                  |                                                                                     |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| <p><b>1999</b></p> | <p>Project Number: 99126<br/>         Project Title: Habitat Protection &amp; Acquisition Support<br/>         Agency: National Park Service</p> | <p>FORM 3B<br/>         Personnel<br/>         &amp; Travel<br/>         DETAIL</p> |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|

Prepared: 19 of 21

FORM 3B  
Personnel  
& Travel  
DETAIL

4/9/98

## October 1, 1998 - September 30, 1999

|                    |                                                                                                                                                  |                                                                                            |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|
| <p><b>1999</b></p> | <p>Project Number: 99126<br/>         Project Title: Habitat Protection &amp; Acquisition Support<br/>         Agency: National Park Service</p> | <p>FORM 3B<br/>         Contractual &amp;<br/>         Commodities<br/>         DETAIL</p> |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|

4/9/98

October 1, 1998 - September 30, 1999

1999

|                                                                                                                   |
|-------------------------------------------------------------------------------------------------------------------|
| Project Number: 99126<br>Project Title: Habitat Protection & Acquisition Support<br>Agency: National Park Service |
|-------------------------------------------------------------------------------------------------------------------|

# FORM 3B Equipment DETAIL

99127

## Project Title: Tatitlek Coho Salmon Release

Project Number: 99127  
Restoration Category: General Restoration  
Proposer: Tatitlek IRA Council  
Lead Trustee Agency: ADF&G  
Cooperating Agencies: Tatitlek IRA Council  
Alaska SeaLife Center No  
Duration: 5<sup>th</sup> year, 5 year project  
Cost FY 99: \$11,400  
Cost FY 00: \$0.0  
Geographic Area: Boulder Bay, Prince William Sound  
Injured Resource/Service: Salmon/Subsistence

RECEIVED  
APR 15 1998  
EXXON VALDEZ OIL SPILL  
TRUSTEE COUNCIL

### ABSTRACT

Project will create a coho salmon return to Boulder Bay near Tatitlek village. Enough coho eggs to produce 50,000 smolt will be collected from an ADF&G approved stream, incubated and reared to smolt at the Solomon Gulch Hatchery transported and held for two weeks in net pens in Boulder Bay before release. Release will produce a 2,000 to 3,000 adult return to Boulder Bay for harvest in a subsistence fishery.

## **INTRODUCTION**

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

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

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

## **NEED FOR THE PROJECT**

### **A. Statement of Problem**

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

### **B. Rationale/Link to Restoration**

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

### **C. Location**

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

## **COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE**

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

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

## **PROJECT DESIGN**

### **A. Objectives**

1. Continue agreement with the Valdez Fisheries Development Corporation to produce 50,000 coho salmon smolt for release in Boulder Bay.
2. Imprint smolt to Boulder Bay by holding and feeding them in net pens in the bay for two weeks prior to release into the wild.
3. Harvest for subsistence 2,000 to 3,000 coho salmon annually upon their return to the imprint site.

### **B. Methods**

The purpose of this project is to create a run of coho salmon in Boulder Bay near Tatitlek for subsistence use. The project would be undertaken annually and could be classified as "put and take" since it is unlikely that the coho returns produced by this project would establish a wild run.

There are four basic steps to the project; egg take, incubation and rearing to the smolt stage, imprinting and release of smolt and the subsistence harvest.

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

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

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

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

## **SCHEDULE**

### **A. Measurable Project Tasks for FY 99**

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

### **B. Project Milestones and Endpoints**

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

### **C. Completion Date**

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

## **PUBLICATIONS AND REPORTS**

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

## **PROFESSIONAL CONFERENCES**

No travel to professional conferences is planned under this project.

## **COORDINATION AND INTEGRATION OF RESTORATION EFFORT**

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

## **EXPLANATION OF CHANGES IN CONTINUING PROJECTS**

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

## **PROPOSED PRINCIPAL INVESTIGATOR**

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

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

|                             |                               |                             |                                                   |                      |                      |                      |  |  |
|-----------------------------|-------------------------------|-----------------------------|---------------------------------------------------|----------------------|----------------------|----------------------|--|--|
| <b>Budget Category:</b>     | <b>Authorized<br/>FY 1998</b> | <b>Proposed<br/>FY 1999</b> |                                                   |                      |                      |                      |  |  |
| Personnel                   |                               | \$0.0                       |                                                   |                      |                      |                      |  |  |
| Travel                      |                               | \$0.0                       |                                                   |                      |                      |                      |  |  |
| Contractual                 |                               | \$10.7                      |                                                   |                      |                      |                      |  |  |
| Commodities                 |                               | \$0.0                       |                                                   |                      |                      |                      |  |  |
| Equipment                   |                               | \$0.0                       | LONG RANGE FUNDING REQUIREMENTS                   |                      |                      |                      |  |  |
| Subtotal                    | \$0.0                         | \$10.7                      |                                                   | Estimated<br>FY 2000 | Estimated<br>FY 2001 | Estimated<br>FY 2002 |  |  |
| General Administration      |                               | \$0.7                       |                                                   |                      |                      |                      |  |  |
| Project Total               | \$0.0                         | \$11.4                      |                                                   | \$0.0                | \$0.0                | \$0.0                |  |  |
| Full-time Equivalents (FTE) |                               | 0.1                         |                                                   |                      |                      |                      |  |  |
| Other Resources             |                               |                             | Dollar amounts are shown in thousands of dollars. |                      |                      |                      |  |  |
| Comments:                   |                               |                             |                                                   |                      |                      |                      |  |  |
|                             |                               |                             |                                                   |                      |                      |                      |  |  |
|                             |                               |                             |                                                   |                      |                      |                      |  |  |
|                             |                               |                             |                                                   |                      |                      |                      |  |  |

**FY 99**

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

**FORM 3A  
 TRUSTEE  
 AGENCY  
 SUMMARY**

October 1, 1998 - September 30, 1999

|                     |                                                                                                                                                         |                                                                     |
|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------|
| <p><b>FY 99</b></p> | <p>Project Number: 99127<br/>         Project Title: Tatitlek Coho Salmon Release<br/>         Name: Tatitlek IRA Council<br/>         Agency: ADFG</p> | <p><b>FORM 4A<br/>         Non-Trustee<br/>         SUMMARY</b></p> |
|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------|

4/14/98, 2 of 5

October 1, 1998 - September 30, 1999

FY 99

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

4/14/98, 3 of 5

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

| Contractual Costs:                                                       |  | Proposed |
|--------------------------------------------------------------------------|--|----------|
| Description                                                              |  | FY 1999  |
| Transport 20,000 coho smolt to Boulder Bay, provide fish food & supplies |  | 6.1      |
| Village skiff rental                                                     |  | 0.8      |
| Contractual Total                                                        |  | \$6.9    |
| Commodities Costs:                                                       |  | Proposed |
| Description                                                              |  | FY 1999  |
| Commodities Total                                                        |  | \$0.0    |

**FY 99**

Prepared: 4/14/98

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

**FORM 4B**  
**Contractual &**  
**Commodities**  
**DETAIL**

October 1, 1998 - September 30, 1999

|                     |                                                                                                                                                         |                                                                |
|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------|
| <p><b>FY 99</b></p> | <p>Project Number: 99127<br/>         Project Title: Tatitlek Coho Salmon Release<br/>         Name: Tatitlek IRA Council<br/>         Agency: ADFG</p> | <p><b>FORM 4B</b><br/> <b>Equipment</b><br/> <b>DETAIL</b></p> |
|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------|

Prepared: 4/14/98

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

4/14/98, 5 of 5

99131

**Project Title: Chugach Native Region Clam Restoration**

RECEIVED

APR 15 1998

EXXON VALDEZ OIL SPILL  
TRUSTEE COUNCIL

Project Number: 99131  
Restoration Category: General Restoration  
Proposer: Chugach Regional Resources Commission  
Lead Trustee Agency: Alaska Department of Fish & Game  
Cooperating Agencies: Chugach Regional Resources Commission, Native Villages of  
Tatitlek, Nanwalek, Port Graham and Eyak  
Alaska SeaLife Center: No  
Duration: 5th year, 5-year project  
Cost FY 99 \$285,400  
Cost FY 00 \$0.0  
Geographic Areas: Native villages in Prince William Sound and lower Cook Inlet  
Injured Resource/Service: Clams/Subsistence

**ABSTRACT**

Cost effective procedures for establishing easily accessible subsistence clam populations near Native villages in the oil spill region will be established. In FY 99 the scope of work will be confined to developing effective, standardized techniques for producing Littleneck clam seed at the Qutekcak hatchery and analyzing growth and mortality of this seed placed on the beaches in FY 96, FY 97 and FY 98. Total seeded area during the project will not exceed 5 hectares. Follow-up research on success of seeding will be conducted. Growout development work will be confined to areas near the Native villages of Tatitlek, Nanwalek and Port Graham.

## INTRODUCTION

### A. General

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

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

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

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

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

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

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

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

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

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

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

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

In FY 99 the project scope will be narrowed to focus on improving hatchery production to the point that seed growth and survival meets shellfish hatchery standards. All hatchery work under this project in FY 99 will be restricted to littleneck clams. Work on the growout phase in FY 99 will concentrate on collecting and analyzing data to determine growth and mortality of littleneck clams planted in FY 96, FY 97 and FY 98.

Hatchery seed produced in FY 99 will be used to continue work on bringing hatchery nursery production up to acceptable standards and to continue studies on remote nursery production using the tidal FLUPSY. Nursery seed produced by both the hatchery and the tidal FLUPSY will be planted on project beaches in order to maintain the development schedule for creating subsistence clam beaches.

Since its inception the project has been contacted by other villages about having beaches near them included in the project. The three villages (Tatitlek, Nanwalek and Port Graham) that are currently involved in the various beach studies offer enough variety to accommodate all facets of the development phase. Including additional villages at this time would only detract from the project by spreading the limited resources over a larger geographic area.

In FY 96 a policy was put in place to accommodate additional villages that want to join the project. This involved conducting a baseline tidelands survey near each interested village to determine the extent of existing shellfish resources and the potential for enhancement. In FY 96 the villages of Chenega Bay and Ouzinkie had baseline surveys conducted. No further baseline surveys will be conducted under this project until the actual clam enhancement procedures that could be used to develop subsistence clam beds are better defined.

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

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

There are other funding sources, in addition the EVOS Trustee Council, that are contributing to this project.

## B. Funding

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

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

Once the objectives of this project have been met, and the hatchery is in commercial production, funding for the continued maintenance of the subsistence clam beds will come from the shellfish hatchery and the participating Native villages. Seed for the subsistence clam beds would be produced by the Qutekcak hatchery. Hatchery seed production for subsistence use would be a small piece of the anticipated commercial hatchery production and would not require additional funding.

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

## **NEED FOR THE PROJECT**

### **A. Statement of Problem**

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

### **B. Rationale/Link to Restoration**

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

### **C. Location**

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

## **COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE**

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

## PROJECT DESIGN

### A. Objectives

1. Hatchery Processes- Develop reliable, cost effective hatchery techniques for the littleneck clam (*Protothaca staminea*) and the cockle (*Clinocardium nutalli*). Produce a 5mm seed in the hatchery within 19 weeks after spawning.
2. Nursery- Develop cost effective, reliable techniques to grow 5mm hatchery seed to an out-planting size of 10mm - 15mm within 12 weeks.
3. Growout - Describe current local clam populations through interviews and resource assessments. Locate sites, develop reliable, cost effective growout techniques, and evaluate the efficacy of proposed methods. Develop permanent subsistence beaches.

### B. Methods

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

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

### OBJECTIVE 1. HATCHERY

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

Although a great deal had been accomplished at the hatchery, operations and procedures needed to become more reliable and efficient for the hatchery program to succeed over the long term. Total survival and production were low. To address this problem an experienced shellfish culturist with twelve years of practical hatchery experience was brought on as hatchery manager (see attached resume). He will remain on staff for the duration of this project at least and will be responsible for developing operational procedures and policies, finishing and equipping the new hatchery, training staff and making hatchery operations more successful and efficient.

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

improve broodstock development and clam seed and alga culture production.

The small pilot facility that had been used for the hatchery/nursery portion of this project is being closed down. Hatchery operations are currently in the process of being moved to the new shellfish hatchery facility that was completed by the state in the fall of 1977. Negotiations for the Qutekcak Native Tribe to lease and operate were completed in December 1997.

With the new facility online littleneck seed production can be increased. In FY 99 the hatchery will work with only littleneck clams under this project. The littleneck clam seed production goal for FY 98 is a minimum of 600,000. A set of standard procedures will be adopted for the production of hatchery seed.

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

#### 1. Broodstock Conditioning and Development

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

This protocol has repeatedly yielded well-ripened adults that mass spawn three to five million eggs per female. Lowering the conditioning temperatures to below 10 C rapidly solved our prior problem where half of the brood clams failed to undergo gametogenesis (females) or spawn (males). These same brood clams began spontaneous spawning at 10.5 C within one month after lowering the conditioning temperature to 10 C. We spawned them twice more in mid-winter ( normally an inactive period ) and during these controlled spawns the embryos developed normally to D-veliger larvae unlike the previous summer. Additional clam brood from Port Graham placed in conditioning in mid-March 1997 underwent rapid, normal gametogenesis as well. Starting from a completely spent gonadal state we have been able to spawn sub-groups these additional clams as necessary after only eight weeks. The embryos from these controlled spawns have developed to normal D-veligers as well and have not subsequently grown deformed.

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

## 2. Spawning and Larval Rearing

Two spawning methods will be tested in the new hatchery to determine the most successful.

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

After fertilization the clam embryos are transferred to the 30,000 liter larval rearing tanks filled with 1 $\mu$  filtered, UV-irradiated seawater at 16 C for the next 48 hours. One micron filtration has proven necessary to remove the fine glacial flour seasonally present in our waters. Initial densities will not exceed ten embryos per milliliter (ml). During the 48 hour period of development from egg to D veliger larva is where we have experienced persistent high rates of abnormal development for multiple species during some periods of the year. If extensive abnormal development recurs an additional seawater treatment step consisting of at least 45 minutes of percolation through a bed of granular activated carbon (GAC) will be incorporated. This treatment has improved seawater quality sufficiently enough to reduce the rate of abnormality. Lowering the broodstock conditioning temperature has substantially reduced the problem of abnormal development.

Supplementation of essential metals such as strontium, magnesium, and calcium may also be used during periods of surface water downwelling (induced by sustained, strong southerly winds) combined with high flow rates from a nearby stream. Prior IMS research revealed nutrient depletion down to their 70 m intake depth during periods of downwelling and our own water analysis found a depleted selenium concentration. Sustained downwelling weather conditions occur very infrequently based on our present experience with the IMS seawater system whose intake now sits on the sea floor after many years of sedimentation.

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

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

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

We know that a certain proportion of our lowered yields was due to pathogenically-bacterized algae cultures and higher than optimum larval densities. To determine the cause of larval mortalities experienced in the hatchery, we have and will continue to collect samples during periods of mortality of both live and freshly dead larvae for histopathological examination by Dr. Ralph Elston of AquaTechnics, Inc. Dr. Elston, a certified shellfish pathologist, has extensive experience serving the Pacific Northwest shellfish industry. Some results to date of his examination of Washington state oyster larvae soon dying after being transferred to our hatchery revealed infections with mantle invasive bacteria. He also found "advancing fronts of necrotic host cells suggesting the presence of a bacterial exotoxin." He recommends that bacterial management of the systems be addressed by investigating the usual sources of bacterial contamination and amplification, including stock and expanded algal cultures. We will implement his recommended bacterial management using testing media described in his book on shellfish diseases and his specific advice during an upcoming trip to our hatchery. Additional steps being taken to avoid growing or feeding pathogenically contaminated microalgae are described below under microalgae production. If after effective bacterial management within the new facility substantial larval mortality persists we will conduct an EPA-developed Toxicity Identification Evaluation (TIE). We are still investigating this procedure and seeking someone familiar with its use.

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

### 3. Larval Metamorphosis (Setting) and Spat Rearing

Clam pediveligers are placed into gentle downwelling setting systems at one million pediveligers per 4 cu. ft., screened tray and three trays per 600 liter partially recirculating

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

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

Once clam spat have grown to 1mm and are firmly byssing themselves to the screen surface, the water flow is reversed to an upwelling flow through the trays to better monitor flow rate and to better assure even feeding and oxygenation of the mat of spat on the screen surface. Later the upweller water temperature is dropped in steps to 12 C to prepare the expanding volumes of spat for transfer to outdoor upwelling systems plumbed to the one million liter seawater pond. The spat are transferred in the spring to this outdoor pre-nursery at 2mm in size where much greater quantities of natural food can be grown to support their exponentially increasing appetites and to acclimate them to more natural conditions. Pond seawater will be pumped through the trays of 2 mm spat at about 10 to 15 gpm and at higher flow rates as the spat grow to 3 to 5 mm in size. At this point they are ready for transfer to either the hatchery pre-nursery or a field nursery for the next stage of growth.

#### 4. Microalgae Culture

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

All aeration of the above mentioned cultures is sterile filtered at 0.2 microns. Guillard's L1 nutrient medium (an enhanced F/2) is used to nutrify all cultures. The solutions are prepared from dry compounds in distilled freshwater and kept refrigerated.

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

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

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

## **OBJECTIVE 2. NURSERY SYSTEM**

### **A. Seawater Pond Pre-Nursery**

The QSH utilizes a 1 million liter pond to culture algae for its pre-nursery. The 30m by 37m pond is 5 meters at its deepest point. Raw seawater from a 60 meter deep intake is pumped into the pond to bring in nutrient rich water. The flow can be controlled to allow for adequate flushing yet maintain the ambient air temperature. An air compressor is used to aerate and circulate water in the pond to eliminate stratification and increase phytoplankton production. Fertilizer solutions are added daily to increase the intensity and duration of phytoplankton blooms. Physical parameters of the seawater including temperature, salinity, pH, and redox potential are monitored and water samples are collected at various intervals for nutrient level analysis. Identification of the most abundant phytoplankters as well as secchi disk readings is also made. The food laden pond water is pumped through dense trays of small (1.5-2 mm) bivalve spat.

The flora of the pond can change weekly, usually with *Chaetoceros*, *Coscinodiscus*, *Thalassiosira*, or *Skeletonema* sp. dominant and much lower levels of pennate diatoms like *Nitzschia*, *Thalassiothrix*, *Asterionella*, or *Pleurosigma* sp. present. High levels of unidentified phytoflagellates can also dominate between diatom peaks. Natural cell densities of Resurrection

Bay are 5,000 cells/ml while the pond can be manipulated to produce a dense 250,000 cells/ml or more for feeding the shellfish.

The pond could support good growth for one million 3 - 5 mm clam spat. The full production potential of the pond as a pre-nursery has yet to be tapped, however, due to the limitations of the natural ecosystem that develops in it. It is very difficult to drain and clean regularly so phytoplankton grazers, undesirable species of competitive microalgae, heavy particulate formation, and unlit depths tend to control and reduce the quantity and quality of microalgae that could otherwise grow. This year we have also begun to "inoculate" the pond with 10,000 liter batch cultures of *Thalassiosira gravida* and *Skeletonema costatum* isolated from natural blooms here. Once the pond is so inoculated the diatoms have usually bloomed in the pond. The tanks are filled with the same unfiltered, 70 m seawater as flows into the pond, nutrified with Guillard's L1 medium, provided with aeration, and then inoculated with a carboy culture of the above species. During the summer passive solar gain quickly raises the tank temperature to between 13 C and 18 C which is 3 to 4 C warmer than the pond. Plastic sheeting over the top of the tank helps retain more heat during cooler periods. Growth is from ambient daylight only. A tank is harvested in 5 to 8 days at about 400,000 cells/ml. The same mono- or bi-specific tank cultures will also be fed directly to the pre-nursery spat to augment the ever-changing pond flora.

Because hatchery production of spat will quickly exceed the building and ponds present pre-nursery capacity and because the existing pond liner has many tears and holes it needs to be replaced as soon as possible. The plan is to replace the liner with four 40 foot diameter open top fiberglass tanks individually plumbed with seawater and drains. Alga cultures in these tanks could be grown much more intensively than possible in the pond because they can be easily and regularly drained and thoroughly cleaned. Improved passive solar gain may also accelerate the algae and spat grown with these partially recirculated cultures.

### **B. Remote Nursery Systems**

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

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

A prototype tidal FLUPSY was built toward the end of FY 96. Because of production problems in the hatchery there was no clam seed available to test in the FLUPSY. A modest amount of oyster seed was placed in the FLUPSY in lieu of clam and they did quite well for the time they were in it. The FLUPSY broke its moorings during a mid-winter storm and most of the seed was lost. The moorings have been strengthened and the FLUPSY is back in place. Clam seed, from the hatchery and/or the wild, was placed in the FLUPSY in FY 98 to test growth potential. These tests will be carried over and expanded in FY 99. The production objective for a tidal FLUPSY will be to produce 10+mm littleneck clam seed in a 12 week period between April 15 and October

### **OBJECTIVE 3. GROWOUT**

#### **A. Growout Techniques**

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

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

This does not preclude the use of hanging, floating or caged culture systems in this project. Some of these will be used during the development phase as learning tools to gain an understanding of growth and mortality under diverse conditions.

#### **1. Seeding Intertidal Areas**

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

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

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

The littleneck clam study involves the placement of seed clams (5 mm to 15 mm valve length) in a replicate, blocked design which will examine growth and mortality as a function of tidal height and in the presence or absence of protective predator exclusion devices. A uniform seeding density of 30 seed clams per square foot is utilized.

The following is a description of the seeding procedures that are followed for littleneck clams. Figures 1 and 2 at the back of this proposal present a schematic of the seeding activities at the project beaches.

**Growth and mortality of caged clams.** To get an accurate assessment of growth and mortality of clams it is necessary that they be caged in order to prevent individuals from moving in or out of the sample. One hundred seed clams will be placed in "Norplex™" bags for a detailed growth and mortality study. The valve lengths of all clams placed in the bags will be measured to the nearest 0.01 mm using vernier calipers. Clams placed in bags will be a random sample from the seed used in other parts of the study. Therefore, the mean lengths of clams in the bags will be used as the mean lengths of the clams seeded into other parts of the study.

Clam bag ends will be secured with electrical ties on one end and a 1" piece of split PVC pipe on the other end. Each bag will receive a shovelfull of sieved (1/2" sieve) gravel. Bags will then be nestled into the substrate to a minimum depth of 6". The top surfaces of each bag will extend a minimum of 1" above the substrate. Each bag will be secured to a piece of 1/2" rebar driven into the substrate to a minimum depth of 18" or when hitting bedrock. Identical study layouts will be used at all three Villages.

Bags will be retrieved at three-month intervals and all contents removed from the bags. The number of surviving clams, and the number of empty clamshells, will be determined. The valve length of each clam will be measured and recorded. Fouling organisms will be removed from the bags and clams will be replaced in the bags with a shovelfull of sieved (1/2") gravel. Clam bags will be carefully nestled in the sediment. It should take less than 20 minutes per bag to accomplish this. Clam bags should be retrieved individually, measured and replaced before the next bag is removed. This will minimize stress in the clams.

**Clam enhancement evaluation.** A minimum of 4 feet will be required between each treatment block. This will provide access without disturbing adjacent plots. Half the test plots will be covered with predator control netting. Car-cover netting will be used initially. However, as the clams grow and become more prone to sea otter predation, stronger mesh will be used. Experience with oyster hardening bags indicates that a heavy-duty vexar mesh will be sufficient, however wire mesh fencing cloth will be used if necessary. The netting will be precut to a dimension of 8'x 5'. It will be secured in a trench on all four sides of each 1.0 meter by 2.0 meter plot. The heavier mesh netting may be further secured by bar anchors set on the netting in the trench and covered over. Each plot will be marked with four pieces of PVC pipe driven into the substrate at each corner. Each piece of PVC pipe will have the plot number written on it (i.e. A +1.5). After all plots are seeded, the tidal elevation of the center of each plot or bag will be measured against a known tidal elevation. Sediment samples will be taken adjacent to each set of netted, un-netted and bagged samples for analysis of total volatile solids and sediment grain size. In addition to treatment samples, control stations will be sampled annually and processed in a similar manner.

**Seeding.** All large (>10.0 cm diameter) rock and cobble will be removed from the area to be seeded. The area will be dug to remove all clams larger than 1.0 cm. The valve length of clams removed will be measured and recorded. Three random samples of seed for each beach will be weighed and counted to obtain an average weight per clam. A total clam weight equivalent to 600 clams will be seeded into each 1.0 x 2.0 meter area as the tide floods. Clams will be seeded through the car cover netting.

**Maintenance.** Village culturists will need to monitor these studies on a weekly basis, or as tidal conditions permit. All rips in the netting must be repaired and all predators removed. Badly damaged nets should be replaced with as little disturbance to the culture as possible.

**Data recording.** Clams in the enhancement evaluation will be examined annually during the 1997, 1998 and 1999 fieldwork. Clam plots will be evaluated by noting the presence of predators, and covering the netted plots and collecting three randomly selected 0.1 M<sup>2</sup> samples from each plot. The clams in the samples will be counted, measured in-situ and immediately replaced at a shallow depth with the substrate taken from the quadrat. New netting will then be installed.

