19.04.03 (1 of 3)

19.04.03

1993 Work Plan

Detailed Project Descriptions

19.4.3

APPLIED
marine
SCIENCES

September 13, 1994

Ron Bryuere
CACI
645 G Street
Anchorage, Alaska 99501

Dear Ron:

Enclosed please find the copies of the 1993 Detailed Project Descriptions you requested. DPD # 93038 was faxed to you previously, therefore, it is not included in this package.

Please don't hesitate to contact me if you have any questions concerning this shipment.

Sincerely,

S. Chase

Susanna L. Chase
Administrative Assistant

cc: Molly McCammon
Eric Myers

2155 Las Positas Court, Suite S Livermore, CA 94550 510.373.7142 FAX 510.373.7834

DRAFT

REQUEST FOR PROPOSALS FOR:

COORDINATION AND DEVELOPMENT OF A COMPREHENSIVE AND INTEGRATED RESTORATION MONITORING PLAN FOR THE *EXXON VALDEZ* OIL SPILL AREA

PHASE 2 - DEVELOP DETAILED DESIGN SPECIFICATIONS

I. BACKGROUND

The *Exxon Valdez* Oil Spill Trustee Council has initiated a planning effort to develop a comprehensive and integrated monitoring program for natural resources and services (human use) injured by the *Exxon Valdez* oil spill. A monitoring program will be implemented to follow the progress of recovery, evaluate the effectiveness of restoration activities, and document long-term trends in the conditions of resources and services affected by the spill. Resulting information will guide restoration activities during the recovery phase of the spill, provide information useful to the long-term management of resources and services in the spill area, and improve upon the environmental baseline from which the impacts of other disturbances are assessed.

Because of the complexities of both institutional and technical issues associated with developing a meaningful monitoring program for the spill area, a phased approach was undertaken. In Phase 1, a contractor is developing a conceptual design for the monitoring program. The conceptual planning in Phase 1 is intended to address goals and objectives, what resources and services to monitor, what process is required to determine monitoring priorities, what relationships need to be established with other monitoring programs within the spill zone, and what process including infrastructure is required to guide implementation and management of monitoring. It is the intent of this effort to guide more detailed, technical planning in Phase 2.

II. OBJECTIVE

The objective of this Request For Proposals is to invite the services of a qualified contractor to develop detailed monitoring design specifications. It is the intent for a description of this document to be included in the Final Restoration Plan, now scheduled for completion in December 1993.

III. Scope and Limitations

It can be assumed that not all resources and services affected in all areas of the spill can be monitored with equal intensity and frequency, even with an unlimited budget. The size and severity of the spill, the complexity of the ecosystem, and the available

funding all impose limitations on the scale of the monitoring program and necessitate prioritizing individual program elements. The contractor will adopt the following scope and limitations in responding to this RFP:

1. Geographic Scope

Monitoring generally should be confined to the oil spill area as defined by the attached map; however, monitoring outside the oil spill area may be permitted to document recovery of migratory species, or for other reasons.

2. Environmental Scope

The spill area includes at least five distinct environments affected by oil and clean-up, or important to the recovery of injured resources, habitats and services. These are: marine, estuarine, freshwater stream, river and lake, and adjacent upland. Species and habitats associated with these environments that, at minimum, may be monitored include, marine mammals (harbor seal, killer whale, sea and river otter), birds (common murre, marbled murrelet, pigeon guillemot, black oystercatcher, harlequin duck, bald eagle), fish (sockeye salmon, pink salmon, cutthroat trout, Dolly Varden, pacific herring, rockfish), intertidal and subtidal. Archaeological sites and artifacts as well as designated wilderness areas also should be addressed.

3. Scope of Human Use Services

Principal services injured by the spill that will require monitoring include recreation (e.g., boating, camping, fishing, hunting) commercial fishing, commercial tourism, subsistence, and passive use (aesthetics).

4. Logistical Limitations

The very short sampling season and remoteness of the spill area places additional limitations on design of a monitoring program for Prince William Sound and the Gulf of Alaska. The natural distribution of organisms as well as patterns of human use in the spill area also limit which organisms and test subjects can be used as "indicators" of recovery.

5. Limitations as to Approach or Technique

Monitoring approaches and techniques should be scientifically sound, feasible, sensitive, precise and cost-effective.

6. Cost Limitations

The exact amount of funds available for monitoring will not be known until late 1993 when the Trustees approve a final restoration

plan. The staff has proposed a program of between $2.5 and $6.0 million per year over a 10-year period. The staff also recommended investing a portion of this money in an interest-bearing endowment that could support some level of monitoring indefinitely. For purposes of this RFP, however, the contractor should assume a funding limitation of $5 million per year.