A sediment sample will be collected from the top four inches of the substrate at randomly selected stations along each of the orthogonal transects. The RPD will be measured at each of these points and a second sediment sample retained for total volatile solids analysis. The substrate will be characterized to include the following:

- A. Substrate color
- B. Presence of attached macroalgae
- C. Presence of predators
- D. Evidence of excessive littoral drift or log damage
- E. Oily sheen
- F. Odor (hydrogen sulfide, ammonia or petroleum)
- G. Suitability for specific culture techniques.
- H. A photographic record of the site will be made to include at least 20 pictures describing the general area, shoreline, fetch, and substrate type.
- I. A small drogue will be placed in the water on arrival and its progress along the shoreline monitored during the period of study to assess currents.
- J. A transit will be used to measure the elevation of the water height at a specific time and of each sample station on the transects run orthogonal to the beach.
- K. Water temperature, dissolved oxygen and salinity will be measured. A 500 ml water sample will be retained for total suspended solids and total volatile solids analysis.
- L. At a minimum, each beach survey will include:
  - 1. 12 shellfish samples
  - 2. 4 sediment samples (50 gm each) for sediment grains size analysis
  - 3. 4 sediment samples for Total Volatile Solids analysis.
  - 4. One 500 ml water sample

Sediment grain size will be determined using the sieve and pipette method. Sediments greater than 1 cm will be pooled. Additional sieve sizes will include 2 mm, 1 mm, 500  $\mu$ m, 125  $\mu$ m, and 63  $\mu$ m. Silt (>3.9  $\mu$ m) and clay (<3.9  $\mu$ m) will be differentiated using the pipette method.

Sediment Total Volatile Solids will be determined by drying a sediment sample at  $103 \pm 2^\circ \text{C}$  until no further weight reduction is observed and then ashing the sample at  $550^\circ \text{C}$  until no further weight loss is recorded.

Water Total Suspended Solids and Total Volatile Solids. A 0.45  $\mu$ m glass filter is ashed at  $550^\circ \text{C}$  and weighed. A 350 ml sample of thoroughly mixed water is suction filtered and the residue dried at  $103 \pm 2^\circ \text{C}$  to determine TSS. Total volatile solids are determined following ashing of the sample at  $550^\circ \text{C}$ .

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

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

## **SCHEDULE**

### **A. Measurable Project Tasks for FY 98**

10/98 – ongoing: Continue to collect broodstock, and transport to hatchery  
10/98 - 9/99: continue to develop techniques to mature and spawn broodstock  
10/98 - 9/99: continue to develop techniques for producing 5 mm seed in hatchery  
3/99 - 7/99; transfer 5 mm seed to hatchery pre-nursery and FLUPSY  
4/10/99: submit annual project report for FY 98  
4/99 – ongoing: continue develop techniques for producing 10 mm to 15 mm seed for growout  
10/98 – ongoing: continue work on nursery production in tidal FLUPSY at Tatitlek  
10/98 – ongoing: continue predator control studies on razor clam beaches near Eyak.  
10/98 – ongoing: continue growth/mortality and predator control studies for littleneck clams – initiate seeding density and substrate adaptability studies on cockles.  
4/10/00: submit annual project report for FY 99.

### **B. Project Milestones and Endpoints**

#### **Objective 1.**

June, 1995: initial procedure developed for Littleneck clam  
June, 1997: completed for littleneck clam

#### **Objective 2.**

September, 1998: Littleneck clam in hatchery  
October, 1999: Complete tests on tidal FLUPSY.

#### **Objective 3.**

August, 1995: Describe current local clam populations for Tatitlek and Port Graham/Nanwalek areas.  
September, 1995: Locate sites in Tatitlek and Port Graham/Nanwalek areas for developing beach growout methods.  
March, 1996: Obtain permits and begin fieldwork at growout sites at Tatitlek and Port Graham/Nanwalek.  
June, 1996: Initiate predator control studies on razor clam beaches near Eyak.  
June/July, 1996: Conduct baseline beach survey at Chenega Bay and Ouzinkie.  
June/July, 1997: Initiate process for establishing permanent subsistence beaches at Tatitlek and Port Graham/Nanwalek.  
September, 1998: Initiate process for incorporating predator control

### **C. Completion Date**

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

### **PUBLICATIONS AND REPORTS**

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

### **PROFESSIONAL CONFERENCES**

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

### **COORDINATION AND INTERGRATION OF RESTORATION EFFORT**

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

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

## **EXPLANATION OF CHANGES IN CONTINUING PROJECTS**

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

## **PROPOSED PRINCIPAL INVESTIGATOR(S)**

Dave Daisy/Jeff Hetrick/Jon Agosti  
Chugach Regional Resources Commission  
4201 Tudor Centre Drive, Suite 300  
Anchorage, AK 99508  
Phone: (907) 562-6647  
Fax: (907) 562-4939

## **PERSONNEL**

### **PATRICIA BROWN SCHWALENBERG**

6450 Andover Drive  
Anchorage, Alaska 99516  
907 345-2187

#### **Employment:**

June 1994 to Present: Executive Director Chugach Regional Resource Commission. Responsible for Natural Resource and Fisheries development for the seven native villages in the Chugach region. This includes administering office staff, village projects in mariculture and fisheries and protecting and enhancing subsistence opportunities.

October 92 to June 1994: Office Manager Bering Sea Commercial Fisheries Development Foundation. Responsibilities included maintaining all management systems for the organization including financial, personnel, property and central filing. She was responsible for financial management and accountability of all grants, payroll, taxes and financial statements, and organizing and overseeing public relations.

October 1987 to June 1992 Society Administrator /Public Relations Director. Native American Fish and Wildlife Society. Assisted in the establishment and development of a national office for the Native American Fish and Wildlife Society. Implemented personnel policies and procedures, property management policies, record and financial management systems. Implemented strategies to obtain goals and objectives of the society.

#### **Education:**

Business Administration University of Alaska-Anchorage (ongoing).  
Certification of Completion. 1977 Humboldt Institute

**DAVID DAISY**  
**3936 Westwood Drive**  
**Anchorage, Alaska 99517**  
**(907) 243-8544**

**Employment:**

October, 1987-Present: Fisheries consultant with emphasis on aquaculture. Contractor to Chugach Regional Resource Commission developing salmonid hatcheries at Port Graham and Nanwalek and oyster mariculture operations at Tatitlek and Chenega Bay. Oversight and management of these projects involves grant writing and financial and activity reporting to granting agencies.

February, 1979 to October, 1987: Regional Program Manager, Region II, Fisheries Rehabilitation, Enhancement and Development (FRED) Division, Alaska Department of Fish & Game. Under general supervision of the FRED Director, responsible for the planning, development, operation and control of the State's salmonid enhancement and rehabilitation program in Region II which encompasses all of Alaska except Southeast.

November, 1977 to February, 1979: Regional Project Manager: Cook Inlet - Prince William Sound, Fisheries Rehabilitation, Enhancement and Development (FRED) Division, Alaska Department of Fish & Game. Under supervision of the Regional Program Manager responsible for the implementation and control of salmon enhancement research and development projects in the Prince William Sound and Cook Inlet areas. Assisted the Regional Program Manager in hatchery development planning.

April, 1968 to February, 1979: Management Biologist, Commercial Fisheries Division, Alaska Department of Fish and Game in the Ketchikan, Cook Inlet and Upper Cook Inlet areas. Oversaw various management projects (weirs, counting towers, fisheries sampling) determined and set fishing periods for herring and salmon and responsible for meeting escapement and recruitment goals.

**Education:**

B.Sc. Fisheries, University of Massachusetts, Amherst, 1965.

**JEFF HETRICK**  
**P. O. Box 7**  
**Moose Pass, Alaska 99631**  
**(907) 288-3667**

**Employment:**

1987- Present: Hatchery Manager Cook Inlet Aquaculture Association. Manage Trail Lakes Hatchery which produces 12 million sockeye salmon fry and 2 million sockeye salmon smolts annually.

1988-Present: Consultant for Shellfish Culture. Clients include:  
Chugach Regional Resource Commission- develop oyster farms at Chenega Bay and Tatitlek. Included permitting, farm design, training and marketing.  
Qutekcak Native Tribe- Design and develop first shellfish hatchery in Alaska.

1983-1987 Assistant Manager. Alaska Department of Fish and Game.  
Assistant manager at Main Bay (Chum and Sockeye Salmon) and Cannery Creek (Pink Salmon)  
Hatcheries in Prince William Sound.

**Education:**

MBA California Coast University- Thesis under review  
B.Sc. Biological Sciences. University of Maryland, 1980

**DR. KENNETH M. BROOKS**

644 old Eaglemount Road  
Port Townsend, WA 98368  
(360) 732-4464

**Employment**

|              |                                                              |
|--------------|--------------------------------------------------------------|
| 1959-1979    | U.S. Navy Officer - retired in 1959                          |
| 1979-1992    | Owner/operator of Black Angus ranch                          |
| 1982-1992    | Environmental mediator for Washington state                  |
| 1988-1990    | Battelle Marine Science Laboratory, NORCUS grant             |
| 1989-present | President, Aquatic Environmental Sciences, Port Townsend, WA |
| 1993-present | Director, Fisheries Technology Program, Peninsula College    |

**Education**

B. Sc. - Physics, Naval Postgraduate School (NPS), 1973  
M. Sc. - Physics, NPS, 1974  
Ph.D. - College of Ocean Sciences and Fisheries, University of Washington, 1991

**John L. Agosti**

P. O. Box 369  
Seward, AK 99664  
(907) 224-5181

**Employment**

|              |                                                                      |
|--------------|----------------------------------------------------------------------|
| 1983-1984    | Hatchery Technician, Westcott Bay Sea Farm, Friday Harbor, WA        |
| 1984-1986    | Research Consultant, Ketron Island Sea Farm, Stellacoom, WA          |
| 1986-1996    | Assistant Hatchery Manager, Westcott Bay Sea Farm, Friday Harbor, WA |
| 1996-present | Hatchery Manager, Qutekcak Shellfish Hatchery, Seward, AK            |

**Education**

B. Sc., Biological Oceanography, Humbolt State University, 1984  
Prepared 04/14/98

## REFERENCES

- Adams, C. et al. 1991. Investing in Commercial Hardclam Culture: A Comprehensive Guide to the South Atlantic States. Florida Sea Grant College Program (SGR-104).
- Alaska Department of Fish & Game, 1992 Annual Report on Aquatic Farming, PO Box 3-2000 Juneau, AK 99802.
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- Fall, J. and R. Maraglia, 1994 . Personal communication. Alaska Department of Fish & Game, Subsistence Division 333 Raspberry Road, Anchorage, AK 99518.
- Horn, S. 1993. Shellfish Development in Kachemak Bay: Resource Directory. Kenai Peninsula Borough Economic Development District, Inc. 110 South Willow Street, Suite 106, Kenai, AK 99611.
- Manzi, J.J., M. Castagna, (Editors) 1989. Clam Culture in North America. Developments in Aquaculture and Fisheries Science, Volume 19, Elsevier Science Publishing, 665 Avenue of the Americas, New York, NY 10010.
- Orth, Franklin et al. 1975. The Alaska Clam Fishery: A survey and Analysis of Economic Potential. U of Alaska Institute of Marine Science report No. R75-3; Alaska Sea Grant Report No. 75-5 U of A, IMS, Fairbanks, AK 99701.
- Paul, A.J., Feder, Howard 1976. Clam, Mussel and Oyster Resources of Alaska. U of Alaska Institute of Marine Science Report No. 76-4 U of A, IMS, Fairbanks, AK 99701.
- South Carolina Sea Grant Program 1994. Harnessing the Tides for Clam Aquaculture: An Emerging Technology. S. C. Sea Grant video Charleston, SC 29401.

# FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

| Budget Category:                                  | Authorized<br>FY 1998 | Proposed<br>FY 1999 |                                 |                      |                      |                      |  |  |
|---------------------------------------------------|-----------------------|---------------------|---------------------------------|----------------------|----------------------|----------------------|--|--|
| Personnel                                         |                       | \$0.0               |                                 |                      |                      |                      |  |  |
| Travel                                            |                       | \$0.0               |                                 |                      |                      |                      |  |  |
| Contractual                                       |                       | \$267.5             |                                 |                      |                      |                      |  |  |
| Commodities                                       |                       | \$0.0               |                                 |                      |                      |                      |  |  |
| Equipment                                         |                       | \$0.0               |                                 |                      |                      |                      |  |  |
| Subtotal                                          | \$0.0                 | \$267.5             | LONG RANGE FUNDING REQUIREMENTS |                      |                      |                      |  |  |
| General Administration                            |                       | \$17.9              |                                 | Estimated<br>FY 2000 | Estimated<br>FY 2001 | Estimated<br>FY 2002 |  |  |
| Project Total                                     | \$0.0                 | \$285.4             |                                 | \$0.0                | \$0.0                | \$0.0                |  |  |
| Full-time Equivalents (FTE)                       |                       | 1.1                 |                                 |                      |                      |                      |  |  |
| Dollar amounts are shown in thousands of dollars. |                       |                     |                                 |                      |                      |                      |  |  |
| Other Resources                                   |                       |                     |                                 |                      |                      |                      |  |  |
| Comments:                                         |                       |                     |                                 |                      |                      |                      |  |  |

FY 99

Project Number: 99131  
 Project Title: Chugach Native Region Clam Restoration  
 Agency: ADFG

FORM 3A  
 TRUSTEE  
 AGENCY  
 SUMMARY

# FY 99 EXXON VALDEZ TRAIL COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

| Budget Category:                                                                                                                               | Authorized<br>FY 1998 | Proposed<br>FY 1999 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                      |                      |                      |  |  |  |             |  |           |                       |        |                                     |             |       |                               |          |  |                                     |                      |       |              |                    |       |           |                       |       |             |           |        |             |                       |        |               |       |         |
|------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|----------------------|----------------------|--|--|--|-------------|--|-----------|-----------------------|--------|-------------------------------------|-------------|-------|-------------------------------|----------|--|-------------------------------------|----------------------|-------|--------------|--------------------|-------|-----------|-----------------------|-------|-------------|-----------|--------|-------------|-----------------------|--------|---------------|-------|---------|
| Personnel                                                                                                                                      | \$53.8                | \$56.4              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                      |                      |                      |  |  |  |             |  |           |                       |        |                                     |             |       |                               |          |  |                                     |                      |       |              |                    |       |           |                       |       |             |           |        |             |                       |        |               |       |         |
| Travel                                                                                                                                         | \$2.4                 | \$2.4               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                      |                      |                      |  |  |  |             |  |           |                       |        |                                     |             |       |                               |          |  |                                     |                      |       |              |                    |       |           |                       |       |             |           |        |             |                       |        |               |       |         |
| Contractual                                                                                                                                    | \$201.2               | \$187.6             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                      |                      |                      |  |  |  |             |  |           |                       |        |                                     |             |       |                               |          |  |                                     |                      |       |              |                    |       |           |                       |       |             |           |        |             |                       |        |               |       |         |
| Commodities                                                                                                                                    | \$0.0                 | \$0.7               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                      |                      |                      |  |  |  |             |  |           |                       |        |                                     |             |       |                               |          |  |                                     |                      |       |              |                    |       |           |                       |       |             |           |        |             |                       |        |               |       |         |
| Equipment                                                                                                                                      | \$0.0                 | \$0.0               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                      |                      |                      |  |  |  |             |  |           |                       |        |                                     |             |       |                               |          |  |                                     |                      |       |              |                    |       |           |                       |       |             |           |        |             |                       |        |               |       |         |
| Subtotal                                                                                                                                       | \$257.4               | \$247.1             | LONG RANGE FUNDING REQUIREMENTS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                      |                      |                      |  |  |  |             |  |           |                       |        |                                     |             |       |                               |          |  |                                     |                      |       |              |                    |       |           |                       |       |             |           |        |             |                       |        |               |       |         |
| Indirect                                                                                                                                       | \$13.8                | \$20.4              | Estimated<br>FY 2000                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Estimated<br>FY 2001 | Estimated<br>FY 2002 | Estimated<br>FY 2003 |  |  |  |             |  |           |                       |        |                                     |             |       |                               |          |  |                                     |                      |       |              |                    |       |           |                       |       |             |           |        |             |                       |        |               |       |         |
| Project Total                                                                                                                                  | \$271.2               | \$267.5             | \$0.0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | \$0.0                | \$0.0                | \$0.0                |  |  |  |             |  |           |                       |        |                                     |             |       |                               |          |  |                                     |                      |       |              |                    |       |           |                       |       |             |           |        |             |                       |        |               |       |         |
| Full-time Equivalents (FTE)                                                                                                                    |                       | 1.1                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                      |                      |                      |  |  |  |             |  |           |                       |        |                                     |             |       |                               |          |  |                                     |                      |       |              |                    |       |           |                       |       |             |           |        |             |                       |        |               |       |         |
| Dollar amounts are shown in thousands of dollars.                                                                                              |                       |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                      |                      |                      |  |  |  |             |  |           |                       |        |                                     |             |       |                               |          |  |                                     |                      |       |              |                    |       |           |                       |       |             |           |        |             |                       |        |               |       |         |
| Other Resources                                                                                                                                |                       |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                      |                      |                      |  |  |  |             |  |           |                       |        |                                     |             |       |                               |          |  |                                     |                      |       |              |                    |       |           |                       |       |             |           |        |             |                       |        |               |       |         |
| <p>Comments: The Shellfish Culture and Hatchery Operations Specialist will be employed by CRRC and not by the Qutekcak Shellfish Hatchery.</p> |                       |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                      |                      |                      |  |  |  |             |  |           |                       |        |                                     |             |       |                               |          |  |                                     |                      |       |              |                    |       |           |                       |       |             |           |        |             |                       |        |               |       |         |
| Hatchery Budget Breakdown                                                                                                                      |                       |                     | <table style="width: 100%; border: none;"> <tr> <td style="width: 40%;"></td> <td style="width: 20%; text-align: right;">Contractual</td> <td style="width: 40%;"></td> </tr> <tr> <td>Personnel</td> <td style="text-align: right;">Shellfish Health Mngt</td> <td style="text-align: right;">\$20.0</td> </tr> <tr> <td>1/2 Hatchery Specialist (full time)</td> <td style="text-align: right;">Maintenance</td> <td style="text-align: right;">\$6.0</td> </tr> <tr> <td>1/2 Technician II (half time)</td> <td style="text-align: right;">Supplies</td> <td></td> </tr> <tr> <td>1/2 Maintenance/Tech II (full time)</td> <td style="text-align: right;">Maintenance supplies</td> <td style="text-align: right;">\$6.8</td> </tr> <tr> <td>Fringe @ 21%</td> <td style="text-align: right;">Hatchery chemicals</td> <td style="text-align: right;">\$4.0</td> </tr> <tr> <td>Utilities</td> <td style="text-align: right;">Plumbing &amp; electrical</td> <td style="text-align: right;">\$6.0</td> </tr> <tr> <td>Boiler Fuel</td> <td style="text-align: right;">Insurance</td> <td style="text-align: right;">\$10.0</td> </tr> <tr> <td>Electricity</td> <td style="text-align: right;">Tribal Administration</td> <td style="text-align: right;">\$16.2</td> </tr> <tr> <td>Sewer &amp; Water</td> <td style="text-align: right;">Total</td> <td style="text-align: right; border-top: 1px solid black;">\$161.2</td> </tr> </table> |                      |                      |                      |  |  |  | Contractual |  | Personnel | Shellfish Health Mngt | \$20.0 | 1/2 Hatchery Specialist (full time) | Maintenance | \$6.0 | 1/2 Technician II (half time) | Supplies |  | 1/2 Maintenance/Tech II (full time) | Maintenance supplies | \$6.8 | Fringe @ 21% | Hatchery chemicals | \$4.0 | Utilities | Plumbing & electrical | \$6.0 | Boiler Fuel | Insurance | \$10.0 | Electricity | Tribal Administration | \$16.2 | Sewer & Water | Total | \$161.2 |
|                                                                                                                                                | Contractual           |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                      |                      |                      |  |  |  |             |  |           |                       |        |                                     |             |       |                               |          |  |                                     |                      |       |              |                    |       |           |                       |       |             |           |        |             |                       |        |               |       |         |
| Personnel                                                                                                                                      | Shellfish Health Mngt | \$20.0              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                      |                      |                      |  |  |  |             |  |           |                       |        |                                     |             |       |                               |          |  |                                     |                      |       |              |                    |       |           |                       |       |             |           |        |             |                       |        |               |       |         |
| 1/2 Hatchery Specialist (full time)                                                                                                            | Maintenance           | \$6.0               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                      |                      |                      |  |  |  |             |  |           |                       |        |                                     |             |       |                               |          |  |                                     |                      |       |              |                    |       |           |                       |       |             |           |        |             |                       |        |               |       |         |
| 1/2 Technician II (half time)                                                                                                                  | Supplies              |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                      |                      |                      |  |  |  |             |  |           |                       |        |                                     |             |       |                               |          |  |                                     |                      |       |              |                    |       |           |                       |       |             |           |        |             |                       |        |               |       |         |
| 1/2 Maintenance/Tech II (full time)                                                                                                            | Maintenance supplies  | \$6.8               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                      |                      |                      |  |  |  |             |  |           |                       |        |                                     |             |       |                               |          |  |                                     |                      |       |              |                    |       |           |                       |       |             |           |        |             |                       |        |               |       |         |
| Fringe @ 21%                                                                                                                                   | Hatchery chemicals    | \$4.0               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                      |                      |                      |  |  |  |             |  |           |                       |        |                                     |             |       |                               |          |  |                                     |                      |       |              |                    |       |           |                       |       |             |           |        |             |                       |        |               |       |         |
| Utilities                                                                                                                                      | Plumbing & electrical | \$6.0               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                      |                      |                      |  |  |  |             |  |           |                       |        |                                     |             |       |                               |          |  |                                     |                      |       |              |                    |       |           |                       |       |             |           |        |             |                       |        |               |       |         |
| Boiler Fuel                                                                                                                                    | Insurance             | \$10.0              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                      |                      |                      |  |  |  |             |  |           |                       |        |                                     |             |       |                               |          |  |                                     |                      |       |              |                    |       |           |                       |       |             |           |        |             |                       |        |               |       |         |
| Electricity                                                                                                                                    | Tribal Administration | \$16.2              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                      |                      |                      |  |  |  |             |  |           |                       |        |                                     |             |       |                               |          |  |                                     |                      |       |              |                    |       |           |                       |       |             |           |        |             |                       |        |               |       |         |
| Sewer & Water                                                                                                                                  | Total                 | \$161.2             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                      |                      |                      |  |  |  |             |  |           |                       |        |                                     |             |       |                               |          |  |                                     |                      |       |              |                    |       |           |                       |       |             |           |        |             |                       |        |               |       |         |

FY 99

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

FORM 4A  
Non-Trustee  
SUMMARY

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

| Personnel Costs:                                                           |                                                     |  |                 | Months<br>Budgeted | Monthly<br>Costs | Overtime          | Proposed<br>FY 1999 |
|----------------------------------------------------------------------------|-----------------------------------------------------|--|-----------------|--------------------|------------------|-------------------|---------------------|
| Name                                                                       | Position Description                                |  |                 |                    |                  |                   |                     |
| 2 positions                                                                | village project worker                              |  |                 | 1.5                | 2.4              |                   | 0.0                 |
| 1 position                                                                 | shellfish culture & hatchery operations specialist. |  |                 | 12.0               | 4.4              |                   | 3.6                 |
|                                                                            |                                                     |  |                 |                    |                  |                   | 52.8                |
|                                                                            |                                                     |  |                 |                    |                  |                   | 0.0                 |
|                                                                            |                                                     |  |                 |                    |                  |                   | 0.0                 |
|                                                                            |                                                     |  |                 |                    |                  |                   | 0.0                 |
|                                                                            |                                                     |  |                 |                    |                  |                   | 0.0                 |
|                                                                            |                                                     |  |                 |                    |                  |                   | 0.0                 |
|                                                                            |                                                     |  |                 |                    |                  |                   | 0.0                 |
|                                                                            |                                                     |  |                 |                    |                  |                   | 0.0                 |
|                                                                            |                                                     |  |                 |                    |                  |                   | 0.0                 |
|                                                                            |                                                     |  |                 |                    |                  |                   | 0.0                 |
|                                                                            |                                                     |  |                 |                    |                  |                   | 0.0                 |
| Subtotal                                                                   |                                                     |  |                 | 13.5               | 6.8              | 0.0               |                     |
| Personnel Total                                                            |                                                     |  |                 |                    |                  |                   | \$56.4              |
| Travel Costs:                                                              |                                                     |  | Ticket<br>Price | Round<br>Trips     | Total<br>Days    | Daily<br>Per Diem | Proposed<br>FY 1999 |
| Description                                                                |                                                     |  |                 |                    |                  |                   |                     |
| Hatchery staff to present papers at Pacific Northwest Shellfish Conference |                                                     |  |                 |                    |                  |                   | 0.0                 |
|                                                                            |                                                     |  |                 |                    |                  |                   | 2.4                 |
|                                                                            |                                                     |  |                 |                    |                  |                   | 0.0                 |
|                                                                            |                                                     |  |                 |                    |                  |                   | 0.0                 |
|                                                                            |                                                     |  |                 |                    |                  |                   | 0.0                 |
|                                                                            |                                                     |  |                 |                    |                  |                   | 0.0                 |
|                                                                            |                                                     |  |                 |                    |                  |                   | 0.0                 |
|                                                                            |                                                     |  |                 |                    |                  |                   | 0.0                 |
|                                                                            |                                                     |  |                 |                    |                  |                   | 0.0                 |
|                                                                            |                                                     |  |                 |                    |                  |                   | 0.0                 |
|                                                                            |                                                     |  |                 |                    |                  |                   | 0.0                 |
| Travel Total                                                               |                                                     |  |                 |                    |                  |                   | \$2.4               |

**FY 99**

Prepared: 4/14/98

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

**FORM 4B  
 Personnel  
 & Travel  
 DETAIL**

4/14/98, 3 of 5

**FY 99 EXXON VALDEZ TRU COUNCIL PROJECT BUDGET**

October 1, 1998 - September 30, 1999

| <b>Contractual Costs:</b>                                                                       |  | Proposed       |
|-------------------------------------------------------------------------------------------------|--|----------------|
| Description                                                                                     |  | FY 1999        |
| Broodstock development and seed production at Outekcak Shellfish Hatchery                       |  | 161.2          |
| Contracts for technical assistance in hatchery, nursery and growout operations and final report |  | 26.4           |
| <b>Contractual Total</b>                                                                        |  | <b>\$187.6</b> |
| <b>Commodities Costs:</b>                                                                       |  | Proposed       |
| Description                                                                                     |  | FY 1999        |
| final report materials                                                                          |  | 0.7            |
| <b>Commodities Total</b>                                                                        |  | <b>\$0.7</b>   |

**FY 99**

Prepared: 4/14/98

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

**FORM 4B**  
**Contractual &**  
**Commodities**  
**DETAIL**

4/14/98, 4 of 5

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

[illegible]**FY 99**

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

FORM 4B  
Equipment  
DETAIL

99139A2

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

**Project Number:** 99139-A2.

**Restoration Category:** General Restoration.

**Proposer:** Alaska Department of Fish and Game.

**Lead Trustee Agency:** Alaska Department of Fish and Game

**Cooperating Agency:**

**Alaska Sea Life Center:**

**Duration:** 4th year, 5 year project

**Cost FY 99:** \$85,800 (includes general administration).

**Cost FY 00:** \$47,000

**Cost FY 01:** \$10,000

**Cost FY 02:** \$5,000

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

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

**ABSTRACT**

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

RECEIVED

APR 14 1998

EXXON VALDEZ OIL SPILL  
TRUSTEE COUNCIL

## INTRODUCTION

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

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

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

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

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

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

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

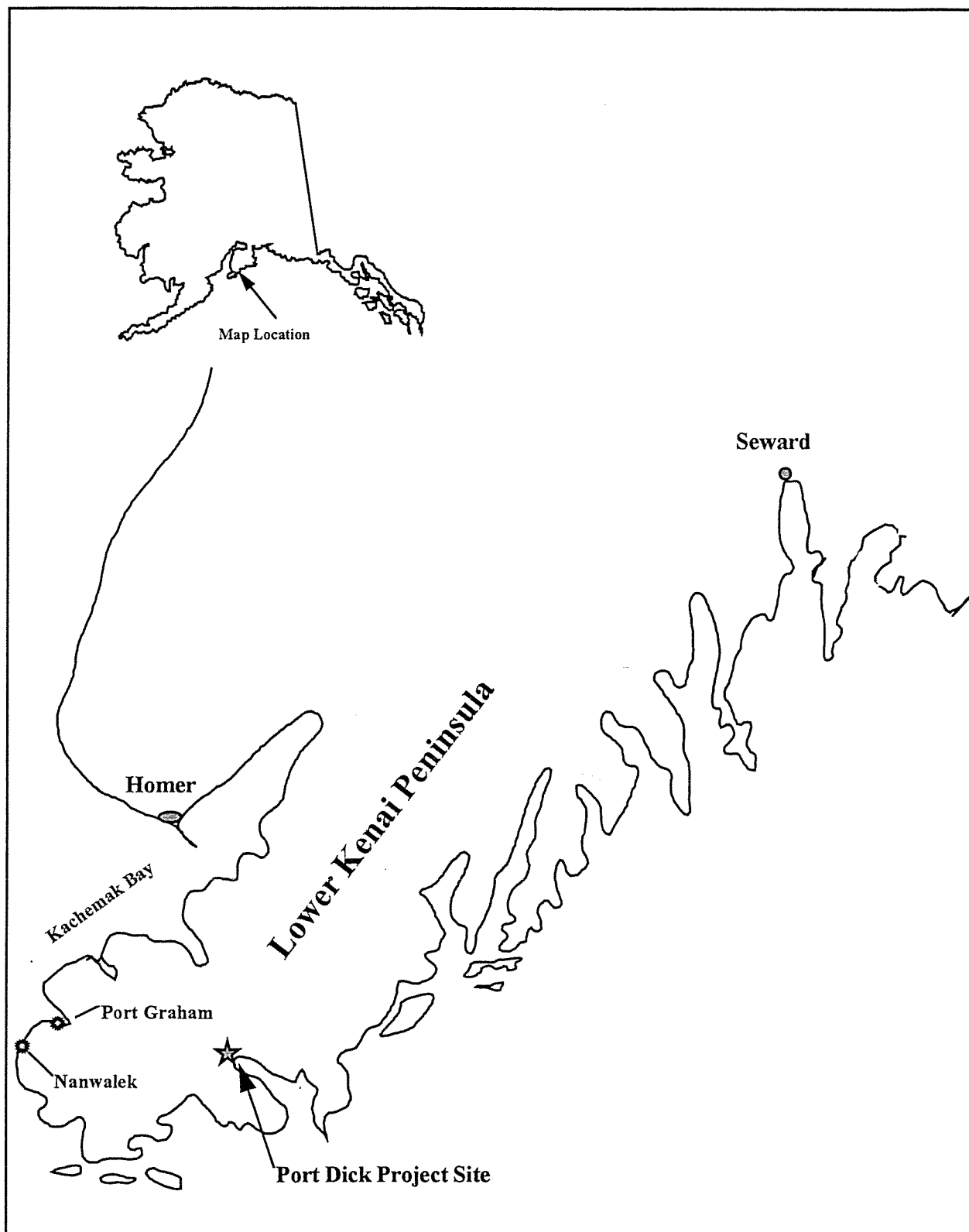


Figure 1 . Map of the outer gulf coast of the Kenai Peninsula showing the location Port Dick Project site.

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

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

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

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

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

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

## **NEED FOR THE PROJECT**

### **A. Statement of Problem**

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

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

### **B. Rationale/Link to Restoration**

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

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

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

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

### **C. Location**

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

## **COMMUNITY INVOLVEMENT**

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

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

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

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

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

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

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

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

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

## **PROJECT DESIGN**

### **A. Objectives**

(October 1, 1999 through September 31, 2000)

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

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

## B. Methods

### Part A. Spawning success

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

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

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

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

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

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

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

The third variable to estimate egg to fry survivals is the degree of egg retention. Actual egg retention will not be measured at Port Dick Creek. Therefore, we chose a conservative egg retention factor of 5.1%, to estimate survivals. Helle et al. 1964, found pink salmon egg retention rates of 2.7 - 5.1% on Olsen Creek in Prince William Sound. Higher retention rates of up to 41.5%, were found, however, they were associated with over crowding and competition for redd areas and were not considered for this evaluation.

Egg to fry survival success will be compared to survival rates found in natural streams and ground water fed spawning channels. For example, (Heard, 1978) found that survival rates for pink salmon in natural streams range from 0.2% to 22.8% and (Lister et. al. 1980) calculated survivals of 1.3% to 16.9% for chum salmon in ground water fed spawning channels in southern British Columbia.

## Part B. Physical Parameter Evaluation

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

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

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

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

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

In addition, salmon eggs require sufficient water velocities to keep the stream well-oxygenated, protect the streambed from freezing temperatures, and to remove waste metabolites ( $\text{CO}_2$ ).

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

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

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

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

#### Part C. Sediment Transport and Spawning Channel Stability Evaluation:

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

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

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

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

### Stream Transects

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

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

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

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

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

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

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

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

#### Tracer Gravel

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

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

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

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

#### Scour Chains

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

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

#### Sediment Transport Analyses

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

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

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

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

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

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

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

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

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

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

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

### **SCHEDULE**

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

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

#### **B. Project Milestones and Endpoints**

- June 1996 Excavate spawning tributaries at Port Dick Creek.

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

### **C. Completion Date**

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

### **PUBLICATIONS AND REPORTS**

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

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

## **PROFESSIONAL CONFERENCES**

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

## **NORMAL AGENCY MANAGEMENT**

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

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

## **COORDINATION AND INTEGRATION OF RESTORATION EFFORT**

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

## **EXPLANATION OF CHANGES IN CONTINUING PROJECTS**

### **PROJECT DESIGN Part B (Methods)**

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

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

## **PRINCIPAL INVESTIGATOR**

Wes Bucher

Mr. Bucher is the finfish area management biologist with the Alaska Department of Fish and Game in Lower Cook Inlet. He has worked for the Department as a fisheries biologist since 1971 serving in several capacities throughout Cook Inlet and Bristol Bay. While he has been responsible for a variety of fishery research and management programs ranging from hydroacoustics, limnology, rehabilitation and enhancement, most of his recent work has involved management of commercial salmon and herring fisheries.

## **OTHER KEY PERSONNEL**

Project Manager

Mark Dickson, Fish and Wildlife Technician IV.

Mr. Dickson has been employed as a fish culturist and fish and game technician with the Alaska Department of Fish and Game for the past 19 seasons. He has considerable experience in fish cultural practices in the field and in the hatchery management projects that restore and enhance sport and commercial fisheries in the Lower Cook Inlet area. Mr. Dickson has worked in the Lower Cook Inlet area participating in and managing salmon restoration projects.

Geoff Coble, Project Geoscientist and Engineer

Mr. Coble is currently the owner and manager of CGS, a local firm specializing in water resources geophysics. Mr. Coble has a multi-disciplinary and academic approach to his career, combining three college degrees in Water Resources Science, Geology and Geophysics with water resources numerical modeling as a specialty. The fact that basic questions concerning transport of gravel in gravel-bedded streams remain unanswered, combined with the unique complexities of this site make it an ideal research project for Mr. Coble.

The Port Dick Creek sedimentology project was selected and defined based on the strengths of Mr. Coble and the value of the project for research. Mr. Coble has a long record of presenting its work for peer review, and has already made agreements for project review with other nationally published experts in hydrology and sediment transport.

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# 1999 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

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

1999

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

FORM 3A  
 TRUSTEE  
 AGENCY  
 SUMMARY

Prepared:

4/7/98

4/13/98

# 1999 EXXON VALDEZ TRAILER COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

| Personnel Costs:                                                                                                                    |                         | GS/Range/<br>Step | Months<br>Budgeted | Monthly<br>Costs | Overtime          | Proposed<br>FFY 1997 |
|-------------------------------------------------------------------------------------------------------------------------------------|-------------------------|-------------------|--------------------|------------------|-------------------|----------------------|
| Name                                                                                                                                | Position Description    |                   |                    |                  |                   |                      |
| <b>Fry survival evaluation phase</b><br>April 15-May 15 1997                                                                        |                         |                   |                    |                  |                   |                      |
| 11-5362                                                                                                                             | Fish and Game Tech. III | 11B               | 2.5                | 3644.0           |                   | 9,110.0              |
| 11-5319                                                                                                                             | Fish and Game Tech.II   | 9A                | 2.5                | 3552.0           |                   | 8,880.0              |
| <b>Project Admin:</b> Fisheries data reduction & analysis. Annual report preparation & writing. Project management, DPD development |                         |                   |                    |                  |                   |                      |
|                                                                                                                                     | Fish and Game Tech IV   | 13J               | 5.0                | 4853.0           |                   | 24,265.0             |
|                                                                                                                                     | Fish and Game Tech III  | 11A               | 0.5                | 3538.0           |                   | 1,769.0              |
|                                                                                                                                     |                         |                   |                    |                  |                   | 0.0                  |
| Subtotal                                                                                                                            |                         |                   | 10.5               | 15587.0          | 0.0               |                      |
| Personnel Total                                                                                                                     |                         |                   |                    |                  |                   | \$44.0               |
| Travel Costs:                                                                                                                       |                         | Ticket<br>Price   | Round<br>Trips     | Total<br>Days    | Daily<br>Per Diem | Proposed<br>FFY 1997 |
| Description                                                                                                                         |                         |                   |                    |                  |                   |                      |
| Round trip, Anchorage for 3 days and return                                                                                         |                         | 180.0             | 1                  | 3                | 150.0             | 630.0                |
|                                                                                                                                     |                         |                   |                    |                  |                   | 0.0                  |
|                                                                                                                                     |                         |                   |                    |                  |                   | 0.0                  |
|                                                                                                                                     |                         |                   |                    |                  |                   | 0.0                  |
|                                                                                                                                     |                         |                   |                    |                  |                   | 0.0                  |
|                                                                                                                                     |                         |                   |                    |                  |                   | 0.0                  |
|                                                                                                                                     |                         |                   |                    |                  |                   | 0.0                  |
|                                                                                                                                     |                         |                   |                    |                  |                   | 0.0                  |
|                                                                                                                                     |                         |                   |                    |                  |                   | 0.0                  |
|                                                                                                                                     |                         |                   |                    |                  |                   | 0.0                  |
|                                                                                                                                     |                         |                   |                    |                  |                   | 0.0                  |
|                                                                                                                                     |                         |                   |                    |                  |                   | 0.0                  |
|                                                                                                                                     |                         |                   |                    |                  |                   | 0.0                  |
| Travel Total                                                                                                                        |                         |                   |                    |                  |                   | \$0.6                |

1999

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

FORM 3B  
Personnel  
& Travel  
DETAIL

**1999 EXXON VALDEZ TRAIL COUNCIL PROJECT BUDGET**

October 1, 1998 - September 30, 1999

| <b>Contractual Costs:</b>                                                                                          |  | Proposed      |
|--------------------------------------------------------------------------------------------------------------------|--|---------------|
| Description                                                                                                        |  | FFY 1997      |
| 4A Linkage                                                                                                         |  | 27,700.0      |
| <u>Fry survival evaluation phase:</u>                                                                              |  |               |
| Air charter to transport 2 person crew in and out of project site @ 1 hr per trip at \$580.00 per trip (D-H Otter) |  | 1,160.0       |
| Logistical support, 6 trips @ 1 hr. @ \$160.00 per hr. (Cessna 305)                                                |  | 960.0         |
| -                                                                                                                  |  |               |
| When a non-trustee organization is used, the form 4A is required.                                                  |  |               |
| <b>Contractual Total</b>                                                                                           |  | <b>\$29.8</b> |
| <b>Commodities Costs:</b>                                                                                          |  | Proposed      |
| Description                                                                                                        |  | FFY 1997      |
| Food for 2 people for 75 days @ \$15.00 per day per person while estimating fry survival.                          |  | 2,250.0       |
| Restoration workshop preparation, (film processing, poster board preparation)                                      |  | 400.0         |
| <b>Commodities Total</b>                                                                                           |  | <b>\$2.7</b>  |

**1999**

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

FORM 3B  
 Contractual &  
 Commodities  
 DETAIL

Prepared:

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

| New Equipment Purchases:                                                                        |  | Number<br>of Units         | Unit<br>Price       | Proposed<br>FFY 1997 |
|-------------------------------------------------------------------------------------------------|--|----------------------------|---------------------|----------------------|
| Description                                                                                     |  |                            |                     |                      |
| No new equipment purchases are anticipated at this time.                                        |  |                            |                     | 0.0                  |
| Equipment purchased in FY/96 will be used throughout the remainder of the project               |  |                            |                     | 0.0                  |
|                                                                                                 |  |                            |                     | 0.0                  |
|                                                                                                 |  |                            |                     | 0.0                  |
|                                                                                                 |  |                            |                     | 0.0                  |
|                                                                                                 |  |                            |                     | 0.0                  |
|                                                                                                 |  |                            |                     | 0.0                  |
|                                                                                                 |  |                            |                     | 0.0                  |
|                                                                                                 |  |                            |                     | 0.0                  |
|                                                                                                 |  |                            |                     | 0.0                  |
|                                                                                                 |  |                            |                     | 0.0                  |
| Those purchases associated with replacement equipment should be indicated by placement of an R. |  | <b>New Equipment Total</b> |                     | <b>\$0.0</b>         |
| Existing Equipment Usage:                                                                       |  | Number<br>of Units         | Inventory<br>Agency |                      |
| Description                                                                                     |  |                            |                     |                      |
| Full set camping and cooking set to accommodate 3 people                                        |  | 1                          | ADF&G               |                      |
| Fish cultural equipment such as spawning knives, buckets, nets, ice chests and holding nets     |  | 1                          | ADF&G               |                      |
| Full sets of rain gear and hip waders                                                           |  | 4                          | ADF&G               |                      |
| Fyke net; to capture and enumerate emigrating salmon fry.                                       |  | 1                          | ADF&G               |                      |
| 1750 generator                                                                                  |  | 1                          | ADF&G               |                      |
| High frequency radio                                                                            |  | 2                          | ADF&G               |                      |
| Whetherport portable shelter for use while in the field                                         |  | 1                          | ADF&G               |                      |

**1999**

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

**FORM 3B  
Equipment  
DETAIL**

Prepared:

4/7/98  
4 of 8

4/13/98

# 1999 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

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

1999

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

FORM 4A  
 Non-Trustee  
 SUMMARY

Prepared:

4/7/98 of 8

4/13/98

October 1, 1998 - September 30, 1999

1999

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

FORM 4B  
Personnel  
& Travel  
DETAIL

4/7/98  
6 of 8

4/13/98

# 1999 EXXON VALDEZ TRUSTEES COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

| <b>Contractual Costs:</b>                                                                            |                      |
|------------------------------------------------------------------------------------------------------|----------------------|
| Description                                                                                          | Proposed<br>FFY 1997 |
| <b>Original Proposal (Physical Parameter Monitoring)</b>                                             |                      |
| 1 USGS Type AA (Price-type) Current Meter, Digital, rental                                           | 0.4                  |
| 2 Pressure Transducer, Hastelloy diaphragm-stainless casing, rental                                  | 0.3                  |
| 3 Temperature Probe, rental                                                                          | 0.3                  |
| 2 Conductivity probe, rental                                                                         | 0.3                  |
| 2 Datalogger, rugged full bridge, half bridge and pulse measurements, rental                         | 0.5                  |
| <b>Proposed Increment( Spawning Channel Stability Evaluation)</b>                                    |                      |
| 1 rotating laser level, stadia rod, detector and 300 ft surveyor tape, rental                        | 0.5                  |
| 1 metal detector for tracer gravel, 1 meter depth sensitivity, and tracer gravel expendables, rental | 0.4                  |
| 1 Helly-Smith bedload sampler, with bags and expendables, rental                                     | 0.6                  |
| <b>Contractual Total</b>                                                                             | <b>\$3.3</b>         |
| <b>Commodities Costs:</b>                                                                            |                      |
| Description                                                                                          | Proposed<br>FFY 1997 |
| 1 project-specific insurance cost                                                                    | 0.7                  |
| <b>Commodities Total</b>                                                                             | <b>\$0.7</b>         |

1999

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

FORM 4B  
Contractual &  
Commodities  
DETAIL

Prepared:

4/7/98  
7 of 8

4/13/98

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

| New Equipment Purchases:                                                                        |                                                                                  | Number<br>of Units | Unit<br>Price              | Proposed<br>FFY 1997 |
|-------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|--------------------|----------------------------|----------------------|
| Description                                                                                     |                                                                                  |                    |                            |                      |
|                                                                                                 |                                                                                  |                    |                            | 0.0                  |
|                                                                                                 |                                                                                  |                    |                            | 0.0                  |
|                                                                                                 |                                                                                  |                    |                            | 0.0                  |
|                                                                                                 |                                                                                  |                    |                            | 0.0                  |
|                                                                                                 |                                                                                  |                    |                            | 0.0                  |
|                                                                                                 |                                                                                  |                    |                            | 0.0                  |
|                                                                                                 |                                                                                  |                    |                            | 0.0                  |
|                                                                                                 |                                                                                  |                    |                            | 0.0                  |
|                                                                                                 |                                                                                  |                    |                            | 0.0                  |
|                                                                                                 |                                                                                  |                    |                            | 0.0                  |
|                                                                                                 |                                                                                  |                    |                            | 0.0                  |
|                                                                                                 |                                                                                  |                    |                            | 0.0                  |
| Those purchases associated with replacement equipment should be indicated by placement of an R. |                                                                                  |                    | <b>New Equipment Total</b> | <b>\$0.0</b>         |
| Existing Equipment Usage:                                                                       |                                                                                  | Number<br>of Units |                            |                      |
| Description                                                                                     |                                                                                  |                    |                            |                      |
|                                                                                                 | Datalogger, rugged full bridge, half bridge and pulse measurements               | 3                  |                            |                      |
|                                                                                                 | Pressure transducer, Hastelloy diaphragm-stainless casing, 0,01 ft accuracy      | 3                  |                            |                      |
|                                                                                                 | thermistors, 0.4 degree C accuracy, soil and water measurement                   | 4                  |                            |                      |
|                                                                                                 | data downloading equipment (laptop, optical interface, keypad etc.)              | 1                  |                            |                      |
|                                                                                                 | data field enclosures for datalogging equipment                                  | 4                  |                            |                      |
|                                                                                                 | temperature and conductivity instrument for field calibrations                   | 1                  |                            |                      |
|                                                                                                 | conductivity sensors                                                             | 2                  |                            |                      |
|                                                                                                 | Helly-Smith bedload sampler, with bags and expendables                           | 1                  |                            |                      |
|                                                                                                 | rotating laser level, stadia rod, detector and 300 ft surveyors tape             | 1                  |                            |                      |
|                                                                                                 | scour chains, stainless, and installation equipment                              | 1                  |                            |                      |
|                                                                                                 | metal detector for tracer gravel, 1 meter depth sensitivity                      | 1                  |                            |                      |
|                                                                                                 | installation supplies (mounting brackets, conduit for exposed cable, expendables | 1                  |                            |                      |

**1999**

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

**FORM 4B  
Equipment  
DETAIL**

Prepared:

4/7/98  
8 of 8

4/13/98

99144

## Common Murre Population Monitoring

|                           |                                                                                                                                       |
|---------------------------|---------------------------------------------------------------------------------------------------------------------------------------|
| Project Number:           | 99144                                                                                                                                 |
| Restoration Category:     | Restoration Monitoring                                                                                                                |
| Proposer:                 | DOI-FWS                                                                                                                               |
| Lead Trustee Agency:      | USFWS                                                                                                                                 |
| Cooperating Agencies:     | None                                                                                                                                  |
| Alaska SeaLife Center:    |                                                                                                                                       |
| Duration:                 | 1 year                                                                                                                                |
| Cost FY 99:               | \$72.2K                                                                                                                               |
| Geographic Area:          | Barren Islands, lower Cook Inlet (specifically the East Amatuli Island - Light Rock and Nord Island - Northwest Islet murre colonies) |
| Injured Resource/Service: | Common murres                                                                                                                         |

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APR 15 1998

EXXON VALDEZ OIL SPILL  
TRUSTEE COUNCIL

### ABSTRACT

This proposed common murre (*Uria aalge*) restoration monitoring project is designed as a follow-up study to the restoration projects that censused the Barren Islands murre colonies in FY 96 - FY 97 (Projects 96144 and 97144). We are proposing to recensus the Barren Islands murre colonies in FY 99 instead of deferring the work until FY 00 or FY 01 because returning 3-, 4-, 5-, and 6-year-old birds from the strong 1993-1996 chick cohorts will provide an excellent opportunity to determine whether population increases documented in FY 97 are continuing, and if they are, obtain the information needed to satisfy the remaining recovery goal for this injured species in the spill area (a potential finding appropriate for the 10th anniversary of the spill). We are also proposing to conduct this study because large-scale El Niño and La Niña events may strongly influence environmental conditions and seabird food webs in the northern Gulf of Alaska during 1998-1999. These events have potential to affect the recovery of murres in the spill area; any changes in population size that might result from them should be well documented, because undocumented changes may be difficult to interpret a few years later (e.g., in FY 00 or FY 01, if recensusing the colonies is deferred beyond FY 99).