III. STATEMENT OF WORK

A. General Considerations

The detailed monitoring design will address, but will not be limited to, the following provisions:

1. the locations where monitoring should be conducted for each resource or service of interest;

2. a technical design for each monitoring component that specifies how and when data will be collected, analyzed, interpreted, and reported;

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

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

6. cost estimates for each monitoring component;

7. a design including management structure for how the monitoring plan should be integrated, coordinated and administered;

8. a design for coordination of this monitoring plan with other monitoring programs in the oil spill area that may exist or be proposed; and

9. a design for review and update to ensure that the most appropriate locations are sampled and the most cost-effective monitoring methods are applied.

B. Project Tasks

Task 1. - Collect and Review Relevant *Exxon Valdez* Oil Spill Literature and Data

The contractor will be expected to become familiar with the relevant *Exxon Valdez* oil spill literature and databases. This

should include the results of clean-up, damage assessment, restoration science, and natural resource monitoring studies, as well as the reviews of literature on oil spills and recovery funded by the Trustee Council. This information should be reviewed for purposes of understanding both pre- and post-spill conditions in the spill area, and knowing which designs and methods have been used to monitor the fate and effects of *Exxon Valdez* oil. The contractor also will draw on the Trustee's approved conceptual monitoring plan, and will be familiar with the provisions of the National Research Council's recent publication, Managing Troubled Waters - The Role of Environmental Monitoring.

Task 2. - Evaluate Alternative Monitoring Designs and Techniques

The literature search and data collection in Task 1 will be useful in identifying the resources, habitats, and services injured by the oil spill, the status of their recovery, as well as potentially useful monitoring designs and techniques. After the completion of Task 1, the contractor will develop guidance for what to measure, how, where and when to take measurements, and how to analyze and interpret resulting data. For this evaluation, the contractor will use the decision model described in the Phase 1 Conceptual Monitoring Plan.

Task 3. - Design Specific Program Elements

The contractor will be expected to use the guidance developed in Task 2 and work directly with the Trustee agencies and peer reviewers to select and design definitive sampling protocols that specify how and when data are collected, analyzed, interpreted, reported, and evaluated.

Task 4. - Estimate Costs by Program Element

As the most appropriate designs and methods are selected for each species, habitat or service, cost estimates for each will be developed. As appropriate, the unit cost or the cost per station will be estimated.

Task 5. - Prepare Draft Comprehensive and Integrated Restoration Monitoring Plan

The contractor will then utilize the information developed in Task 3 and Task 4 to prepare the Draft Comprehensive and Integrated Restoration Monitoring Plan.

Task 6 - Design and Conduct Monitoring Plan Review

The contractor also will be expected to design and conduct a two or three day workshop in Anchorage, Alaska to review the Draft Comprehensive and Integrated Restoration Monitoring Plan. It is

anticipated that the workshop will include the Chief Scientist and other peer reviewers, as well as experts with monitoring experience in regions outside Alaska. Some of the Trustee's Principal Investigators also will be invited. While the workshop should be limited in size to no more than 20-25 attendees, the contractor is encouraged to seek comment from a larger number of reviewers (other members of Peer Review Team, Restoration Team, Trustee scientists) through key-informant interviews or a similar process.

Task 7 - Prepare Final Comprehensive and Integrated Restoration Monitoring Plan

Based on review and comment of the draft detailed monitoring plan provided in Task 5, the contractor will prepare the Final Comprehensive and Integrated Restoration Monitoring Plan.

IV. DELIVERABLES

A comprehensive and integrated (detailed) monitoring plan for resources and services injured by the *Exxon Valdez* oil spill will be required to fulfill the proposed scope of work. The key program elements of this document will be presented for review by technical experts at the monitoring plan review workshop. Additionally, letter reports will be submitted monthly covering project status, costs to date and any problems or delays encountered or anticipated.

V. SCHEDULE

The contract period will be eight months. The workshop to review the draft plan will be held during the fifth month of the contract. It also is anticipated that there will be a need for at least three meetings (two in Anchorage, one in Seattle). The first meeting will be held in Anchorage at the beginning of the contract period to develop a working outline of the detailed monitoring plan and to design the monitoring plan review workshop. A second meeting will be held four or five months into the contract to review progress to develop a detailed plan, but could occur while the contractor is in Anchorage to conduct the workshop. A third and final meeting will be held in Anchorage to present the detailed plan to the Trustee organization and public.

The Draft Comprehensive and Integrated Restoration Monitoring Plan for the *Exxon Valdez* Oil Spill will be submitted at least two weeks prior to the date of the workshop. The Final Plan will due one month after the return of comments on the Draft Plan.

VI. BUDGET

Cost estimates should be developed by task.

VII. PROPOSAL EVALUATION FACTORS

Proposals will be evaluated based on the qualifications and demonstrated experience of the proposed contractor (including prior experience in the design and conduct of environmental monitoring programs in northern or far southern latitudes), and the responsiveness of the proposal to the Trustee Council's objectives, proposed statement of work, and schedule. Cost is also a consideration.