## INTRODUCTION

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

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

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

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

## NEED FOR THE PROJECT

### A. Statement of Problem

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

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

## **B. Rationale/Link to Restoration**

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

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

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

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

## **C. Location**

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

## COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE

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

## PROJECT DESIGN

### A. Objectives

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

### B. Methods

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

#### *Data Collection*

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

## Data Analysis

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

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

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

## SCHEDULE

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

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

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

## **B. Project Milestones and Endpoints**

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

## **C. Completion Date**

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

## **PUBLICATIONS AND REPORTS**

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

## **PROFESSIONAL CONFERENCES**

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

## **NORMAL AGENCY MANAGEMENT**

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

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

## **COORDINATION AND INTEGRATION OF RESTORATION EFFORT**

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

## **EXPLANATION OF CHANGES IN CONTINUING PROJECTS**

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

## **PROPOSED PRINCIPAL INVESTIGATOR, IF KNOWN**

Name: David G. Roseneau

Affiliation: Alaska Maritime National Wildlife Refuge

Mailing address: 2355 Kachemak Bay Drive (Suite 101), Homer, Alaska 99603-8021

Phone number: (907) 235-6546

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E-mail address: dave\_roseneau@mail.fws.gov

## **PRINCIPAL INVESTIGATOR**

### **David G. Roseneau (Principal Investigator)**

Mr. Roseneau will be responsible for the overall day-to-day operation of the project in both the field and the office. He will supervise project personnel, review and approve logistics plans and expenditures, and ensure that work stays on schedule. He will also be in charge of overall data

analysis and interpretation, preparing posters and presentations for scientific conferences and meetings, and writing annual and final reports and manuscripts for publication. Mr. Roseneau received his B.S. degree in wildlife management and M.S. degree in biology from the University of Alaska - Fairbanks in 1967 and 1972, respectively. His thesis research was on the numbers and distribution of gyrfalcons, *Falco rusticolus* on the Seward Peninsula, Alaska. He joined the U.S. Fish and Wildlife Service in January 1993, and was project leader for EVOS-sponsored common murre restoration studies at the Barren Islands during 1993-1994 (Projects 93049 and 94039). Mr. Roseneau was also principal investigator of the APEX Barren Islands seabird and large fish as samplers studies during 1995-1997 (Projects 95163J, 95163K, 96163J, 97163J, and 97163K), and the murre population monitoring work at the Barren Islands in 1996-1997 (Projects 96144 and 97144). Currently, he is co-principal investigator for APEX project 98163J and principal investigator of APEX project 98163K and the Chiswell Islands murre population monitoring study (Project 98144). Prior to 1993, Mr. Roseneau worked as a consulting biologist for 20 years, conducting and managing marine bird, raptor, and large mammal projects in Alaska and Canada for government agencies and private-sector clients. He has been involved in several large-scale murre (*Uria* spp.) monitoring projects. During 1976-1983, as co-principal investigator of NOAA/OCSEAP Research Unit 460, he conducted monitoring studies of murres and black-legged kittiwakes (*Rissa tridactyla*) at capes Lisburne, Lewis, and Thompson in the Chukchi Sea, and St. Lawrence, St. Matthew, and Hall islands in the Bering Sea. He also studied auklets (*Aethia* spp.) at St. Lawrence and St. Matthew islands, and participated in murre and kittiwake projects at Bluff in Norton Sound. In 1984-1986, he participated in follow-up studies of murres and kittiwakes in the northeastern Chukchi Sea, and during 1987-1988, 1991-1992, and 1995-1997 he helped conduct additional murre and kittiwake work at Chamisso and Puffin islands and capes Thompson and Lisburne. Mr. Roseneau is experienced in collecting and analyzing data on numbers, productivity, and food habits of seabirds; relating trends in numbers and productivity to changes in food webs and environmental parameters (e.g., air and sea temperatures, current patterns); and assessing potential impacts of petroleum exploration and development on nesting and foraging marine birds. He has broad knowledge of rock climbing techniques and has operated inflatable rafts and other outboard-powered boats in the Bering, Chukchi, and Beaufort seas and on various Alaskan rivers in excess of 2,900 hrs. Mr. Roseneau has also accrued several hundred additional hours operating time in small boats and larger, more powerful vessels (e.g. 25 ft, 300-400 hp HydroSports and Boston Whalers) in Kachemak Bay, Prince William Sound, and Kenai Peninsula and Barren Island waters. During his career, Mr. Roseneau has authored and co-authored over 75 reports and publications, including about 25 on Alaskan seabirds.

#### Selected Seabird Publications

- Murphy, E.C., A.M. Springer, and D.G. Roseneau. 1991. High annual variability in reproductive success of kittiwakes (*Rissa tridactyla* L.) at a colony in western Alaska. *J. Anim. Ecol.* 60: 515-534.
- Springer, A.M., E.C. Murphy, D.G. Roseneau, C.P. McRoy, and B.A. Cooper. 1987. Paradox of pelagic food webs in the northern Bering Sea - I. Seabird food habits. *Cont. Shelf Res.* 7: 895-911.
- Murphy, E.C., A.M. Springer, and D.G. Roseneau. 1986. Population status of *Uria aalge* at a colony in western Alaska: results and simulations. *Ibis* 128: 348-363.
- Springer, A.M., D.G. Roseneau, D.S. Lloyd, C.P. McRoy, and E.C. Murphy. 1986. Seabird responses to fluctuating prey availability in the eastern Bering Sea. *Marine Ecol. Prog. Ser.* 32: 1-12.
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- Murphy, E.C., D.G. Roseneau, and P.J. Bente. 1984. An inland nest record for the Kittlitz's murrelet. *Condor* 86: 218.

Springer, A.M., D.G. Roseneau, E.C. Murphy, and M.I. Springer. 1984. Environmental controls of marine food webs: food habits of seabirds in the eastern Chukchi Sea. *Can. J. Fish Aquat. Sci.* 41: 1202-1215.

## **OTHER KEY PERSONNEL**

### **1. G. Vernon Byrd (Project Manager)**

Mr. Byrd will supply overall guidance to the project, including providing advice during data analysis and report writing. He will also review reports and presentations as needed, and help prepare manuscripts for publication. Mr. Byrd received a B.S. degree in wildlife management from the University of Georgia in 1968, did post-graduate studies in wildlife biology at the University of Alaska-Fairbanks in 1975, and completed his M.S. degree in wildlife resources management at the University of Idaho in 1989. His thesis, entitled "Seabirds in the Pribilof Islands, Alaska: Trends and monitoring methods", explored statistical procedures for analyzing kittiwake (*Rissa* spp.) and murre (*Uria* spp.) population data. Mr. Byrd has worked for the U.S. Fish and Wildlife Service for over 20 years, focusing on studies of marine birds in Alaska and Hawaii. His major interests center around monitoring long-term trends in seabird populations, including numbers of birds and reproductive performance at colonies. He has worked at murre colonies in the Aleutian Islands, the Bering and Chukchi seas, and western Gulf of Alaska. Mr. Byrd was a co-author of the final T/V *Exxon Valdez* oil spill damage assessment report for murre. Also, he was project manager of the 1993-1994 common murre restoration monitoring studies (Projects 93049 and 94039, projects to remove predators from islands containing seabird colonies (Projects 94041 and 95041), and the 1995-1997 APEX and murre monitoring studies (Projects 95163J, 95163K, 96163J, 96144, 97163J, 97163K, and 97144). Mr. Byrd is currently serving as project manager for APEX projects 98163J and 98163K, and the Chiswell Islands murre population monitoring study (Project 98144). He has authored over 50 scientific papers and 60 U.S. Fish and Wildlife Service reports on field studies, and has made about 30 presentations on seabirds at scientific meetings. Mr. Byrd is the supervisory wildlife biologist at the Alaska Maritime National Wildlife Refuge, the premier seabird nesting area in the national public land system.

#### **Selected Seabird Publications**

Byrd, G.V., E.C. Murphy, G.W. Kaiser, A.J. Kondratyev, and Y.V. Shibaev. 1993. Status and ecology of offshore fish-feeding alcids (murres and puffins) in the North Pacific Ocean. Proceedings of "Symposium on the Status, Ecology, and Conservation of Marine Birds of the Temperate North Pacific". Canadian Wildlife Service, Ottawa.

Byrd, G.V., and J.C. Williams. Whiskered Auklet. 1993. A chapter describing the biology of the species in The birds of North America, No. 76 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia PA, and the American Ornithologists' Union, Washington, D.C. 12 pp.

Byrd, G.V., and J.C. Williams. Red-legged Kittiwake. 1993. A chapter describing the biology of the species in The birds of North America No. 60 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia PA, and the American Ornithologists' Union, Washington, D.C. 12 pp.

Springer, A.M. and G.V. Byrd. 1989. Seabird dependence on walleye pollock in the southeastern Bering Sea. Pages 667-677 in Proceedings of the International Symposium on the Biology and Management of Walleye Pollock. Alaska Sea Grant Rep. No. 89-1, Univ. of Alaska-Fairbanks.

### **2. Arthur B. Kettle (Biological Technician)**

Mr. Kettle will assist with data collection and analysis, as in past years. He will also help prepare poster, draft and final reports, and manuscripts for publication. Mr. Kettle received his B.A.

degree in Human Ecology from the College of the Atlantic in 1984. Since that time, he has participated in several large-scale seabird projects at remote locations. He joined the U.S. Fish and Wildlife Service in May 1993, and was camp leader for the 1993-1994 EVOS Barren Islands common murre restoration studies (Projects 93049 and 94039). He also served as field team leader during the 1995-1997 APEX Barren Islands seabird studies (Projects 95163J, 96163J, 97163J) and participated in the 1996-1997 Barren Islands murre population monitoring projects (Projects 96144 and 97144). Mr. Kettle is currently co-principal investigator for APEX project 98163J. During Mr. Kettle's 1993-1997 work at the Barren Islands, he was responsible for logistics and data collection at Amatuli Cove camp, and for ensuring that data were obtained according to study design. His broad knowledge of boat-mooring systems and technical rock climbing techniques allowed him to safely collect productivity and chronology data from a series of study plots he established on East Amatuli Island (a difficult technical task not accomplished during any previous pre- or postspill study). Mr. Kettle also collected productivity data and censused birds at East Amatuli Island during Exxon-sponsored University of Washington studies in 1990-1992. In addition to this work, he participated in large-scale University of Washington studies of magellanic penguins (*Spheniscus magellanicus*) in Argentina during 1987-1991, and tufted puffins (*Fratercula cirrhata*) and fork-tailed storm-petrels (*Oceanodroma furcata*) at the Barren Islands colonies in 1990-1992. Mr. Kettle has over 17 years experience safely operating small boats in the north Atlantic and Pacific oceans (e.g., Maine and Alaska), including 8 consecutive field seasons running outboard-powered craft at the Barren Islands.

#### Selected Seabird Publications

Boersma, P.D., J.K. Parrish, and A.B. Kettle. 1995. Common murre abundance, phenology, and productivity on the Barren Islands, Alaska: The *Exxon Valdez* oil spill and long-term environmental change. Pp. 820-853 in *Exxon Valdez Oil Spill: Fate and effects in Alaskan waters*, ASTM STP 1219, P.G. Wells, J.N. Butler, and J.S. Hughes (eds.), Amer. Soc. for Testing and Materials, Philadelphia, PA.

#### **LITERATURE CITED**

- Boersma, P.D., J.K. Parrish, and A.B. Kettle. 1995. Common murre abundance, phenology, and productivity on the Barren Islands, Alaska: The *Exxon Valdez* oil spill and long-term environmental change. *Exxon Valdez Oil Spill: Fate and effects in Alaskan waters*, ASTM STP 1219, P.G. Wells, J.N. Butler, and J.S. Hughes (eds.), Amer. Soc. for Testing and Materials, Philadelphia, PA.
- Byrd, G.V. 1989. Seabirds in the Pribilof Islands, Alaska: Trends and monitoring methods. M.S. thesis. Univ. of Idaho.
- Dipple, C. and D. Nysewander. 1992. Marine bird and mammal censuses in the Barren Islands, 1989 and 1990, with specific emphasis on species potentially impacted by the 1989 *Exxon Valdez*, including supplemental appendices for 1991 murre data. Unpubl. rept., U. S. Fish Wildl. Serv., Homer, AK. 71 pp
- Dragoo, D.E., G. V. Byrd, D.G. Roseneau, D.A. Dewhurst, J.A. Cooper, and J.H. McCarthy. 1995. Effects of the T/V *Exxon Valdez* oil spill on murre: A perspective from observations at breeding colonies four years after the spill. Final rept., Restoration Proj. No. 11, U.S. Fish Wildl. Serv., Homer, AK.
- ECI (Ecological Consulting, Inc.). 1991. Assessment of direct seabird mortality in Prince William Sound and the western Gulf of Alaska resulting from the *Exxon Valdez* oil spill. Unpubl. rept., Ecol. Consulting, Inc., Portland, OR. 153 pp.

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- Gerrodette, T. 1987. A power analysis for detecting trends. *Ecology* 68:1,364-1,372.
- Hatch, S.A. and M.A. Hatch. 1989. Attendance patterns of common and thick-billed murres at breeding sites: Implications for monitoring. *J. Wildl. Manage.* 53:483-493.
- Nysegwander, D. and C. Dipple. 1990. Population surveys of seabird nesting colonies in Prince William Sound, the outside coast of the Kenai Peninsula, Barren Islands, and other nearby colonies, with emphasis on changes in numbers and reproduction of murres. Bird Study No. 3. Unpubl. prog. rept., U.S. Fish Wildl. Serv., Homer, AK. 48 pp.
- \_\_\_\_\_. 1991. Population surveys of seabird nesting colonies in Prince William Sound, the outside coast of the Kenai Peninsula, Barren Islands, and other nearby colonies, with emphasis on changes of numbers and reproduction of murres. Bird Study No. 3. Unpubl. prog. rept., U. S. Fish Wildl. Serv., Homer, AK. 70 pp.
- Nysegwander, D., C.H. Dippel, G.V. Byrd, and E.P. Knudtson. 1993. Effects of the T/V *Exxon Valdez* oil spill on murres: A perspective from observations at breeding colonies. Bird Study No. 3. Final rept., U.S. Fish Wildl. Serv., Homer, AK. 40 pp.
- Piatt, J.F, C.J. Lensink, W. Butler, M. Kendziorek, and D.R. Nysegwander. 1990. Immediate impact of the "Exxon Valdez" oil spill on marine birds. *Auk* 107:387-397.
- Roseneau, D.G., A.B. Kettle, and G.V. Byrd. 1995. Common murre restoration monitoring in the Barren Islands, Alaska, 1993. Unpubl. final rept. by the Alaska Maritime National Wildlife Refuge, Homer, Alaska for the *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska (Restoration Project 93049).
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- \_\_\_\_\_. 1997a. Common murre restoration monitoring in the Barren Islands, Alaska, 1996. 1997 Unpubl. final rept. by the Alaska Maritime National Wildlife Refuge, Homer, Alaska for the *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska (Restoration Project 96144).
- \_\_\_\_\_. 1997b. Barren Islands seabird studies, 1996. Appendix J in *Apex: Alaska Predator Ecosystem Experiment* (D.C. Duffy, Compiler), Exxon Valdez Oil Spill Restoration Proj. Annual rept. (Restoration Proj. 96163), Alaska Natural Heritage Program, Univ. of Alaska, Anchorage, Alaska.

- \_\_\_\_\_. 1998a. Common murre restoration monitoring in the Barren Islands, Alaska, 1997. 1998. Unpubl. final rept. by the Alaska Maritime National Wildlife Refuge, Homer, Alaska for the *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska (Restoration Project 97144).
- \_\_\_\_\_. 1998b. Barren Islands seabird studies, 1997. Appendix J in *Apex: Alaska Predator Ecosystem Experiment* (D.C. Duffy, Compiler), Exxon Valdez Oil Spill Restoration Proj. Annual rept. (Restoration Proj. 97163), Alaska Natural Heritage Program, Univ. of Alaska, Anchorage, Alaska.
- Sowls, A.L., S.A. Hatch, and C.J. Lensink. 1978. Catalog of Alaskan seabird colonies. U.S. Fish Wildl. Serv., Biol. Serv. Prog. FWS/OBS 78/78, Anchorage, AK. 153 pp.

## Appendix 1. Power analysis of common murre counts in the Barren Islands, Alaska.<sup>1</sup>

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

1. *Rate of Change*: 2 levels (8% yr<sup>-1</sup> and 13% yr<sup>-1</sup>) — these levels were chosen because they represent the normal range of values reported in the literature for common murre.
2. *Coefficient of Variation CV*: 15% was used because that is the average value recorded for counts made in the Barren Islands during 1992-1994.
3. *Alpha ( $\alpha$ ) and Beta ( $\beta$ ) Levels*: We were more concerned about Type II errors than Type I errors; therefore we relaxed Alpha to 0.1 and set the power at 0.9.
4. *Model Selection*: Murre populations are expected to grow exponentially rather than in a linear fashion.

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

| Rate of Change (year <sup>-1</sup> ) | Years Between Surveys | CV   | $\alpha$ | $\beta$ | Number of Surveys Required <sup>a</sup> | Number of Years Required to Detect Trends |
|--------------------------------------|-----------------------|------|----------|---------|-----------------------------------------|-------------------------------------------|
| 0.8                                  | 1                     | 0.15 | 0.1      | 0.9     | 7                                       | 7                                         |
|                                      | 2                     | 0.15 | 0.1      | 0.9     | 5                                       | 10                                        |
|                                      | 3                     | 0.15 | 0.1      | 0.9     | 4                                       | 12                                        |
|                                      | 4                     | 0.15 | 0.1      | 0.9     | 4                                       | 16                                        |
|                                      | 5                     | 0.15 | 0.1      | 0.9     | 4                                       | 20                                        |
| 0.13                                 | 1                     | 0.15 | 0.1      | 0.9     | 5                                       | 5                                         |
|                                      | 2                     | 0.15 | 0.1      | 0.9     | 4                                       | 8                                         |
|                                      | 3                     | 0.15 | 0.1      | 0.9     | 4                                       | 12                                        |
|                                      | 4                     | 0.15 | 0.1      | 0.9     | 3                                       | 12                                        |
|                                      | 5                     | 0.15 | 0.1      | 0.9     | 3                                       | 15                                        |

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

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

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

# 1999 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

| Budget Category:                                                                                                                | Authorized<br>FFY 1998 | Proposed<br>FFY 1999 |                                 |                       |  |  |  |  |
|---------------------------------------------------------------------------------------------------------------------------------|------------------------|----------------------|---------------------------------|-----------------------|--|--|--|--|
| Personnel                                                                                                                       | \$26.2                 | \$16.7               |                                 |                       |  |  |  |  |
| Travel                                                                                                                          | \$2.8                  | \$3.0                |                                 |                       |  |  |  |  |
| Contractual                                                                                                                     | \$19.8                 | \$43.2               |                                 |                       |  |  |  |  |
| Commodities                                                                                                                     | \$1.8                  | \$2.6                |                                 |                       |  |  |  |  |
| Equipment                                                                                                                       | \$1.0                  | \$1.2                |                                 |                       |  |  |  |  |
| Subtotal                                                                                                                        | \$51.6                 | \$66.7               | LONG RANGE FUNDING REQUIREMENTS |                       |  |  |  |  |
| General Administration                                                                                                          | \$5.5                  | \$5.5                | Estimated<br>FFY 1999           | Estimated<br>FFY 2000 |  |  |  |  |
| Project Total                                                                                                                   | \$57.1                 | \$72.2               | \$72.2                          | \$0.0                 |  |  |  |  |
| Full-time Equivalents (FTE)                                                                                                     | 0.7                    | 0.4                  |                                 |                       |  |  |  |  |
| Dollar amounts are shown in thousands of dollars.                                                                               |                        |                      |                                 |                       |  |  |  |  |
| Other Resources                                                                                                                 |                        |                      |                                 |                       |  |  |  |  |
| Comments: This project is designed as a follow-up study to restoration Projects 96144 and 97144 (see DPD Abstract for details). |                        |                      |                                 |                       |  |  |  |  |

**1999**

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

FORM 3A  
TRUSTEE  
AGENCY  
SUMMARY

Prepared: 04/10/96

October 1, 1998 - September 30, 1999

1999

|                                                                                               |
|-----------------------------------------------------------------------------------------------|
| Project Number: 99144<br>Project Title: Common Murre Population Monitoring<br>Agency: DOI-FWS |
|-----------------------------------------------------------------------------------------------|

FORM 3B  
Personnel  
& Travel  
DETAIL

Prepared: 04/10/96

# 1999 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

| <b>Contractual Costs:</b>                                                                                                                                                                                                                               |  | Proposed      |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|---------------|
| Description                                                                                                                                                                                                                                             |  | FFY 1999      |
| 24 vessel days @ \$1.8K/day = \$43.2K                                                                                                                                                                                                                   |  | 43.2          |
| When a non-trustee organization is used, the form 4A is required.                                                                                                                                                                                       |  |               |
| <b>Contractual Total</b>                                                                                                                                                                                                                                |  | <b>\$43.2</b> |
| <b>Commodities Costs:</b>                                                                                                                                                                                                                               |  | Proposed      |
| Description                                                                                                                                                                                                                                             |  | FFY 1999      |
| Food for 2 people @ \$12.00/day/person for 12.5 days (25 person days x \$12.00/day = \$0.3K)                                                                                                                                                            |  | 0.3           |
| Fuel (outboard gas & oil; estimated @ \$0.15K)                                                                                                                                                                                                          |  | 1.7           |
| Other field supplies (maps, notebooks, film = \$0.2K; boating supplies, including ropes, spark-plugs, emergency flares & other survival gear = \$0.8K; miscellaneous camping supplies replacement of rain gear, rubber boots, waterproof bags = \$0.7K) |  | 0.0           |
| Costs of producing & printing 2 large format posters for public display of project results                                                                                                                                                              |  | 0.5           |
| [Note: FWS will furnish office materials and additional camping, boating, & survival supplies.]                                                                                                                                                         |  |               |
| <b>Commodities Total</b>                                                                                                                                                                                                                                |  | <b>\$2.5</b>  |

**1999**

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

FORM 3B  
Contractual &  
Commodities  
DETAIL

Prepared: 04/10/96

## October 1, 1998 - September 30, 1999

## 1999

FORM 3B  
Equipment  
DETAIL

99145

# **Closeout of Study on Cutthroat Trout and Dolly Varden in Prince William Sound, Alaska: the Relation Among and Within Populations of Anadromous and Resident Forms**

Project Number: 99145 - CLO

Restoration Category: Monitoring and Research

Proposer: USFS, Pacific Northwest Research Station

Lead Trustee Agency: USFS

Cooperating Agencies: Dept. of Fisheries and Wildlife, Oregon State University

Duration: 3 years

Cost FY 96: \$200

Cost FY 97: \$229.7

Cost FY 98: \$120.7

Cost FY 99: \$73.0

Geographic Area: Prince William Sound

Injured Resource/Service: Dolly Varden  
Cutthroat Trout

RECEIVED

APR 15 1998

EXXON VALDEZ OIL SPILL  
TRUSTEE COUNCIL

## **ABSTRACT**

Dolly Varden and cutthroat trout are listed as injured resources whose recovery is unknown. Restoration efforts have taken the form of in stream habitat modification and stock supplementation. Given that the impact of the oil spill on these fish is unknown at present this approach is conservative. Since the usefulness of this approach in the long-term is unknown, a strategy based on ecological and genetic relations of the affected fish is needed. We are determining the relation between resident and anadromous forms of these fish within the same watershed and between watersheds in Prince William Sound. We will be continuing the analysis of genetic, meristic, and life-history features of each group which were sampled in FY96 and FY97. We are requesting a one year extension because it has taken longer to complete the genetic analysis than originally thought. Results from this study will allow development of a long-term, comprehensive and ecologically sound restoration strategy for these fish.

## INTRODUCTION

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

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

## NEED FOR THE PROJECT

### A. Statement of Problem

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

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

### B. Rationale/Link to Restoration

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

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

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

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

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

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

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

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

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

### **C. Location**

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

## **COMMUNITY INVOLVEMENT**

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

## **PROJECT DESIGN**

### **A. Objectives**

The objectives of this proposed study are to:

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

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

We will test the following hypotheses:

1. Resident and anadromous forms of each species from a watershed will exhibit similar genetic and meristic features.  
Corollaries
  - 1.1 Similarities will be strongest in watersheds where resident forms have been isolated the least amount of time.
  - 1.2 Similarities will be strongest in watersheds where isolating barriers allow a flow of individuals from the resident to the anadromous populations.
2. Populations of each species in Prince William Sound will exhibit similar genetic and meristic features and can be considered a metapopulation.

## **B. Methods**

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

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

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

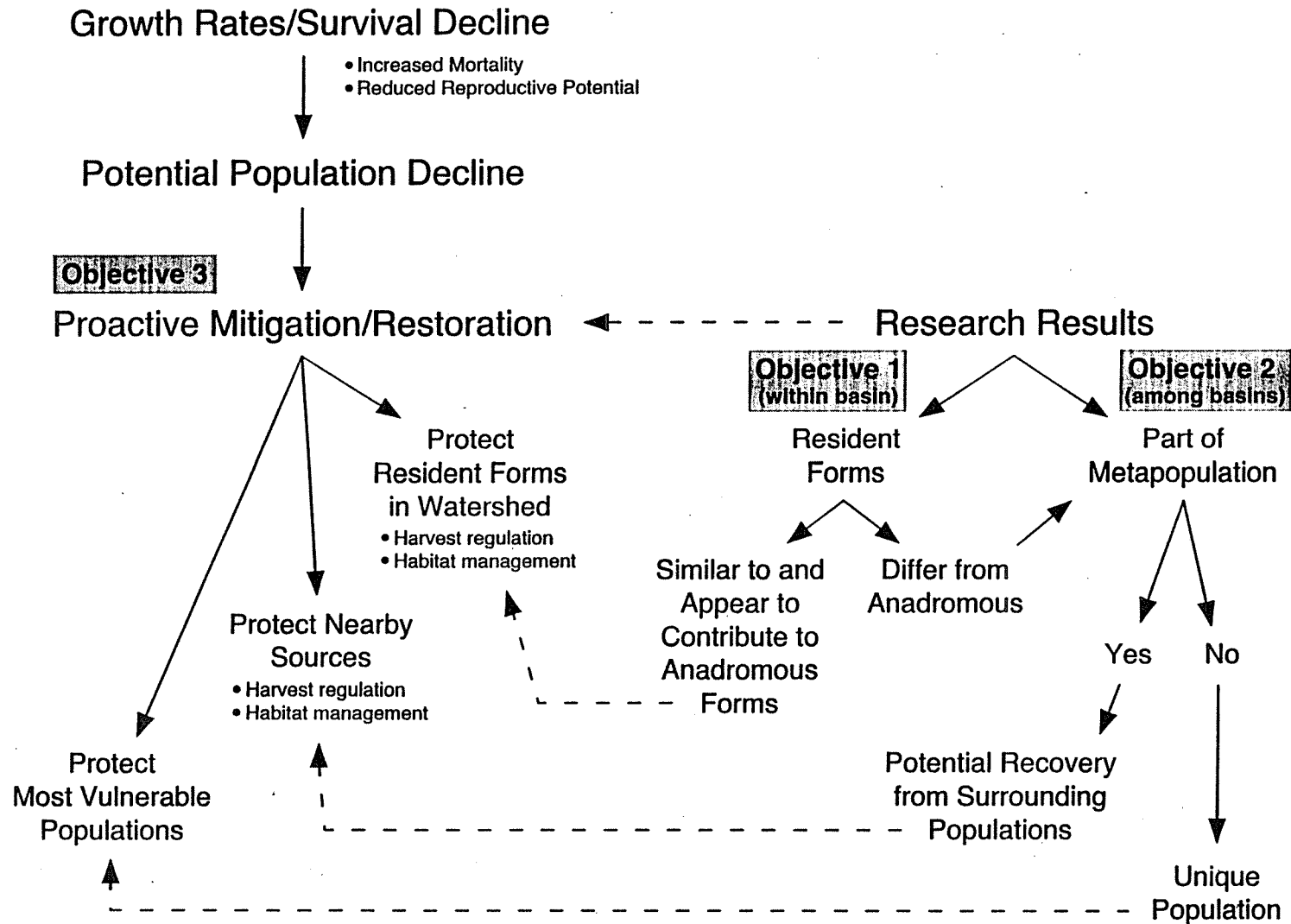


Figure 1. Flow diagram of possible research outcomes and feedback to mitigation and restoration.

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

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

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

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

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

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

## ALLOZYME DATA

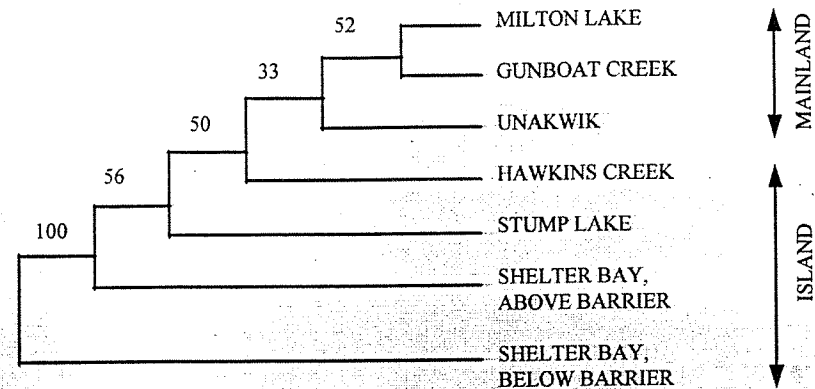


Figure 2. Allozyme data of coastal cutthroat trout from Prince William Sound, Alaska.

## MICROSATELLITE DNA DATA

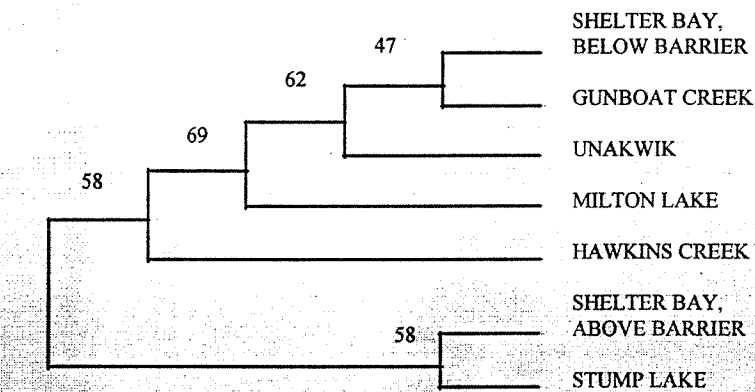


Figure 3. Microsatellite data of coastal cutthroat trout from Prince William Sound, Alaska.

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

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

Development of microsatellite protocol was initiated in July 1996. Selection of primer pairs for microsatellite analysis was based on Wenberg's (1996) work with coastal cutthroat trout and steelhead. Primer pairs were synthesized and labeled with three specific fluorescent tags, which allows for more than one primer pair to be separated on a gel at a time. We amplified DNA from cutthroat trout using PCR with the primer pairs that follow: Sfo8, Omy77, Ssa85, One $\mu$ 11, One $\mu$ 14, Ots1, One $\mu$ 2, Omy325, Ssa14. PCR products from these primer sets were separated on a denatured polyacrylamide gel using a Perkin Elmer Applied Biosystems, Inc. (ABI) 377 automated sequencer and analyzed using ABI GeneScan 672, analysis software, version 2.0.2. A subsample of 95 coastal cutthroat trout was screened with nine microsatellite loci. Peak height and base pair size was determined with genotyper 2.1 software. Analysis of four of these loci is presented in Figure 3. A small sample of Dolly Varden have been screened with the same nine microsatellite loci.

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

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

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

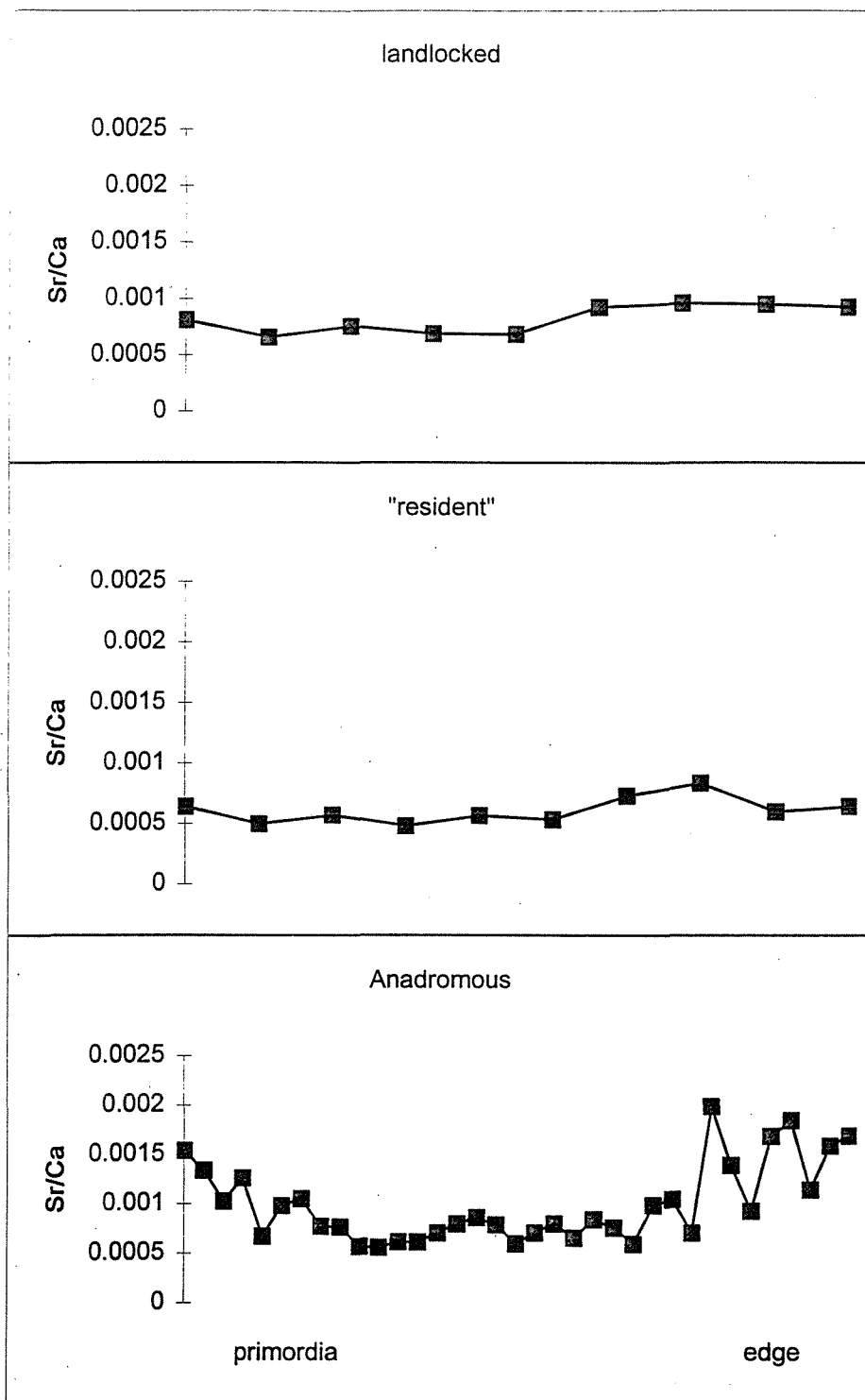


Figure 4. Otolith microchemistry of Sr/Ca in Dolly Varden from Power Creek, near Cordova, Alaska. Landlocked sample a) came from above a waterfall barrier, resident and anadromous samples b) and c) were collected from below a waterfall barrier.

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

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

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

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

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

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

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

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

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

## **SCHEDULE**

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

#### **Genetics and Meristics**

October 1998-

July 1999:

Renew cooperative agreement with OSU

Continue genetic and meristic analysis of cutthroat trout and Dolly Varden collected in July and September, FY97

Continue otolith microchemistry analysis

March 1999:

Attend Tenth Anniversary Workshop

August - September 1999:

Final Report and manuscript preparation

### **B. Project Milestones and Endpoints**

All objectives will be met in FY99.

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

June 1999:

Prepare report on preliminary analysis of genetic, meristic, and otolith microchemistry from FY96 and FY 97.

September 1999:

Report final results and articulation of restoration strategy  
Submit papers on results to peer-reviewed journals

### **C. Completion Date**

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

## **PUBLICATIONS AND REPORTS**

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

## **PROFESSIONAL CONFERENCES**

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

## **NORMAL AGENCY MANAGEMENT**

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

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

## **COORDINATION AND INTEGRATION OF RESTORATION EFFORT**

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

## **PROPOSED PRINCIPAL INVESTIGATORS**

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Corvallis, OR 97331

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360-753-8659  
kcurrens@nwifc.wa.gov

## **PERSONNEL**

The core personnel for this proposal are eminently qualified to implement this project. Gordon H. Reeves, Co-principal Investigator, is a research fish biologist with the USFS, Pacific Northwest Research Station, Corvallis, OR. He has been in that capacity for 10 years and has worked on anadromous salmonids research in streams throughout the Pacific Northwest and southeast Alaska. He has been involved with the development of conservation and restoration for anadromous salmonids in the Pacific Northwest. He is currently directing a study that is determining the relation of coastal cutthroat trout populations throughout their distributional range. He has published several articles on the ecology of anadromous salmonids and their freshwater habitat in peer-reviewed journals.

Kenneth P. Currens, the other Co-principal Investigator, was the Genetics Program Leader, Oregon Cooperative Fishery Research Unit, Dept. of Fisheries and Wildlife, Oregon State University from 1992 to 1996. He is currently the geneticist for the Northwest Indian Fisheries Commission. He has been involved in numerous studies examining allozymes, DNA, morphological, and genetic breeding studies of Pacific salmon, including cutthroat trout. He has advised and coordinated with state, federal, and tribal fishery agencies on genetic risk assessment. He has published several articles on genetics of salmon and trout in the peer-reviewed literature. Currens is currently supervising the genetic analysis for this study.

Kitty Griswold is a fish biologist at the USFS, Pacific Northwest Research Station, Corvallis, OR. She will be the research assistant on this project. She will supervise field work and be responsible for the otolith microchemistry analysis. She recently completed a study examining the relation between resident and anadromous cutthroat trout in watersheds in Alaska and in Oregon.

Brief resumes for each of these individuals follow.

### **GORDON H. REEVES**

USDA Forest Service, Pacific Northwest Research Station, Oregon State University, Corvallis, OR 97331.

#### Education:

B.A. - Biology, State University of New York, Oswego. 1973.

M.S. - Fisheries Science, Humboldt State University. 1978.

Ph.D. - Fisheries Science, Oregon State University. 1985.

#### Experience:

Assistant Professor, Department of Fisheries and Wildlife, Oregon State University. 1987 to present.

Courtesy Assistant Professor, Department of Fisheries. Humboldt State University. 1986 to present.

Research Fishery Biologist, USDA Forest Service, Pacific Northwest Forest and Range Experiment Station. 1986 to present.

Commercial Fisherman, Trinidad, California. 1978-79.

Research Biologist, New York State Research Foundation. State University of New York, Oswego. 1973-1976.

#### Professional Societies:

American Fisheries Society, North American Benthological Society. Sigma Xi National Honor Society

#### Professional Activities:

President, Oregon Chapter of the American Fisheries Society. 1989.

President-elect, Oregon Chapter of the American Fisheries Society. 1988.

#### Honors and Awards:

Certificate of Merit, USDA Forest Service. 1984

Certificate of Merit and Quality Step Increase, USDA Forest Service. 1986, 1989, and 1994.

Ethics in Science Award, USDA Forest Service. 1989.

Oldfield Team Award, College of Agriculture, Oregon State University. Award given for outstanding research by the Stream Team. 1991.

USDA Forest Service Rise to the Future Award for outstanding contributions in fishery research. 1991.

Conservationist of the Year Award, Pacific Rivers Council. 1992 and 1994.

USDA Secretary's Award for outstanding contribution to research contributing to understanding of aquatic ecosystems. 1995.

#### Special Assignments

Member Scientific Panel on Late-Successional Forest Ecosystem - formed by the Agriculture Committee and the Merchant Marine and Fisheries Committee of the U.S. House of Representatives to develop and evaluate alternatives for managing and conserving late-successional forest and aquatic ecosystems on federal lands in northern California and western Oregon and Washington. 1991.

Co-Leader PacFish Team - responsible for developing and evaluating alternatives for managing freshwater habitat of anadromous salmonids on federal lands in northern California, Oregon, Washington, Idaho, and Alaska. 1992-1993.

Member Scientific Assessment Team - develop management strategy for maintaining biodiversity of

federal lands in northern California and western Oregon and Washington at request of U.S. Federal Circuit Court Judge. 1992.

Co-leader of Aquatic Group of Forest Ecosystem Management and Assessment Team -responsible for developing and evaluating alternatives for managing federal lands in northern California and western Oregon and Washington. 1993.

#### Selected Publications

- Reeves, G. H., F. H. Everest, and J. D. Hall. 1987. Influence of water temperature on interactions between the redbside shiner (*Richardsonius balteatus*) and the steelhead trout (*Salmo gairdneri*). Canadian Journal of Fisheries and Aquatic Sciences 44:1603-1613.
- Hankin, D. G. and G. H. Reeves. 1988. Estimating total fish abundance and total habitat area in small streams based on visual estimation methods. Canadian Journal of Fisheries and Aquatic Sciences 45:833-844.
- Dolloff, C. A. and G. H. Reeves. 1990. Microhabitat partitioning among stream-dwelling juvenile coho salmon, *Oncorhynchus kisutch*, and Dolly Varden, *Salvelinus malma*. Canadian Journal of Fisheries and Aquatic Sciences 47:2297-2306.
- Sedell, J. R., G. H. Reeves, F. R. Hauer, J. A. Stanford, and C. P. Hawkins. 1990. Role of refugia in recovery from disturbances: modern fragmented and disconnected river systems. Environmental Management 14:711-724.
- Reeves, G. H., J. D. Hall, T. D. Roelofs, C. O. Baker, and T. Hickman. 1991. Habitat enhancement and rehabilitation for anadromous salmonids. Pages 519-557. American Fisheries Society Publication No. 19.
- Bisson, P. A., T. P. Quinn, G. H. Reeves, and S. V. Gregory. 1992. Best management practices, cumulative effects, and long-term trends in fish abundance in Pacific Northwest river systems. Pages 189-232. in R.J. Naiman, editor. Watershed management: balancing sustainability and environmental change. Springer-Verlag, New York.
- Reeves, G. H. and J. R. Sedell. 1992. An ecosystem approach to the conservation and management of freshwater habitat for anadromous salmonids in the Pacific Northwest. Transactions of the 57th North American Wildlife and Natural Resources Conference 1992:408-415.
- Thomas, J. W., G. H. Reeves, and others. 1993. Viability assessments and management considerations for species associated with late-successional and old-growth forests of the Pacific Northwest: the report of the Scientific Analysis Team. USDA Forest Service, Portland, OR 530 p.
- Reeves, G. H., F. H. Everest, and J. R. Sedell. 1993. Diversity of juvenile anadromous salmonid assemblages in basins in coastal Oregon with different levels of timber harvest activities. Transactions of the American Fisheries Society 122:309-317.
- Thomas, J. W., G. H. Reeves, and others. 1993. Forest ecosystem management: an ecological, economic, and social assessment. Report of the Forest Ecosystem Management Assessment Team. USDA Forest Service, Portland, OR
- Hicks, B. J. and G. H. Reeves. 1994. Restoration of stream habitat for fish using in-stream structures. Pages 67-92. in K. J. Collier, editor. Restoration of aquatic habitats. Selected papers from the second day of the New Zealand Limnological Society 1993 Annual Conference. New Zealand Department of Conservation, Wellington, New Zealand.
- Reeves, G. H., L. E. Benda, P. A. Bisson, and J. R. Sedell. 1995. A disturbance-based ecosystem approach to maintaining and restoring freshwater habitats of evolutionary significant units of

anadromous salmonids in the Pacific Northwest. Pages 334-349. *in* J. L. Nielsen, ed. Evolution and the aquatic ecosystem: defining unique units in population conservation. American Fisheries Society Symposium 17.

#### KENNETH P. CURRENS

Northwest Indian Fisheries Commission, 6730 Martin Way E, Olympia, WA 98516

#### Education

Ph.D. Oregon State University (1995). Conservation Genetics and Risk Assessment in Management of Hatchery and Wild Rainbow Trout Populations.

M.S. Fishery Science. Oregon State University (1987). Genetic Differentiation of Resident and Anadromous Rainbow Trout in the Deschutes River Basin, Oregon.

B.S. Fishery Science (with High Scholarship). Oregon State University (1983).

B.A. English. University of Oregon, Eugene, Oregon (1979).

#### Experience

Conservation Geneticist for the Northwest Indian Fisheries Commission (1995-present)

Conservation Geneticist for U.S. Fish and Wildlife Service endangered salmon issues (1992-1995).

Genetics Program Leader, Oregon Cooperative Fishery Research Unit (1992-present).

Analysis of allozyme, DNA, morphological, and genetic breeding studies of Pacific salmon

Advising and coordination with state, federal, and Tribal fishery agencies, and private groups Genetic risk assessment.

Fishery Biologist. Represented Oregon State University in the Sea of Cortez, Mexico (1987).

Graduate Research Assistant (1983-1986). Genetic analysis of Columbia River chinook salmon and steelhead.

Teaching Assistant. Economic Ichthyology. Oregon State University (1983).

Technician. Oregon State University Fish Museum (1982-1983).

Chemist. Winter Products Company, Portland, Oregon (1979-1981).

Mathematics and Language Arts Tutor. Canby Union High School, Canby, Oregon (1978-1979).

#### Honorary Societies and Awards

Walter Jones Certificate of Excellence in Fisheries Development (1987).

SOLMAREX Graduate Research Opportunity Award (1987).

Masters Student of Excellence in Fisheries and Wildlife (1985).

Phi Kappa Phi (1984).

#### Professional Organizations

American Association for the Advancement of Science

The American Fisheries Society

The American Society of Ichthyologists and Herpetologists

The Gilbert Ichthyological Society

Society for Conservation Biology

Society for the Study of Evolution

#### Professional and University Service

Scientific Reviewer for the *Transactions of the American Fisheries Society*, *Journal of Great Lakes Research*, *Conservation Biology*, *Aquaculture*, National Geographic Society, Research and

Exploration, National Marine Fishery Service Saltonstall-Kennedy Grants (1992, 1993, 1995), NMFS Endangered Species Act Status Reviews (1995), Washington Sea Grant Program (1994), Washington Department of Fish and Wildlife, OS Extension Service (1991).

#### Genetic Consulting, Education and Policy Reviews:

Northwest Power Planning Council - chaired geneticist committee at two symposia.

Oregon Department of Fisheries and Wildlife

Oregon State University, Department of Fisheries and Wildlife - Guest lecturer: Genetics in Fisheries and Aquaculture Short Course (1988, 1990), Fishery Management (1992), Ecological Aspects of Park Management (1993), Wildlife Techniques (1994) - Conservation Biology Committee (1991), Promotion and Tenure Committee (1989-1990), Graduate Committee (1988-1989).

Oregon Trout

Oregon Aqua-Foods, Inc.

Pacific Rivers Council

#### Selected Publications

- Currens, K.P., C.B. Schreck and H.W. Li. 1988. Reexamination of the use of otolith nuclear dimensions to identify juvenile anadromous and nonanadromous rainbow trout, Salmo gairdneri. Fish. Bull., U.S. 86:160-163.
- Currens, K.P., C.S. Sharpe, R. Hjort, C.B. Schreck and H.W. Li. 1989. Effects of different feeding regimes on the morphometrics of chinook salmon (Oncorhynchus tshawytscha) and rainbow trout (O. mykiss). Copeia 1989(3):689-695.
- Currens, K.P., C.B. Schreck and H.W. Li. 1990. Allozyme and morphological divergence of rainbow trout (Oncorhynchus mykiss) above and below waterfalls in the Deschutes River, Oregon. Copeia 1990(3):730-746.
- Currens, K.P. 1991. Rangeland redbands - trout of the desert. Oregon's Wildlife Resources 1(4):1-2
- Schreck, C.B., M.S. Fitzpatrick and K.P. Currens. 1995. Pacific salmon (Oncorhynchus sp.). Pages 197-219 in N.R. Bromage and R.J. Roberts (eds.). Broodstock Management and Egg and Larval Quality, Blackwell Science Ltd., University Press, Cambridge.
- Busack, C.A., and K.P. Currens. In Press. Genetic risks and hazards in hatchery operations: fundamental concepts and issues. Uses and Effects of Cultured Fishes in Aquatic Ecosystems. American Fisheries Society Special Publication XX.
- Currens, K.P. In Press. What is a wild trout? A Population Geneticist's Perspective. Wild Trout V. Trout Unlimited, Inc. and the United States Fish and Wildlife Service, Denver, Colorado.
- Adams, N.S., W.J. Spearman, C.V. Burger, K.P. Currens, C.B. Schreck, and H.W. Li. In Press. Variation in mitochondrial DNA and allozymes discriminates early and late forms of chinook salmon (Oncorhynchus tshawytscha) in the Kenai and Kasilof rivers, Alaska. Can. J. Fish. Aquat. Sci.
- Li, H.W., K.P. Currens, D. Bottom, S. Clarke, J. Dambacher, C. Frissell, P. Harris, R.M. Hughes, D. McCullough, A. McGie, K. Moore, R. Nawa, and S. Thiele. In Press. Safe Havens: refuges and evolutionary significant units. Evolution and the Aquatic Ecosystem. American Fisheries Society Special Publication
- Currens, K.P., and C.A. Busack. (Accepted). Genetic risk assessment. Fisheries.
- Currens, K.P., C.A. Busack, G.K. Meffe, D.P. Philipp, E.P. Pister, F.M. Utter and S. Yundt. (Accepted). A hierarchical approach to conservation genetics and production of anadromous salmonids in the Columbia River Basin. NOAA Technical Reports NMFS.

#### In preparation

Currens, K.P., C.B. Schreck, and H.W. Li. Mitochondrial DNA Variation in Oregon coho salmon

- (Oncorhynchus kisutch). Can. J. Fish. Aquat. Sci.
- Currens, K.P., C.B. Schreck, and H.W. Li. Genetic variation of rainbow trout in the Columbia River and northern Great Basin. *Copeia*.
- Currens, K.P., C.B. Schreck, and H.W. Li. Meristic variation in rainbow trout of the Columbia River. *Fishery Bulletin*.
- Currens, K.P., A.R. Hemmingsen, D.V. Buchanan, C.B. Schreck and H.W. Li. Genetic and zoogeographical implications of allozyme divergence and resistance to a microparasite in rainbow trout (Oncorhynchus mykiss). *Evolution*.
- Currens, K.P., A.R. Hemmingsen, D.V. Buchanan, C.B. Schreck and H.W. Li. Allozyme, meristic, and parasitological evidence of introgression between wild and hatchery rainbow trout (Oncorhynchus mykiss). *Trans. Amer. Fish. Soc.*
- Currens, K.P., C.B. Schreck, and H.W. Li. Genetic variation of coastal cutthroat trout (Oncorhynchus clarki clarki) within an Oregon river basin. *Trans. Amer. Fish. Soc.*
- Currens, K.P., C.B. Schreck and H.W. Li. Variation in heritability of hatching time in populations of rainbow trout (Oncorhynchus mykiss) within a river basin. *Trans. Amer. Fish. Soc.*
- Currens, K.P., C.B. Schreck and H.W. Li. Genetic variation and responses to stress in rainbow trout (Oncorhynchus mykiss). *Can. J. Fish. Aquat. Sci.*
- Nehlsen, W., F.W. Allendorf, D. Bayles, D. Bottom, K.P. Currens, C.A. Frissell, D. Hankin, J.A. Lichtowich, P.C. Trotter, and T. Williams. Criteria for prioritizing at-risk stocks of Pacific salmon for conservation and recovery actions. *Conservation Biology*.

#### KITTY GRISWOLD

USDA Forest Service, Pacific Northwest Research Station, Oregon State University, Corvallis, OR 97331.

#### Education

B.A. English Literature, Reed College, Portland, Oregon, January, 1988.  
 M.S. Fisheries, Oregon State University, April, 1996.  
 Ph.D. candidate, Oregon State University

#### Professional Experience

Research Biologist, USDA Forest Service, Pacific Northwest Research Station, Oregon State University, Corvallis, OR. November 1995-present  
 Graduate Research Assistant, Department of Fisheries and Wildlife, Oregon State University. March 1995 to November 1995.  
 Teaching Assistant, Department of Fisheries and Wildlife, Oregon State University. January, 1995-March 1995. "Multicultural Perspectives of Natural Resources" FW 240.  
 Graduate Research Assistant, Department of Fisheries and Wildlife, Oregon State University. Conducted research on the genetic relationships and life histories of coastal cutthroat trout in two basins.  
 Biological Technician, U.S.F.S., PNW Research Station. June 1991-February 1992.  
 Data Entry, U.S.F.S., PNW Research Station, Corvallis, OR. March, 1991-June, 1991.  
 Biological Aid, U.S.F.S., Waldport District, Waldport, OR. June, 1990-September, 1990.

#### Presentations

Stream Team, Oregon State University. October, 1992. Presented conceptual framework and methods for M.S. research.

Fishery Biology, Department of Fisheries and Wildlife, Oregon State University. November, 1993 and 1994. Guest lecturer "Genetics and Stock Identification".

Stream Team, Oregon State University. December, 1994. Genetic variation of cutthroat trout within two coastal basins.

American Fisheries Society, Ashland, Oregon. February, 1995. Genetic relationships of resident and anadromous coastal cutthroat trout.

#### Awards

Oregon Federation of Fly fishers Scholarship 1992.

Oregon State University College of Agricultural Sciences Registry of Distinguished Graduate Students 1995.

#### Professional Societies

American Fisheries Society, Gilbert Ichthyological Society

#### Selected Publications

Griswold K.E. 1996. Genetic and meristic relationships of coastal cutthroat trout (*Oncorhynchus clarki clarki*) residing above and below barriers in two coastal basins. M.S. Thesis. Oregon State University, Corvallis, Oregon

#### In Preparation

Griswold K.E., K. P. Currens, and G. H. Reeves. Genetic and meristic relationships of coastal cutthroat trout (*Oncorhynchus clarki clarki*) residing above and below barriers in two coastal basins. Can. J. Fish. Aquat. Sci.

## LITERATURE CITED

- Adams, S. M. 1990. Status and use of biological indicators for evaluating the effects of stress on fish. Pages 1-8. in S. M. Adams, editor. Biological indicators of stress in fish. Symposium 8, American Fisheries Society.
- 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, Springfield, Virginia.
- Allendorf, F. W., and R. F. Leary. 1986. Heterozygosity and fitness in natural populations of animals, p. 57-76. In: Conservation Biology: the science of scarcity and diversity. M. E. Soule (ed.). Sunderland, MA.
- Angers, B., L. Bernatchez, A. Angers, and L.Desgroseillers. 1995. Specific microsatellite loci for brook charr reveal strong population subdivision on a microgeographic scale. Journal of Fish Biology 47: 177-185.
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- Awise, J.C. 1986. Mitochondrial DNA and the evolutionary genetics of higher animals. Transactions of the Royal Society of London. B. 312:325-342.

- Brown, J. H. and A. Kodric-Brown. 1977. Turnover rates in insular biogeography: effect of immigration on extinction. *Ecology* 58:445-449.
- Cronin, M.A., W.J. Spearman, R.L. Wilmot, J.C. Patton, and J.W. Bickman. 1993. Mitochondrial DNA variation in chinook salmon (*Oncorhynchus tshawytscha*) and chum salmon (*O. Keta*) detected by restriction enzyme analysis of polymerase chain reaction (PCR) products. *Canadian Journal Fisheries and Aquatic Sciences*. 50:708-715.
- Griswold K.E. 1996. Genetic and meristic relationships of coastal cutthroat trout (*Oncorhynchus clarki clarki*) residing above and below barriers in two coastal basins. M.S. Thesis. Oregon State University, Corvallis, Oregon.
- Gunn, J.S., I.R. Harrowfield, C.H. Proctor and R.E. Thresher. 1992. Electron probe microanalysis of fish otoliths-evaluation of techniques for studying age and stock discrimination. *Journal of Marine Biology and Ecology* 158:1-36.
- Hanski, I. and M. Gilpin. 1991. Metapopulation dynamics: brief history and conceptual domain. *Biological Journal of the Linnean Society* 42:3-16.
- Hepler, K. R., P. A. Hansen, and D. R. Bernard. 1993. Impact of oil Spilled from the *Exxon Valdez* on survival and growth of Dolly Varden and cutthroat trout in Prince William Sound. Alaska Department of Fish and Game, Division of Oil Spill Assessment and Restoration, Anchorage, Alaska. 38 pages.
- Jewett, S.C. and T. A. Dean. 1993. The effects of the *Exxon Valdez* oil spill on infaunal invertebrates in the eelgrass habitat of Prince William Sound. Paper presented at the Exxon Valdez Oil Spill Symposium, 2-5 February, 1993. Anchorage, Alaska.
- Jewett, S.C., T. A. Dean, and D. R. Laur. 1993. The effects of the *Exxon Valdez* on benthic invertebrates in silled fjords in Prince William Sound. Paper presented at the Exxon Valdez Oil Spill Symposium, 2-5 February, 1993. Anchorage, Alaska.
- Kalish, J. M. 1990. Use of otolith microchemistry to distinguish progeny of sympatric anadromous and non-anadromous salmonids. *Fish. Bull.* 88:657-666.
- Labell, M. 1992. Straying patterns of coho salmon (*O. kisutch*) stocks from southeast Vancouver Island, British Columbia. *Canadian Journal of Fisheries and Aquatic Sciences* 49: 1843-1855.
- Leary, R.F., F.W. Allendorf, and K.L. Knudsen. 1984. Superior developmental stability of enzyme heterozygotes in salmonid fishes. *American Naturalist* 124:540-551.
- Leary, R.F., F.W. Allendorf, K.L. Knudsen. 1985a. Inheritance of meristic variation and the evolution of developmental stability in rainbow trout. *Evolution* 39:308-314.
- Leary, R.F., F.W. Allendorf, K.L. Knudsen, and G.H. Thorgaard. 1985b. Heterozygosity and developmental stability in gynogenetic diploid and triploid rainbow trout. *Heredity* 54:219-225.
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- McConnell, S., L. Hamilton, D. Morris. 1995a. Isolation of salmonid microsatellite loci and thier application to the population genetics of Canadian east coast stocks of Atlantic salmon. *Aquaculture*. 137:19-30.
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- Murphy, D. D. and B. R. Noon. 1992. Integrating scientific methods with habitat conservation planning: reserve design for northern spotted owls. *Ecological Applications* 2:3-17.
- Narver, D. W. and M. L. Dahlberg. 1965. Estuarine food of Dolly Varden at Chignak, Alaska. *Transactions of the American Fisheries Society* 94:405-408.
- Nelson, K. and M. E. Soule. 1987. Genetical conservation of exploited fishes. Pages 345-368. *in* N. Ryman and F. Utter, editors. University of Washington Press, Seattle, Washington.
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- Nei, M. 1978. Estimation of average heterozygosity and genetic distance from a small number of individuals. *Genetics* 89:583-590.
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- Northcote, T. G. 1992. Migration and residency in stream salmonids--some ecological considerations and evolutionary consequences. *Nordic Journal of Freshwater Research* 67:5-17.
- Olson, J.B., J.K. Wenburg, P. Bentzen. 1996. Semiautomated multilocus genotyping of Pacific salmon (*Oncorhynchus* spp.) using microsatellites. *Molecular Marine Biology and Biotechnology*. 5:259-272.
- Quattro, J. M., and R. C. Vrijenhoek. 1989. Fitness differences among remnant populations of the endangered Sonoran topminnow. *Science* 245:976-978.
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- Rieman, B., D. Lee, J. McIntyre, K. Overton, and R. Thurow. 1993. Consideration of extinction risks for salmonids. FHR Currents. Fish Habitat Relationships Technical Bulletin, Number 14, December 1993. U.S. Government Printing Office. 1993-583-068.
- Rieman, B.E., D.L. Meyers and R.L. Nielsen. 1994. Use of otolith microchemistry to discriminate *Oncorhynchus nerka* of resident and anadromous origin. *Canadian Journal of Fisheries and Aquatic Sciences* 51:68-77.
- Roff, D.A., and P. Bentzen. 1989. The statistical analysis of mitochondrial DNA polymorphisms:  $X^2$  and the problem of small samples. *Mol. Biol. Evol.* 6:539-545.
- Scott, W. B. and E. J. Crossman. 1979. Freshwater fishes of Canada. Fisheries Research Board of Canada, Bulletin Number 184. 966 pages.
- Simon, R. C. 1972. Gene frequency and the stock problems. Pages 161-169. *in* R. C. Simon and P. A. Larkin, editors. The stock concept in Pacific Salmon. H. R. MacMillan Lectures in Fisheries. University of British Columbia Press, Vancouver, British Columbia.
- Sjogren, P. 1991. Extinction and isolation gradients in metapopulations: the case of the pool frog (*Rana lessonae*). *Biological Journal of the Linnean Society* 42:135-147.
- Teal, J. M. and R. W. Howarth. 1984. Oil spill studies: a review of ecological effects. *Environmental Vrijenhoek, R. C.* 1985. Animal population genetics and disturbance: the effects of local extinctions and recolonization on heterozygosity and fitness, p.265-285. *In: The Ecology of Natural Disturbance and Patch Dynamics.* Academic Press, New York, NY.

- Wenbug, J.K., J.B. Olsen, and P. Bentzen. 1996. Multiplexed systems of microsatellites for genetic analysis in coastal cutthroat trout (*Oncorhynchus clarki clarki*) and steelhead (*Oncorhynchus mykiss*). *Molecular Marine Biology and Biotechnology*. 5:273-283.
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**FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**

October 1, 1998 - September 30, 1999

| Budget Category:                                  | Authorized<br>FY 1998 | Proposed<br>FY 1999 |                                 |                      |                      |                      |  |  |
|---------------------------------------------------|-----------------------|---------------------|---------------------------------|----------------------|----------------------|----------------------|--|--|
| Personnel                                         | \$64.8                | \$60.0              |                                 |                      |                      |                      |  |  |
| Travel                                            | \$2.4                 | \$4.0               |                                 |                      |                      |                      |  |  |
| Contractual                                       | \$40.0                | \$0.0               |                                 |                      |                      |                      |  |  |
| Commodities                                       | \$0.0                 | \$0.0               |                                 |                      |                      |                      |  |  |
| Equipment                                         | \$1.0                 | \$0.0               |                                 |                      |                      |                      |  |  |
| Subtotal                                          | \$108.2               | \$64.0              | LONG RANGE FUNDING REQUIREMENTS |                      |                      |                      |  |  |
| General Administration                            | \$12.5                | \$9.0               |                                 | Estimated<br>FY 2000 | Estimated<br>FY 2001 | Estimated<br>FY 2002 |  |  |
| Project Total                                     | \$120.7               | \$73.0              |                                 |                      |                      |                      |  |  |
| Full-time Equivalents (FTE)                       |                       | 2.0                 |                                 |                      |                      |                      |  |  |
| Dollar amounts are shown in thousands of dollars. |                       |                     |                                 |                      |                      |                      |  |  |
| Other Resources                                   |                       |                     |                                 |                      |                      |                      |  |  |
| Comments: Continuation of 98145                   |                       |                     |                                 |                      |                      |                      |  |  |

**FY 99**

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

FORM 3A  
TRUSTEE  
AGENCY  
SUMMARY

# FY 99 EXXON VALDEZ TRU E COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

| Personnel Costs:                                |                      | GS/Range/<br>Step | Months<br>Budgeted | Monthly<br>Costs | Overtime          | Proposed<br>FY 1999 |
|-------------------------------------------------|----------------------|-------------------|--------------------|------------------|-------------------|---------------------|
| Name                                            | Position Description |                   |                    |                  |                   |                     |
| K. Griswald                                     | Fish Biologist       |                   | 12.0               | 4.0              |                   | 48.0                |
| Vacant                                          | Fish Tech            |                   | 12.0               | 1.0              |                   | 12.0                |
|                                                 |                      |                   |                    |                  |                   | 0.0                 |
|                                                 |                      |                   |                    |                  |                   | 0.0                 |
|                                                 |                      |                   |                    |                  |                   | 0.0                 |
|                                                 |                      |                   |                    |                  |                   | 0.0                 |
|                                                 |                      |                   |                    |                  |                   | 0.0                 |
|                                                 |                      |                   |                    |                  |                   | 0.0                 |
|                                                 |                      |                   |                    |                  |                   | 0.0                 |
|                                                 |                      |                   |                    |                  |                   | 0.0                 |
|                                                 |                      |                   |                    |                  |                   | 0.0                 |
|                                                 |                      |                   |                    |                  |                   | 0.0                 |
| Subtotal                                        |                      |                   | 24.0               | 5.0              | 0.0               |                     |
| Personnel Total                                 |                      |                   |                    |                  |                   | \$60.0              |
| Travel Costs:                                   |                      | Ticket<br>Price   | Round<br>Trips     | Total<br>Days    | Daily<br>Per Diem | Proposed<br>FY 1999 |
| Description                                     |                      |                   |                    |                  |                   |                     |
| Corvallis, Or. To Anchorage to attend work shop |                      | 1.0               | 2                  | 10               | 0.2               | 4.0                 |
|                                                 |                      |                   |                    |                  |                   | 0.0                 |
|                                                 |                      |                   |                    |                  |                   | 0.0                 |
|                                                 |                      |                   |                    |                  |                   | 0.0                 |
|                                                 |                      |                   |                    |                  |                   | 0.0                 |
|                                                 |                      |                   |                    |                  |                   | 0.0                 |
|                                                 |                      |                   |                    |                  |                   | 0.0                 |
|                                                 |                      |                   |                    |                  |                   | 0.0                 |
|                                                 |                      |                   |                    |                  |                   | 0.0                 |
|                                                 |                      |                   |                    |                  |                   | 0.0                 |
|                                                 |                      |                   |                    |                  |                   | 0.0                 |
|                                                 |                      |                   |                    |                  |                   | 0.0                 |
| Travel Total                                    |                      |                   |                    |                  |                   | \$4.0               |

**FY 99**

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

FORM 3B  
Personnel  
& Travel  
DETAIL

Prepared:

4/15/98, 2 of 4

# FY 99 EXXON VALDEZ TRUSTEES COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

|                                                                   |  |                     |
|-------------------------------------------------------------------|--|---------------------|
| <b>Contractual Costs:</b>                                         |  | Proposed<br>FY 1999 |
| Description                                                       |  |                     |
|                                                                   |  |                     |
| When a non-trustee organization is used, the form 4A is required. |  |                     |
| <b>Contractual Total</b>                                          |  | \$0.0               |
| <b>Commodities Costs:</b>                                         |  | Proposed<br>FY 1999 |
| Description                                                       |  |                     |
|                                                                   |  |                     |
| <b>Commodities Total</b>                                          |  | \$0.0               |

FY 99

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

FORM 3B  
 Contractual &  
 Commodities  
 DETAIL

Prepared:

# FY 99 EXXON VALDEZ TRUSTEES COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

| <b>New Equipment Purchases:</b>                                                                 |  | Number<br>of Units         | Unit<br>Price | Proposed<br>FY 1999 |
|-------------------------------------------------------------------------------------------------|--|----------------------------|---------------|---------------------|
| Description                                                                                     |  |                            |               |                     |
|                                                                                                 |  |                            |               | 0.0                 |
|                                                                                                 |  |                            |               | 0.0                 |
|                                                                                                 |  |                            |               | 0.0                 |
|                                                                                                 |  |                            |               | 0.0                 |
|                                                                                                 |  |                            |               | 0.0                 |
|                                                                                                 |  |                            |               | 0.0                 |
|                                                                                                 |  |                            |               | 0.0                 |
|                                                                                                 |  |                            |               | 0.0                 |
|                                                                                                 |  |                            |               | 0.0                 |
|                                                                                                 |  |                            |               | 0.0                 |
|                                                                                                 |  |                            |               | 0.0                 |
|                                                                                                 |  |                            |               | 0.0                 |
|                                                                                                 |  |                            |               | 0.0                 |
| Those purchases associated with replacement equipment should be indicated by placement of an R. |  | <b>New Equipment Total</b> |               | \$0.0               |

| <b>Existing Equipment Usage:</b> |  | Number<br>of Units | Inventory<br>Agency |
|----------------------------------|--|--------------------|---------------------|
| Description                      |  |                    |                     |
|                                  |  |                    |                     |

|              |                                                                                       |                                |
|--------------|---------------------------------------------------------------------------------------|--------------------------------|
| <b>FY 99</b> | Project Number: 99145<br>Project Title: CT/DV Relations<br>Agency: U S Forest Service | FORM 3B<br>Equipment<br>DETAIL |
|--------------|---------------------------------------------------------------------------------------|--------------------------------|



## Archaeological Site Stewardship

Project Number: 99149

Restoration Category: Monitoring

Proposer: ADNR- Alaska Office of History and Archaeology

Lead Trustee Agency: ADNR

Cooperating Agency: DOI- U.S. Fish and Wildlife Service

Alaska SeaLife Center: No

Duration: Closeout of 3 year project

Cost FY 99: \$15,000

Geographic Area: Kenai Peninsula, Kodiak Island, Alaska Peninsula

Injured Resource: Archaeological Resources

RECEIVED

APR 13 1998

EXXON VALDEZ OIL SPILL  
TRUSTEE COUNCIL

## ABSTRACT

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

## INTRODUCTION

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

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

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

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

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

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

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

## **NEED FOR THE PROJECT**

### **A. Statement of Problem**

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

### **B. Rationale**

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

### **C. Location**

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

## **COMMUNITY INVOLVEMENT**

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

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

## **PROJECT DESIGN**

### **A. Objectives**

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

### **B. Methods**

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

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

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

## **SCHEDULE**

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

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

October 1 - November 15, 1998: Beginning of FY 99. No NEPA finding required.

April 15, 1999: Completion of final report.

### **B. Project Milestones and Endpoints**

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

### **C. Completion Date**

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

## **PUBLICATIONS AND REPORTS**

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

## **PROFESSIONAL CONFERENCES**

No professional conference presentations are anticipated.

## **NORMAL AGENCY MANAGEMENT**

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

## **COORDINATION AND INTEGRATION OF RESTORATION EFFORT**

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

## **EXPLANATION OF CHANGES IN CONTINUING PROJECTS**

This proposal is for closeout of the three year project.

## **PROPOSED PRINCIPAL INVESTIGATOR**

Douglas R. Reger  
Office of History and Archaeology  
Alaska Department of Natural Resources  
3601 C Street, Suite 1278  
Anchorage, AK 99503-5921  
(907) 269-8725  
FAX (907)269-8908  
E-mail: dougr @dnr.state.ak.us

## PERSONNEL

Douglas R. Reger  
Archaeologist II  
Office of History and Archaeology  
Alaska Division of Parks and Outdoor Recreation  
3601 C Street, Suite 1278  
Anchorage, AK 99510-7001

1981 PhD.- Anthropology, Washington State University

## PROFESSIONAL EXPERIENCE:

|         |                                                                      |
|---------|----------------------------------------------------------------------|
| 1964    | Field and museum assistant, Univ. of Alaska, Fairbanks               |
| 1965    | Field assistant, Univ. of Alaska, Fairbanks                          |
| 1966    | Field assistant, Alaska Methodist Univ.                              |
| 1966-67 | Laboratory/research assistant, Alaska Methodist Univ.                |
| 1969    | Short field surveys, Cordova and Katmai, AK                          |
| 1970    | Field School instructor, Alaska Methodist Univ., Tangle Lakes        |
| 1970-71 | Excavated site 49KEN-029, near Kenai, AK                             |
| 1971    | Salvage archaeologist, Alyeska Pipeline Project                      |
| 1971-74 | Teaching assistant, Washington State Univ.                           |
| 1972    | Assistant Highways archaeologist, Washington State Univ.             |
| 1973    | Project Archaeologist, Homer Society for Natural History             |
| 1974-75 | Regional archaeologist, USDA Forest Service, Alaska Region           |
| 1975-82 | Alaska State archaeologist, Alaska Division of Parks                 |
| 1978-82 | Deputy State Historic Preservation Officer, Alaska                   |
| 1982-86 | Archaeologist, Alaska Division of Geological and Geophysical Surveys |
| 1986-   | Archaeologist, Alaska Division of Parks and Outdoor Recreation       |

## PUBLICATIONS/REPORTS:

|      |                                                                                                                                                                                                                          |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1972 | <i>An archaeological survey in the Utopia area, Alaska</i> , <b><u>Anthropological Papers of the University of Alaska</u></b> , 15(2), with R.D. Reger                                                                   |
| 1974 | <i>Prehistory of the northern Kenai Peninsula</i> , In <b><u>Prehistory of the North American Subarctic: the Athapaskan Question</u></b> , edited by J.W. Helmer, S. VanDyke, and F.J. Kense, Univ. of Calgary, p. 16-21 |
| 1977 | <i>An Eskimo Site near Kenai, Alaska</i> , <b><u>Anthropological Papers of the University of Alaska</u></b> , 18(2): 37-52                                                                                               |
| 1983 | <i>Norton: a changing southeastern boundary</i> , <b><u>Arctic Anthropology</u></b> 19(2): 93-99, with Joan B. Townsend                                                                                                  |
| 1987 | <i>Archaeology of a late prehistoric subsistence locality, the Clam Gulch Site (49KEN-045)</i> , <b><u>Anthropological Papers of the University of Alaska</u></b> 21:89-103                                              |
| 1992 | Effect of crude oil contamination on some archaeological sites in the Gulf of Alaska, 1991 investigations. <b><u>Office of History and Archaeology Report No. 30.</u></b>                                                |

Alaska Division of Parks and Outdoor Recreation, with J. David McMahan and  
C. E. Holmes.

Debra G. Corbett  
Archaeologist  
U.S. Fish and Wildlife Service  
1011 E. Tudor Road  
Anchorage, AK 99503

1980 BA- Anthropology, University of Arizona  
1992 MA- Anthropology, University of Alaska, Fairbanks

PROFESSIONAL EXPERIENCE

1980 Survey and project clearance, Bureau of Land Management, Idaho Falls  
District, Idaho  
1981 Survey and project clearance, Bureau of Land Management, Salmon District,  
Idaho  
1982 Survey and project clearance, Bureau of Land Management, Phoenix District,  
Arizona  
1983 Excavation, La Ciudad village, Papago Freeway Project, Phoenix, Arizona  
1983-89 ANCSA 14(1) investigations, Bureau of Indian Affairs, Anchorage, Alaska.  
Projects in the Aleutians, Yukon Delta and Kobuk River areas.  
1991 Survey and Project clearances, U.S. Fish and Wildlife Service, wildlife refuges  
throughout Alaska.

Professional Affiliations: Alaska Anthropological Association

# 1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1997 - September 30, 1998

| Budget Category:                                                  | Authorized<br>FY 1998 | Proposed<br>FY 1999 | PROPOSED FY 1999 TRUSTEE AGENCIES TOTALS |                      |                      |                      |     |      |
|-------------------------------------------------------------------|-----------------------|---------------------|------------------------------------------|----------------------|----------------------|----------------------|-----|------|
|                                                                   |                       |                     | ADEC                                     | ADF&G                | ADNR                 | USFS                 | DOI | NOAA |
| Personnel                                                         | \$40.1                | \$13.2              |                                          |                      |                      |                      |     |      |
| Travel                                                            | \$16.0                | \$0.0               |                                          |                      |                      |                      |     |      |
| Contractual                                                       | \$3.4                 | \$0.0               |                                          |                      |                      |                      |     |      |
| Commodities                                                       | \$1.2                 | \$0.0               |                                          |                      |                      |                      |     |      |
| Equipment                                                         | \$0.0                 | \$0.0               | LONG RANGE FUNDING REQUIREMENTS          |                      |                      |                      |     |      |
| Subtotal                                                          | \$60.7                | \$13.2              |                                          | Estimated<br>FY 2000 | Estimated<br>FY 2001 | Estimated<br>FY 2002 |     |      |
| General Administration                                            | \$6.2                 | \$2.0               |                                          |                      |                      |                      |     |      |
| Project Total                                                     | \$66.9                | \$15.2              |                                          | \$0.0                | \$0.0                | \$0.0                |     |      |
| Full-time Equivalents (FTE)                                       | 0.7                   | 0.2                 |                                          |                      |                      |                      |     |      |
| Dollar amounts are shown in thousands of dollars.                 |                       |                     |                                          |                      |                      |                      |     |      |
| Other Resources                                                   | \$0.0                 | \$0.0               |                                          | \$0.0                | \$0.0                | \$0.0                |     |      |
| Comments: This the close-out of projects 96149, 97149, and 98149. |                       |                     |                                          |                      |                      |                      |     |      |

**1999**

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

FORM 2A  
 MULTI-TRUSTEE  
 AGENCY  
 SUMMARY

# 1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1997 - September 30, 1998

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

**1999**

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

FORM 3A  
 TRUSTEE  
 AGENCY  
 SUMMARY

October 1, 1997 - September 30, 1998

1999

|                                                                                                                       |
|-----------------------------------------------------------------------------------------------------------------------|
| Project Number: 99149<br>Project Title: Archaeological Site Stewardship<br>Agency: AK Department of Natural Resources |
|-----------------------------------------------------------------------------------------------------------------------|

FORM 3B  
Personnel  
& Travel  
DETAIL

# 1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1997 - September 30, 1998

|                                                                   |  |                     |
|-------------------------------------------------------------------|--|---------------------|
| <b>Contractual Costs:</b>                                         |  | Proposed<br>FY 1999 |
| Description                                                       |  |                     |
|                                                                   |  |                     |
|                                                                   |  |                     |
|                                                                   |  |                     |
|                                                                   |  |                     |
|                                                                   |  |                     |
|                                                                   |  |                     |
|                                                                   |  |                     |
| When a non-trustee organization is used, the form 4A is required. |  |                     |
| <b>Contractual Total</b>                                          |  | \$0.0               |
| <b>Commodities Costs:</b>                                         |  | Proposed<br>FY 1999 |
| Description                                                       |  |                     |
|                                                                   |  |                     |
|                                                                   |  |                     |
|                                                                   |  |                     |
|                                                                   |  |                     |
|                                                                   |  |                     |
|                                                                   |  |                     |
|                                                                   |  |                     |
|                                                                   |  |                     |
| <b>Commodities Total</b>                                          |  | \$0.0               |

**1999**

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

FORM 3B  
Contractual &  
Commodities  
DETAIL

October 1, 1997 - September 30, 1998

1999

FORM 3B  
Equipment  
DETAIL

# 1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1997 - September 30, 1998

| Budget Category:                                  | Authorized<br>FY 1998 | Proposed<br>FY 1999 |                                 |                      |                      |  |  |
|---------------------------------------------------|-----------------------|---------------------|---------------------------------|----------------------|----------------------|--|--|
| Personnel                                         | \$10.8                | \$4.6               |                                 |                      |                      |  |  |
| Travel                                            | \$12.3                | \$0.0               |                                 |                      |                      |  |  |
| Contractual                                       | \$1.3                 | \$0.0               |                                 |                      |                      |  |  |
| Commodities                                       | \$0.2                 | \$0.0               |                                 |                      |                      |  |  |
| Equipment                                         |                       | \$0.0               |                                 |                      |                      |  |  |
| Subtotal                                          | \$24.6                | \$4.6               | LONG RANGE FUNDING REQUIREMENTS |                      |                      |  |  |
| General Administration                            | \$1.7                 | \$0.7               | Estimated<br>FY 2000            | Estimated<br>FY 2001 | Estimated<br>FY 2002 |  |  |
| Project Total                                     | \$26.3                | \$5.3               | \$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:                                         |                       |                     |                                 |                      |                      |  |  |

**1999**

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

FORM 3A  
 TRUSTEE  
 AGENCY  
 SUMMARY

October 1, 1997 - September 30, 1998

1999

|                                                                                                                  |
|------------------------------------------------------------------------------------------------------------------|
| Project Number: 99149<br>Project Title: Archaeological Site Stewardship<br>Agency: DOI-Fish and Wildlife Service |
|------------------------------------------------------------------------------------------------------------------|

FORM 3B  
Personnel  
& Travel  
DETAIL

# 1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1997 - September 30, 1998

|                                                                   |  |                     |
|-------------------------------------------------------------------|--|---------------------|
| <b>Contractual Costs:</b>                                         |  | Proposed<br>FY 1999 |
| Description                                                       |  |                     |
|                                                                   |  |                     |
|                                                                   |  |                     |
|                                                                   |  |                     |
|                                                                   |  |                     |
|                                                                   |  |                     |
|                                                                   |  |                     |
|                                                                   |  |                     |
| When a non-trustee organization is used, the form 4A is required. |  |                     |
| <b>Contractual Total</b>                                          |  | \$0.0               |
| <b>Commodities Costs:</b>                                         |  | Proposed<br>FY 1999 |
| Description                                                       |  |                     |
| Office supplies                                                   |  |                     |
|                                                                   |  |                     |
|                                                                   |  |                     |
|                                                                   |  |                     |
|                                                                   |  |                     |
|                                                                   |  |                     |
|                                                                   |  |                     |
|                                                                   |  |                     |
|                                                                   |  |                     |
| <b>Commodities Total</b>                                          |  | \$0.0               |

**1999**

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

FORM 3B  
Contractual &  
Commodities  
DETAIL

October 1, 1997 - September 30, 1998

# 1999

FORM 3B  
Equipment  
DETAIL

99159

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

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

**ABSTRACT**

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

RECEIVED

APR 15 1998

EXXON VALDEZ OIL SPILL  
TRUSTEE COUNCIL

## INTRODUCTION

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

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

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

## NEED FOR THE PROJECT

### A. Statement of the Problem

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

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

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

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

## B. Rationale/Link to Restoration

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

Determination of restoration of marine bird populations requires population estimates to monitor whether recovery is occurring or if species are still affected by the oil spill. This project will benefit marine birds by using data collected from 1998 surveys to monitor population trends of species injured by the *T/V Exxon Valdez* oil spill.

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

Cormorants - "will have recovered when their populations return to prespill levels in the oil-spill area. An increasing population trend in Prince William Sound will indicate that recovery is underway."

Harlequin duck - "will have recovered when breeding and postbreeding season densities and production of young have returned to estimated pre-spill levels, or when there are no differences in these parameters between oiled and unoiled areas."

Bald eagle - "will have recovered when their population and productivity return to pre-spill levels."

Black oystercatchers - "will have recovered when populations attain pre-spill levels"

Marbled murrelet - "will have recovered when population trends are increasing."

Pigeon guillemot - "will have recovered when populations are stable or increasing."

Sea otter - "will be considered recovered when population abundance and distribution are comparable to pre-spill abundance and distribution"

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

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

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

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

### **C. Location**

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

## **COMMUNITY INVOLVEMENT**

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

crews from the local area.

## **PROJECT DESIGN**

### **A. Objectives**

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

1. determine distribution and estimate population abundance, with 95% confidence limits, of marine bird populations in Prince William Sound during March and July 1998;
2. determine whether the marine bird species whose populations declined more in oiled areas than in non-oiled areas of Prince William Sound have recovered;
3. determine whether additional species show any oil spill effects;
4. support restoration studies on harlequin duck, black oystercatcher, pigeon guillemot, marbled murrelet, Kittlitz's murrelet, sea ducks, and sea otters by providing data on population changes, distribution, and habitat use of Prince William Sound populations.
5. prepare a paper for publication.

### **B. Methods**

#### **1. Study Area**

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

#### **2. Sampling Methods**

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

#### **3. Statistical Analyses**

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

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

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

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

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

## 5. Statistical Justification for Proposed Monitoring Schedule

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

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

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

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

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

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

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

## **SCHEDULE**

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

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

### **B. Project Milestones and Endpoints**

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

### **C. Completion Date**

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

## **PUBLICATIONS AND REPORTS**

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

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

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

## **PROFESSIONAL CONFERENCES**

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

## **NORMAL AGENCY MANAGEMENT**

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

## **COORDINATION AND INTEGRATION OF RESTORATION EFFORT**

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

## **EXPLANATION OF CHANGES IN CONTINUING PROJECTS**

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

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

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

## **PROPOSED PRINCIPAL INVESTIGATORS**

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## PERSONNEL

### 1. Co-Project Leader - Brian K. Lance, Wildlife Biologist, GS-9.

Brian Lance received his M.S. degree in Wildlife Biology from the University of Alaska, Fairbanks in 1996 and his B.S. degree in Wildlife and Fisheries Biology from Texas A&M University in 1981. He joined the U. S. Fish and Wildlife Service, Office of Migratory Bird Management in March 1998 as a Wildlife Biologist. Mr. Lance has conducted surveys of Prince William Sound and Lower Cook Inlet to determine abundance of marine birds and sea otters. Prior to joining Migratory Birds, he studied diet and nestling growth in Red-legged and Black-legged kittiwakes on St. George Island in the Bering Sea. Brian has been involved with numerous seabird studies in Alaska including: Nearshore Vertebrate Predator Program: Avian Predation on Blue Mussel and seabird colony surveys on the Pribilof Islands.

Brian has presented papers on diet and nestling growth in Red-legged and Black-legged kittiwakes at Pacific Seabird Group meetings and the Alaska Cooperative Fish and Wildlife Research Unit meetings in Fairbanks.

#### Boat Survey Publications:

Bishop, M. A., B. K. Lance, S. P. Green, J. Mason, and E. W. Lance. 1997. Results of avian and marine mammal surveys in the nearshore waters of northeast Orca Inlet. Unpubl. manuscript, Prince William Sound Science Center.

#### Seabird Publications:

Lance, B. K. 1996. Diet and nestling growth in Red-legged and Black-legged kittiwakes: an interspecies cross-fostering experiment. Unpubl. Master's Thesis, University of Alaska, Fairbanks. 127 pp.

Lance, B. K. and D. D. Roby. in review. Diet and postnatal growth in Red-legged and Black-legged kittiwakes (*Rissa brevirostris* and *Rissa tridactyla*): an interspecies comparison. Colonial Waterbirds.

Lance, B. K. and D. D. Roby. in review. Diet and postnatal growth in Red-legged and Black-legged kittiwakes (*Rissa brevirostris* and *Rissa tridactyla*): an interspecies cross-fostering experiment. Auk.

Van Pelt, T. I., J. F. Piatt, B. K. Lance, and D. D. Roby. 1997. Proximate composition and energy density of some North Pacific forage fishes. Comp. Biochem. Physiol. 118A(4) 1393-1398.

### 2. Co-Project Leader - David B. Irons, Ph.D., Wildlife Biologist, GS-12.

Dr. David Irons received his Ph.D from the University of California, Irvine in 1992. His

dissertation was on the foraging ecology and breeding biology of the black-legged kittiwake in Prince William Sound. He received his M.S. from Oregon State University in 1982 where he studied foraging behavior of glaucous-winged gulls in relation to the presence of sea otters. Dr. Irons conducted marine birds and sea otter surveys in Prince William Sound in 1984 and 1985. He has been studying kittiwakes in Prince William Sound for 11 years and completed the *Exxon Valdez* oil spill kittiwake damage assessment study. Dr. Irons has overseen several seabird studies in the past few years, including marine bird and sea otter surveys of Prince William Sound and Cook Inlet, a seabird monitoring study on Little Diomed Island, and a cost of reproduction study on kittiwakes.

#### Selected Seabird Publications:

- Irons, D. B. 1998. Foraging area fidelity of individual seabirds in relation to tidal cycles and flock feeding. *Ecology* 70:647-655.
- Irons, D. B. 1992. Factors affecting black-legged kittiwake reproductive success. Unpubl. Ph.D Dissertation. Univ. of California, Irvine.
- Irons, D. B., R. G. Anthony, and J. A. Estes. 1986. Foraging strategies of glaucous-winged gulls in a rocky intertidal community. *Ecology* 67:1460-74.
- Irons, D. B., S. J. Kendall, W. Erickson, and L. McDonald. In prep. Effects of the *Exxon Valdez* oil spill on Marine Bird Populations in Prince William Sound, Alaska.
- Irons, D. B. In prep. Flexible foraging behavior in seabirds: short-term buffer and long-term tradeoff?
- Irons, D. B. In prep. The role of food availability in sibling aggression and brood reduction of the blacklegged kittiwake.
- Golet, G. H., D. B. Irons, and J.A. Estes. In press. The cost of chick rearing in black-legged kittiwakes. *J. of Animal Ecology*.
- Hatch, S. A., G. V. Byrd, D. B. Irons, and G. L. Hunt. 1993. Status and ecology of kittiwakes in the North Pacific Ocean. Pages 140-53 in K. Vermeer, K. T. Briggs, K. H. Morgan, and D. Siegel-Causey, eds. The status, ecology and conservation of marine birds of the North Pacific, Can. Wildl. Serv., Spec. Publ., Ottawa, Canada.
- Hogan, M. E., and D. B. Irons. 1986. Waterbirds and marine mammals. Pages in M. J. Hameedi, and D. G. Shaw, eds. Environmental management of Port Valdez, Alaska: scientific basis and practical results. Springer-Verlag, New York.
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Number of Surveys

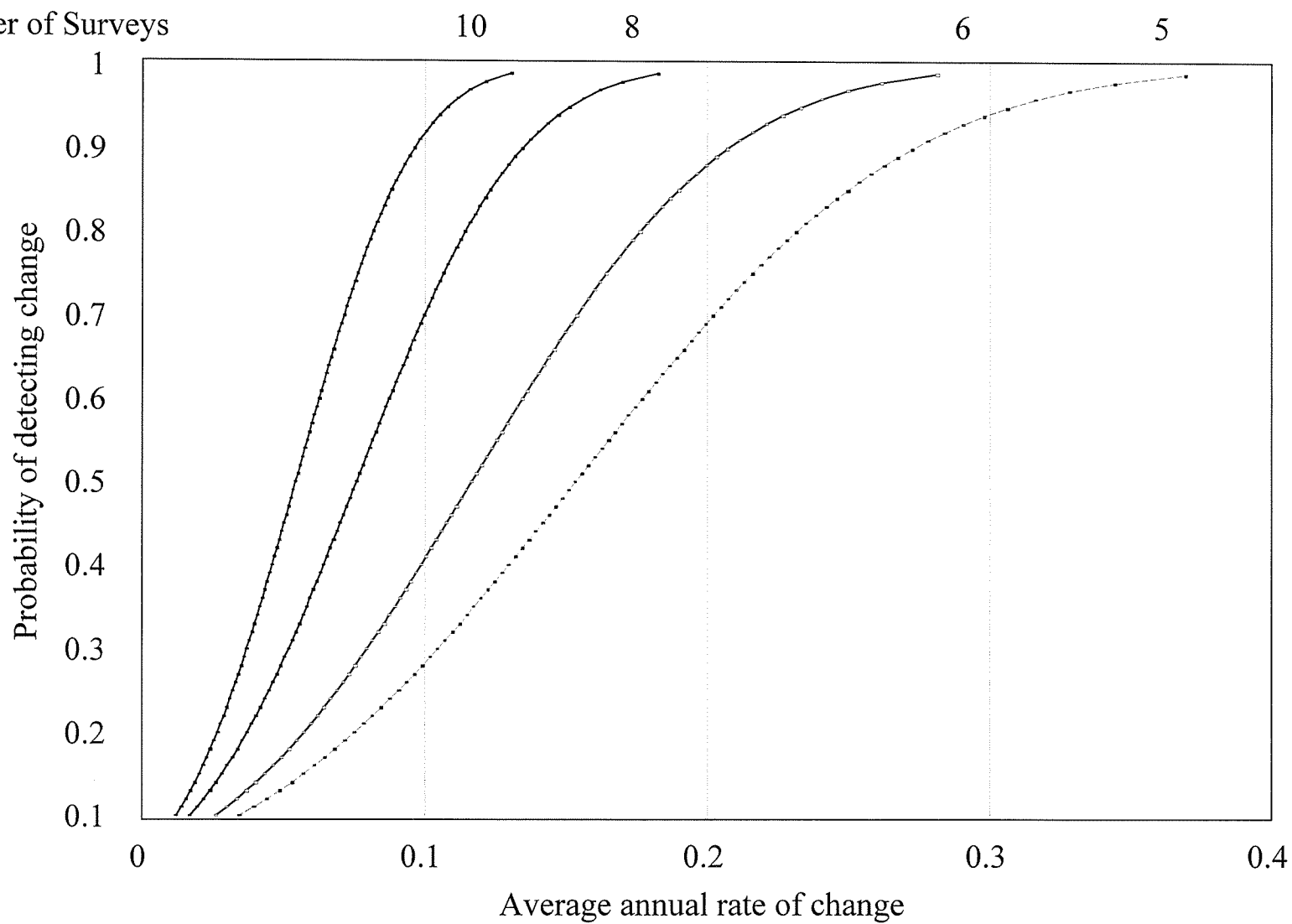


Figure 1. Estimated power (probability of detection) based on number of surveys conducted to detect a trend of marine bird and sea otter populations in Prince William Sound when  $CV = 0.30$ .

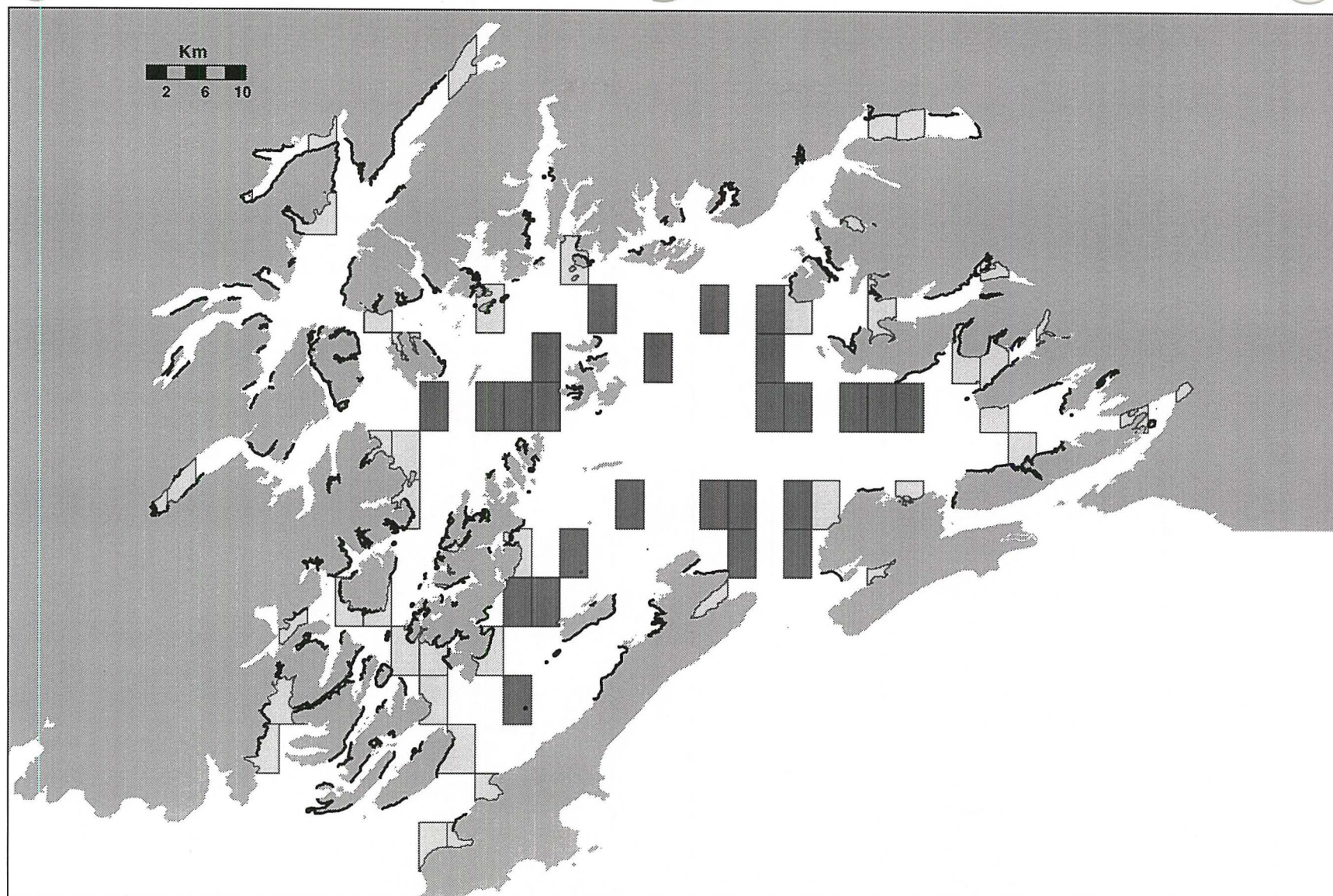


Figure 2. Transects and blocks surveyed during July small boat surveys of Prince William Sound. Transects were classified into 3 strata; the shoreline stratum, (<200 m from land), the coastal-pelagic stratum (lighter shaded blocks), and the pelagic stratum (darker shaded blocks).

Number of Surveys

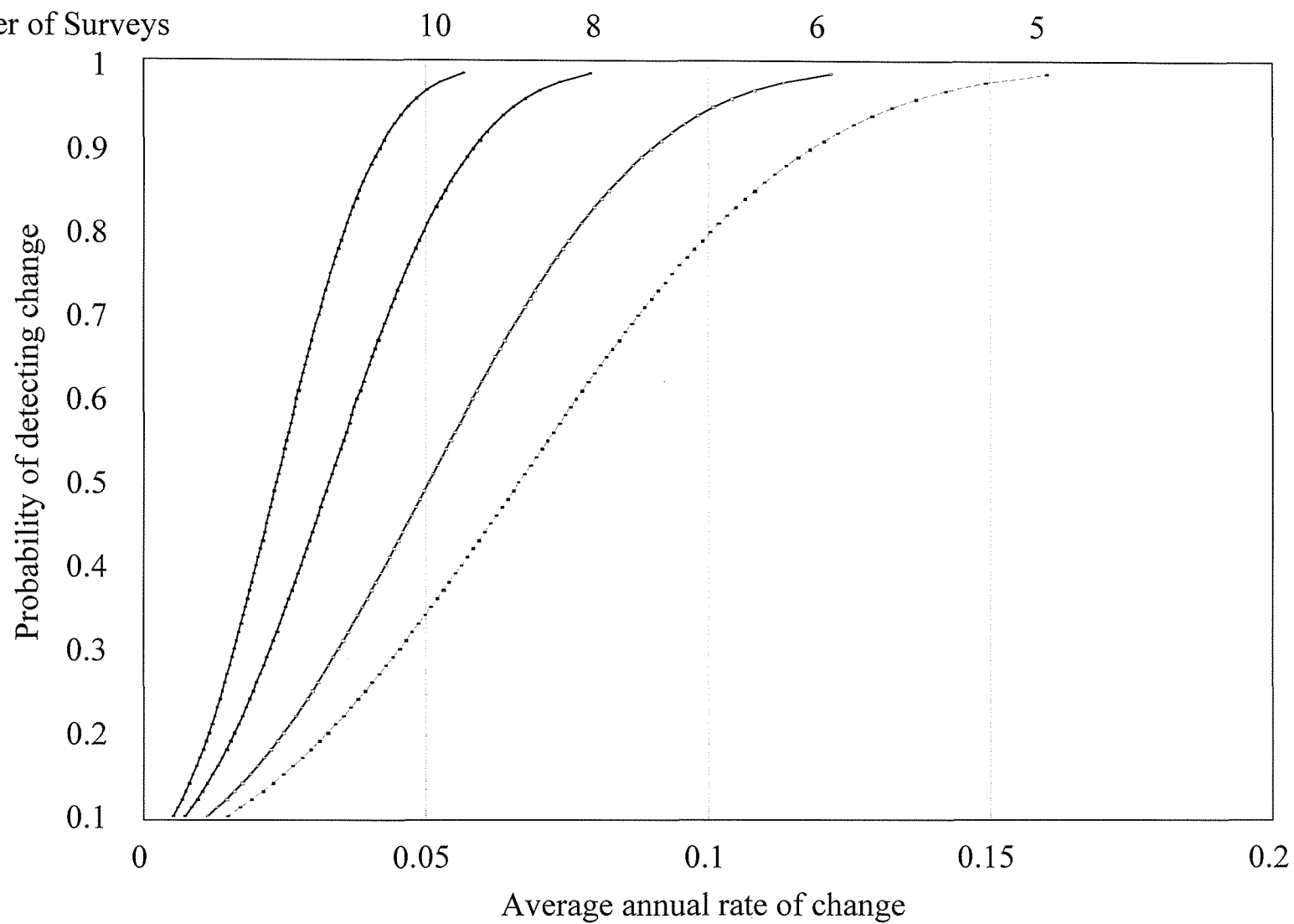


Figure 3. Estimated power (probability of detection) based on numbers of surveys conducted to detect a trend in the July *Brachyramphus* murrelet population in Prince William Sound. The CV = 0.13.

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

| Budget Category:                                                                                                                                                                                                                                                      | Authorized<br>FFY 1998 | Proposed<br>FFY 1999 |                                 |                       |                       |                       |  |  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|----------------------|---------------------------------|-----------------------|-----------------------|-----------------------|--|--|
| Personnel                                                                                                                                                                                                                                                             | \$106.7                | \$31.3               |                                 |                       |                       |                       |  |  |
| Travel                                                                                                                                                                                                                                                                | \$8.9                  | \$0.0                |                                 |                       |                       |                       |  |  |
| Contractual                                                                                                                                                                                                                                                           | \$47.0                 | \$0.0                |                                 |                       |                       |                       |  |  |
| Commodities                                                                                                                                                                                                                                                           | \$34.0                 | \$1.0                |                                 |                       |                       |                       |  |  |
| Equipment                                                                                                                                                                                                                                                             | \$1.5                  | \$0.0                | LONG RANGE FUNDING REQUIREMENTS |                       |                       |                       |  |  |
| Subtotal                                                                                                                                                                                                                                                              | \$198.1                | \$32.3               | Estimated<br>FFY 2000           | Estimated<br>FFY 2001 | Estimated<br>FFY 2002 | Estimated<br>FFY 2003 |  |  |
| General Administration                                                                                                                                                                                                                                                | \$19.3                 | \$4.7                |                                 |                       |                       |                       |  |  |
| Project Total                                                                                                                                                                                                                                                         | \$217.4                | \$37.0               | \$242.0                         | \$38.5                | \$251.0               | \$40.0                |  |  |
| Full-time Equivalents (FTE)                                                                                                                                                                                                                                           | 2.6                    | 0.6                  |                                 |                       |                       |                       |  |  |
| Dollar amounts are shown in thousands of dollars.                                                                                                                                                                                                                     |                        |                      |                                 |                       |                       |                       |  |  |
| Other Resources                                                                                                                                                                                                                                                       |                        |                      |                                 |                       |                       |                       |  |  |
| Comments: Justification of Personnel Costs:<br><u>Publications &amp; Personnel Time</u><br>Final Report, 6 months (EVOS Funded)<br>Population Trends in PWS after the Oil Spill, 1.5 months (EVOS Funded)<br><u>Proposals</u><br>FY2000 DPD, 1.5 months (EVOS Funded) |                        |                      |                                 |                       |                       |                       |  |  |

**1999**

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

FORM 3A  
TRUSTEE  
AGENCY  
SUMMARY

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

| <b>Personnel Costs:</b> |                      | GS/Range/<br>Step | Months<br>Budgeted | Monthly<br>Costs | Overtime          | Proposed<br>FFY 1999 |
|-------------------------|----------------------|-------------------|--------------------|------------------|-------------------|----------------------|
| Name                    | Position Description |                   |                    |                  |                   |                      |
| Lance                   | Co-Project Leader    | GS/9/ 1           | 6.0                | 4.1              |                   | 24.6                 |
| Irons                   | Co-Project Leader    | GS/12/5           | 1.0                | 6.7              |                   | 6.7                  |
|                         |                      |                   |                    |                  |                   | 0.0                  |
|                         |                      |                   |                    |                  |                   | 0.0                  |
|                         |                      |                   |                    |                  |                   | 0.0                  |
|                         |                      |                   |                    |                  |                   | 0.0                  |
|                         |                      |                   |                    |                  |                   | 0.0                  |
|                         |                      |                   |                    |                  |                   | 0.0                  |
|                         |                      |                   |                    |                  |                   | 0.0                  |
|                         |                      |                   |                    |                  |                   | 0.0                  |
|                         |                      |                   |                    |                  |                   | 0.0                  |
|                         |                      |                   |                    |                  |                   | 0.0                  |
|                         |                      |                   |                    |                  |                   | 0.0                  |
|                         |                      |                   |                    |                  |                   | 0.0                  |
| Subtotal                |                      |                   | 7.0                | 10.8             | 0.0               |                      |
| <b>Personnel Total</b>  |                      |                   |                    |                  |                   | <b>\$31.3</b>        |
| <b>Travel Costs:</b>    |                      | Ticket<br>Price   | Round<br>Trips     | Total<br>Days    | Daily<br>Per Diem | Proposed<br>FFY 1999 |
| Description             |                      |                   |                    |                  |                   |                      |
|                         |                      |                   |                    |                  |                   | 0.0                  |
|                         |                      |                   |                    |                  |                   | 0.0                  |
|                         |                      |                   |                    |                  |                   | 0.0                  |
|                         |                      |                   |                    |                  |                   | 0.0                  |
|                         |                      |                   |                    |                  |                   | 0.0                  |
|                         |                      |                   |                    |                  |                   | 0.0                  |
|                         |                      |                   |                    |                  |                   | 0.0                  |
|                         |                      |                   |                    |                  |                   | 0.0                  |
|                         |                      |                   |                    |                  |                   | 0.0                  |
|                         |                      |                   |                    |                  |                   | 0.0                  |
|                         |                      |                   |                    |                  |                   | 0.0                  |
|                         |                      |                   |                    |                  |                   | 0.0                  |
|                         |                      |                   |                    |                  |                   | 0.0                  |
| <b>Travel Total</b>     |                      |                   |                    |                  |                   | <b>\$0.0</b>         |

**1999**

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

FORM 3B  
Personnel  
& Travel  
DETAIL

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

|                                                                   |  |          |
|-------------------------------------------------------------------|--|----------|
| <b>Contractual Costs:</b>                                         |  | Proposed |
| Description                                                       |  | FFY 1999 |
|                                                                   |  |          |
| When a non-trustee organization is used, the form 4A is required. |  |          |
| <b>Contractual Total</b>                                          |  | \$0.0    |
| <b>Commodities Costs:</b>                                         |  | Proposed |
| Description                                                       |  | FFY 1999 |
| Page charges and reprints for 1 publication                       |  | 1.0      |
|                                                                   |  |          |
| <b>Commodities Total</b>                                          |  | \$1.0    |

# 1999

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

FORM 3B  
Contractual &  
Commodities  
DETAIL

Prepared:

3 of 4

4/15/98

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

|                                                                                                 |  |                            |                    |                      |
|-------------------------------------------------------------------------------------------------|--|----------------------------|--------------------|----------------------|
| <b>New Equipment Purchases:</b>                                                                 |  | Number<br>of Units         | Unit<br>Price      | Proposed<br>FFY 1999 |
| Description                                                                                     |  |                            |                    |                      |
|                                                                                                 |  |                            |                    | 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. |  | <b>New Equipment Total</b> | \$0.0              |                      |
| <b>Existing Equipment Usage:</b>                                                                |  |                            | Number<br>of Units | Inventory<br>Agency  |
| Description                                                                                     |  |                            |                    |                      |
|                                                                                                 |  |                            |                    |                      |
|                                                                                                 |  |                            |                    |                      |
|                                                                                                 |  |                            |                    |                      |
|                                                                                                 |  |                            |                    |                      |
|                                                                                                 |  |                            |                    |                      |
|                                                                                                 |  |                            |                    |                      |
|                                                                                                 |  |                            |                    |                      |
|                                                                                                 |  |                            |                    |                      |
|                                                                                                 |  |                            |                    |                      |
|                                                                                                 |  |                            |                    |                      |

# 1999

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

FORM 3B  
Equipment  
DETAIL

99162A

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

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

RECEIVED  
APR 14 1998  
EXXON VALDEZ OIL SPILL  
TRUSTEE COUNCIL

**ABSTRACT**

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

## **INTRODUCTION**

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

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

## **NEED FOR THE PROJECT**

### **A. Statement of Problem**

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

### **B. Rationale - Link to Restoration**

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

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

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

### **C. Location**

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

## **COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE**

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

## **PROJECT DESIGN**

### **A. Objectives**

#### Proposed titles and time)

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

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

## **B. Methods**

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

These journals include:

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

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

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

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

## **SCHEDULE**

### **A. Measurable Project Tasks for FY 99**

Prepare and submit manuscript on VHSV survival in seawater.

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

Prepare and submit manuscript on antibody production in wild herring.

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

Prepare and submit net-pen related disease studies in herring

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

### **B. Project Milestones and Endpoints (FY 99)**

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

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

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

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

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

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

### **C. Completion Date**

Final report for FY 99: April. '99

## **PUBLICATIONS AND REPORTS**

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

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

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

## **PROFESSIONAL CONFERENCES**

SEATAC Annual Conference; San Francisco, CA. November 1997

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

EVOS Annual Workshop; January 1998  
Posters from FY97 studies

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

## **COORDINATION AND INTEGRATION OF RESTORATION EFFORT**

N/A

## **EXPLANATION OF CHANGES IN CONTINUING PROJECTS**

N/A

## **PRINCIPAL INVESTIGATOR**

**Richard M. Kocan, Ph.D.**

University of Washington

Dept. of Fisheries

Box 355100

Seattle, WA 98195

Tel: (206) 685-2984

Fax: (206) 685-3275

E-mail: [Kocan@fish.washington.edu](mailto:Kocan@fish.washington.edu)

Over the past 12 years Dr. Kocan has had extensive experience with petroleum induced toxicity in aquatic organisms and since 1990 has been actively involved in the *Exxon Valdez* oil spill studies in Prince William Sound and has served as a peer reviewer for salmonids, rockfish, shellfish and herring during the Damage Assessment and Restoration phases of the program, as well as an expert witness for the State of Alaska and NOAA. From 1990 to 1993 he worked with the Alaska Department of Fish & Game in Cordova as a subcontractor on Herring Sublethal Effects (project #11), studying embryo-larval damage in Prince William Sound. To date Dr. Kocan has authored or co-authored six peer reviewed scientific publications on the work he has done in PWS, and two additional papers are currently in review.

Dr. Kocan has also worked on oil related problems in Puget Sound associated with near-shore damage and evaluation of oil originating from several shore-based oil operations. These include the Cherry Point shoreline where Texaco, BP Petroleum, ARCO and Intalco Aluminum Co. are located, as well as Fidalgo Bay, where Texaco has a transfer dock and refinery. These studies were originated by the State of Washington and the Lummi and Klallam Indian Tribes and were funded by both the State and the various industries. Since 1995 Dr. Kocan has been PI on a Restoration Project (#s 95162-98162) dealing with disease factors affecting herring populations in PWS and Puget Sound. He has successfully reared herring from egg to 2-years-old and used these fish in disease studies requiring pathogen-free fish.

In 1985, prior to working on oil related problems in Puget Sound, Dr. Kocan spent several months studying with Drs. Westernhagen and Rosenthal at the Biologische Anstalt Helgoland in Germany. There he worked on cod, sole, flounder, herring and turbot embryos and larvae exposed to petroleum contaminated seasurface microlayer in the Baltic Sea and North Sea.

Over the years Dr. Kocan has developed techniques which allow for "on site" exposure of animals in contaminated marine waters as well as laboratory evaluation of sediments for toxicity to marine vertebrates and invertebrates. He has access to flowing seawater research facilities at the University of Washington, the National Biological Survey field station on Marrowstone Island, Washington.

# FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

| Budget Category:                                  | Authorized<br>FY 1998 | Proposed<br>FY 1999 |                                 |                      |                      |                      |  |  |
|---------------------------------------------------|-----------------------|---------------------|---------------------------------|----------------------|----------------------|----------------------|--|--|
| Personnel                                         |                       | \$0.0               |                                 |                      |                      |                      |  |  |
| Travel                                            |                       | \$0.0               |                                 |                      |                      |                      |  |  |
| Contractual                                       |                       | \$54.8              |                                 |                      |                      |                      |  |  |
| Commodities                                       |                       | \$0.0               |                                 |                      |                      |                      |  |  |
| Equipment                                         |                       | \$0.0               |                                 |                      |                      |                      |  |  |
| Subtotal                                          | \$0.0                 | \$54.8              | LONG RANGE FUNDING REQUIREMENTS |                      |                      |                      |  |  |
| General Administration                            |                       | \$3.8               |                                 | Estimated<br>FY 2000 | Estimated<br>FY 2001 | Estimated<br>FY 2002 |  |  |
| Project Total                                     | \$0.0                 | \$58.6              |                                 | \$0.0                | \$0.0                | \$0.0                |  |  |
| Full-time Equivalents (FTE)                       |                       | 0.5                 |                                 |                      |                      |                      |  |  |
| Dollar amounts are shown in thousands of dollars. |                       |                     |                                 |                      |                      |                      |  |  |
| Other Resources                                   | \$12.0                | \$14.0              |                                 |                      |                      |                      |  |  |

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

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

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

FY 99

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

FORM 3A  
 TRUSTEE  
 AGENCY  
 SUMMARY

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

4/13/98, 1 of 5

# FY 99 EXXON VALDEZ TRUSTEES COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

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

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

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

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

**FY 99**

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

FORM 4A  
 Non-Trustee  
 DETAIL

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

4/13/98, 2 of 5

## October 1, 1998 - September 30, 1999

**FY 99**

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

FORM 4B  
Personnel  
& Travel  
DETAIL

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

| <b>Contractual Costs:</b>                                                                  |  | Proposed        |
|--------------------------------------------------------------------------------------------|--|-----------------|
| <b>Description</b>                                                                         |  | <b>FFY 1998</b> |
| * Long distance<br>FAX<br>photocopies<br>postage<br>photography<br>graphics & illustration |  | 0.5             |
| <b>Contractual Total</b>                                                                   |  | <b>\$0.5</b>    |
| <b>Commodities Costs:</b>                                                                  |  | Proposed        |
| <b>Description</b>                                                                         |  | <b>FFY 1998</b> |
| computer discs<br>paper<br>Publication costs                                               |  | 1.0             |
| <b>Commodities Total</b>                                                                   |  | <b>\$1.0</b>    |

**FY 99**

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

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

**FORM 4B**  
**Contractual &**  
**Commodities**  
**DETAIL**

**FY 99 EXXON VALDEZ TRUST COUNCIL PROJECT BUDGET**

October 1, 1998 - September 30, 1999

| New Equipment Purchases:                                                                        |  | Number<br>of Units | Unit<br>Price              | Proposed<br>FFY 1998 |
|-------------------------------------------------------------------------------------------------|--|--------------------|----------------------------|----------------------|
| Description                                                                                     |  |                    |                            |                      |
|                                                                                                 |  |                    |                            | 0.0                  |
|                                                                                                 |  |                    |                            | 0.0                  |
|                                                                                                 |  |                    |                            | 0.0                  |
|                                                                                                 |  |                    |                            | 0.0                  |
|                                                                                                 |  |                    |                            | 0.0                  |
|                                                                                                 |  |                    |                            | 0.0                  |
|                                                                                                 |  |                    |                            | 0.0                  |
|                                                                                                 |  |                    |                            | 0.0                  |
|                                                                                                 |  |                    |                            | 0.0                  |
|                                                                                                 |  |                    |                            | 0.0                  |
|                                                                                                 |  |                    |                            | 0.0                  |
|                                                                                                 |  |                    |                            | 0.0                  |
| Those purchases associated with replacement equipment should be indicated by placement of an R. |  |                    | <b>New Equipment Total</b> | <b>\$0.0</b>         |
| Existing Equipment Usage:                                                                       |  | Number<br>of Units |                            |                      |
| Description                                                                                     |  |                    |                            |                      |
| Power Mac 7600 (SOF; U.W)                                                                       |  | 1                  |                            |                      |
| Power Mac 7600 (Marrowstone Island Field Station)                                               |  | 1                  |                            |                      |
| specimin archive (Marrowstone Island)                                                           |  | N/A                |                            |                      |
| FAX, phone, e-mail: UW and MI                                                                   |  | N/A                |                            |                      |
| Publication Office - U.W. SOF                                                                   |  | 1                  |                            |                      |

**FY 99**

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

**FORM 4B  
 Equipment  
 DETAIL**

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

4/13/98, 5 of 5

99162B

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

Project number: 99162B

Restoration Category: Research Publications and Presentations

Proposer: Dr. Christopher J. Kennedy, Simon Fraser University

Lead Agency: ADFG

Cooperating Agencies: None

Duration: 1st year, 1-year project

Cost FY99: \$13,400

Geographic area: N/A

Injured resource: Herring

RECEIVED  
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EXXON VALDEZ OIL SPILL  
TRUSTEE COUNCIL

**ABSTRACT**

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

## INTRODUCTION

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

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

## NEED FOR THE PROJECT

### A. Statement of Problem

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

## **B. Rationale/Link to Restoration**

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

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

## **C. Location**

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

## **COMMUNITY INVOLVEMENT**

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

## **PROJECT DESIGN**

### **A. Objectives**

#### General Objectives:

1. To write, submit and publish four (4) peer reviewed manuscripts in respected and high quality scientific journals. The manuscripts will describe the nature of Section III (Stressor effects on herring fitness) of the previously funded Herring Disease Project, its methods, results and major conclusions.
2. To prepare two presentations of the major findings of Section III (Stressor effects on herring fitness) of the funded Herring Disease Project, and to present these findings at two meetings:
  - a) The American Fisheries Society in July 1999, and b) The 10th Anniversary of the Exxon Valdez Workshop in January 1999.

## **B. METHODS**

N/A

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

N/A

## **SCHEDULE**

### **A. Measurable Project Tasks for FY 99**

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

### **B. Project Milestones and Endpoints**

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

### **C. Completion date**

The projects objectives will be met July 30 of FY 99

## **PUBLICATIONS AND REPORTS**

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

### Manuscript 1:

Author: Kennedy, C.J.

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

Journal: Mar. Env. Res.

Submission date: November 15, 1998

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

Manuscript 2:

Author: Kennedy, C.J.

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

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

Submission date: December 15, 1998.

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

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

Manuscript 3:

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

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

Journal: Aquat. Toxicol.

Submission date: February 15, 1999.

Abstract: unavailable, experiments complete, data analysis underway.

Manuscript 4:

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

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

Journal: Dis. Aquat. Organisms

Submission date: March 15, 1999.

Abstract: unavailable, experiments complete, data analysis underway.

## PROFESSIONAL CONFERENCES

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

## COORDINATION AND INTEGRATION OF RESTORATION EFFORT

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

**PROPOSED PRINCIPAL INVESTIGATOR**

Christopher J. Kennedy

Simon Fraser University

Dept. of Biological Sciences, SFU, Burnaby, BC, Canada, V5A 1S6.

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Fax: 604-291-3496

email: ckennedy@sfu.ca

**PRINCIPAL INVESTIGATOR**

**Christopher J. Kennedy, Ph.D.**

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

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

| Budget Category:                                                                                                                                                                                                                                                                                                                                  | Authorized<br>FY 1998 | Proposed<br>FY 1999 |                                 |                      |                      |                      |  |  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|---------------------|---------------------------------|----------------------|----------------------|----------------------|--|--|
| Personnel                                                                                                                                                                                                                                                                                                                                         |                       | \$0.0               |                                 |                      |                      |                      |  |  |
| Travel                                                                                                                                                                                                                                                                                                                                            |                       | \$0.0               |                                 |                      |                      |                      |  |  |
| Contractual                                                                                                                                                                                                                                                                                                                                       |                       | \$12.5              |                                 |                      |                      |                      |  |  |
| Commodities                                                                                                                                                                                                                                                                                                                                       |                       | \$0.0               |                                 |                      |                      |                      |  |  |
| Equipment                                                                                                                                                                                                                                                                                                                                         |                       | \$0.0               |                                 |                      |                      |                      |  |  |
| Subtotal                                                                                                                                                                                                                                                                                                                                          | \$0.0                 | \$12.5              | LONG RANGE FUNDING REQUIREMENTS |                      |                      |                      |  |  |
| General Administration                                                                                                                                                                                                                                                                                                                            |                       | \$0.9               |                                 | Estimated<br>FY 2000 | Estimated<br>FY 2001 | Estimated<br>FY 2002 |  |  |
| Project Total                                                                                                                                                                                                                                                                                                                                     | \$0.0                 | \$13.4              |                                 | \$0.0                | \$0.0                | \$0.0                |  |  |
| Full-time Equivalents (FTE)                                                                                                                                                                                                                                                                                                                       |                       | 0.2                 |                                 |                      |                      |                      |  |  |
| Dollar amounts are shown in thousands of dollars.                                                                                                                                                                                                                                                                                                 |                       |                     |                                 |                      |                      |                      |  |  |
| Other Resources                                                                                                                                                                                                                                                                                                                                   |                       |                     |                                 |                      |                      |                      |  |  |
| <b>Comments:</b><br><br>Only 33% of allowable manuscript costs allowed by the Trustee Council guidelines are requested.<br><br>This allows a savings of 67% for the project since that portion of C. Kennedy's salary is covered by S.F.U.<br>Indirect costs include the standard overhead rate for Simon Fraser University (30% on salary only). |                       |                     |                                 |                      |                      |                      |  |  |

**FY 99**

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

**FORM 3A  
 TRUSTEE  
 AGENCY  
 SUMMARY**

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

4/13/98, 1 of 5

# FY 99 EXXON VALDEZ TRUSTEES COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

| Budget Category:                                  | Authorized<br>FY 1998 | Proposed<br>FY 1999 |                                 |                      |                      |                      |  |  |
|---------------------------------------------------|-----------------------|---------------------|---------------------------------|----------------------|----------------------|----------------------|--|--|
| Personnel                                         |                       | \$8.0               |                                 |                      |                      |                      |  |  |
| Travel                                            |                       | \$2.1               |                                 |                      |                      |                      |  |  |
| Contractual                                       |                       | \$0.0               |                                 |                      |                      |                      |  |  |
| Commodities                                       |                       | \$0.0               |                                 |                      |                      |                      |  |  |
| Equipment                                         |                       | \$0.0               |                                 |                      |                      |                      |  |  |
| Subtotal                                          | \$0.0                 | \$10.1              | LONG RANGE FUNDING REQUIREMENTS |                      |                      |                      |  |  |
| Indirect                                          |                       | \$2.4               |                                 | Estimated<br>FY 2000 | Estimated<br>FY 2001 | Estimated<br>FY 2002 |  |  |
| Project Total                                     | \$0.0                 | \$12.5              |                                 |                      |                      |                      |  |  |
| Full-time Equivalents (FTE)                       |                       | 0.2                 |                                 |                      |                      |                      |  |  |
| Dollar amounts are shown in thousands of dollars. |                       |                     |                                 |                      |                      |                      |  |  |
| Other Resources                                   |                       |                     |                                 |                      |                      |                      |  |  |
| Comments:                                         |                       |                     |                                 |                      |                      |                      |  |  |

FY 99

**Project Number: 99162B**

**Project Title: Manuscript Preparation for Herring Disease Studies:**

**Section III. Stressor Effects on Herring Fitness**

**Name: Simon Fraser University**

**Agency: ADF&G**

**FORM 4A  
Non-Trustee  
SUMMARY**

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

4/13/98, 2 of 5

**FY 99 EXXON VALDEZ TRAIL COUNCIL PROJECT BUDGET**

October 1, 1998 - September 30, 1999

| Personnel Costs: |                                                                                 |                                                                    |     | Months<br>Budgeted | Monthly<br>Costs | Overtime      | Proposed<br>FY 1999                                                       |                     |
|------------------|---------------------------------------------------------------------------------|--------------------------------------------------------------------|-----|--------------------|------------------|---------------|---------------------------------------------------------------------------|---------------------|
|                  | Name                                                                            | Position Description                                               |     |                    |                  |               |                                                                           |                     |
|                  | Kennedy, C. J.                                                                  | PI, manuscript preparation and<br>submission, conference presenter |     | 2.0                | 4.0              |               | 8.0<br>0.0<br>0.0<br>0.0<br>0.0<br>0.0<br>0.0<br>0.0<br>0.0<br>0.0<br>0.0 |                     |
| Subtotal         |                                                                                 |                                                                    |     | 2.0                | 4.0              | 0.0           |                                                                           |                     |
| Personnel Total  |                                                                                 |                                                                    |     |                    |                  |               | \$8.0                                                                     |                     |
| Travel Costs:    |                                                                                 |                                                                    |     | Ticket<br>Price    | Round<br>Trips   | Total<br>Days | Daily<br>Per Diem                                                         | Proposed<br>FY 1999 |
|                  | Description                                                                     |                                                                    |     |                    |                  |               |                                                                           |                     |
|                  | Kennedy attends 10th Annual Workshop:<br>Vancouver, BC, Canada to Anchorage, RT |                                                                    | 0.6 | 1                  | 5                | 0.1           | 1.1<br>0.0<br>0.0                                                         |                     |
|                  | Kennedy attends AFS conference:<br>Vancouver, BC, Canada to Hartford, RT        |                                                                    | 0.6 | 1                  | 4                | 0.1           | 1.0<br>0.0<br>0.0<br>0.0<br>0.0<br>0.0<br>0.0<br>0.0                      |                     |
| Travel Total     |                                                                                 |                                                                    |     |                    |                  |               | \$2.1                                                                     |                     |

**FY 99**

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

**FORM 4B  
 Personnel  
 & Travel  
 DETAIL**

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

**FY 99 EXXON VALDEZ TRUST FUND COUNCIL PROJECT BUDGET**  
October 1, 1998 - September 30, 1999

|                           |                             |
|---------------------------|-----------------------------|
| <b>Contractual Costs:</b> | <b>Proposed<br/>FY 1999</b> |
| Description               |                             |
|                           |                             |
|                           |                             |
|                           |                             |
|                           |                             |
|                           |                             |
| <b>Contractual Total</b>  | <b>\$0.0</b>                |
| <b>Commodities Costs:</b> | <b>Proposed<br/>FY 1999</b> |
| Description               |                             |
|                           |                             |
|                           |                             |
|                           |                             |
|                           |                             |
|                           |                             |
| <b>Commodities Total</b>  | <b>\$0.0</b>                |

FY 99

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

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

**FORM 4B**  
**Contractual &**  
**Commodities**  
**DETAIL**

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

| New Equipment Purchases:                                                                        |  | Number<br>of Units | Unit<br>Price              | Proposed<br>FY 1999 |
|-------------------------------------------------------------------------------------------------|--|--------------------|----------------------------|---------------------|
| Description                                                                                     |  |                    |                            |                     |
|                                                                                                 |  |                    |                            | 0.0                 |
|                                                                                                 |  |                    |                            | 0.0                 |
|                                                                                                 |  |                    |                            | 0.0                 |
|                                                                                                 |  |                    |                            | 0.0                 |
|                                                                                                 |  |                    |                            | 0.0                 |
|                                                                                                 |  |                    |                            | 0.0                 |
|                                                                                                 |  |                    |                            | 0.0                 |
|                                                                                                 |  |                    |                            | 0.0                 |
|                                                                                                 |  |                    |                            | 0.0                 |
|                                                                                                 |  |                    |                            | 0.0                 |
|                                                                                                 |  |                    |                            | 0.0                 |
|                                                                                                 |  |                    |                            | 0.0                 |
| Those purchases associated with replacement equipment should be indicated by placement of an R. |  |                    | <b>New Equipment Total</b> | <b>\$0.0</b>        |
| Existing Equipment Usage:                                                                       |  | Number<br>of Units |                            |                     |
| Description                                                                                     |  |                    |                            |                     |
| Computers and software                                                                          |  | 2                  |                            |                     |
| Scanner                                                                                         |  | 1                  |                            |                     |
| Photography for illustrations                                                                   |  | 1                  |                            |                     |

**FY 99**

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

**FORM 4B**  
**Equipment**  
**DETAIL**