It is expected that the proposals will include:

1. statement of objectives,

2. proposed study plan and approach,

3. project organization, including a designated liaison to the Trustee Council's staff,

4. personnel experience,

5. deliverables,

6. schedule, and

7. budget.

VIII. PROPOSAL SUBMISSION

Proposals should be submitted to:

Ms. Heidi Sickles, Contract Administrator
National Oceanic and Atmospheric Administration
Western Administrative Support Center
7600 Sand Point Way NE
Seattle, WA 98115

93002

DETAILED RESTORATION PROJECT DESCRIPTION

Project Title: Sockeye Salmon Overescapement
Revised Study Plan for March 1, 1993 to September 30, 1993

Project ID#: 93002

Project Type: Fish and Shellfish Damage Assessment

Project Leader(s): Dr. Dana Schmidt
Ken Tarbox

Lead Agency: Alaska Department of Fish and Game

Cooperating Agencies: U.S. Fish and Wildlife Service

Project Cost: 670.3 K

Start Date: Continuing (October 1, 1992)
Finish Date: Continuing (September 30, 1993)

Geographic Area: Kodiak Island and the Kenai Peninsula

Project Manager: Dana Schmidt

A. Introduction

This study is a continuation of the oil spill damage assessment program initiated in 1990 (Schmidt and Tarbox 1992). The continuing program is essentially identical to the previous study plans with minor modifications. Recommendations provided by an international review team of sockeye salmon experts provided at a March 15, 1993 meeting have been incorporated.

Commercial fishing for sockeye salmon in 1989, was curtailed in upper CI, the outer Chignik districts, and the Kodiak areas due to presence of oil in the fishing areas from the EVOS. As a result, the number of sockeye salmon entering four important sockeye producing systems (Kenai/Skilak, Chignik/Black, Red, and Frazer Lakes) and two less important lake systems (Akalura and Afognak or Litnik lakes) greatly exceeded levels that are thought to be most productive. Sockeye salmon spawn in lake associated river systems. Adult salmon serve an extremely important role in the ecosystem, providing food for marine mammals, terrestrial mammals, and birds. Additionally, carcass decomposition serves to charge fresh water lake systems with important nutrients. Juvenile salmon which rear in lakes for one or two years serve as a food source for a variety of fish and mammals. Sockeye salmon are also an important subsistence, sport, and commercial species. The ex-vessel value of the commercial catch of sockeye from these lake systems has averaged about $42 million per year since 1979, with the 1988 catch worth $115 million. Sockeye salmon returns to the Kenai River system support some of the largest recreational fisheries in the State.

Overly large spawning escapements may result in poor returns by producing more rearing juvenile sockeye than can be supported by the nursery lake's productivity (Kyle et al. 1988). In general, when rearing fish abundance greatly exceeds the lake's carrying capacity, prey resources are altered by changes in species and size composition (Mills and Schiavone 1982, Koenings and Burkett 1987, Kyle et al. 1988) with concomitant effects on all trophic levels (Carpenter et al. 1985). Because of such changes, juvenile sockeye growth is reduced, mortality increases, larger percentages holdover for another year of rearing; and the poor quality of smolts increases marine mortality. Where escapements are two to three times normal levels, the resulting high juvenile densities crop the prey resources to the extent that more than one year is required to return to normal productivity. Rearing juveniles from subsequent brood-years suffer from both the poor quality of forage and from the increased competition for food by holdover juveniles (Townsend 1989; Koenings and Kyle 1991). This is the brood-year interaction underlying cyclic variation in the year class strength of anadromous fish.

This project will examine the effects of large 1989 spawning escapements on the resulting progeny for a select subset of the above mentioned sockeye nursery lakes. Three impacted lake systems where the 1989 escapements were more than twice the desired levels (Kenai/Skilak in Upper CI; Red and Akalura lakes on Kodiak Island) were selected. Upper Station Lake which is near the two impacted lakes on Kodiak did not receive a large escapement and has been examined as a control. Similarly, Tustumena Lake on the Kenai Peninsula received normal escapements and is used as a control for the Kenai River systems.

B. Project Description

1. Resources and/or Services:

The studies are located on Kodiak Island and the Kenai Peninsula (Figure 1 and 2). Recent findings (Schmidt and Tarbox, 1992) have suggested major economic damage to commercial, subsistence, and sport fisheries may result because of the over-escapement event occurring associated with fisheries closures caused by the 1989 oil spill. Smolt numbers emigrating from the Kenai River in the spring of 1992 were less than one-fiftieth the numbers estimated in 1989. This suggests a likely possibility of future returns below existing escapement goals. Red River smolt numbers from the 1989 escapement on Kodiak Island are estimated to return at rates which will provide for minimal commercial harvests if average marine survival occurs.

In addition to monitoring the damage extent, the mechanism that lead to the collapse requires definition. These studies essentially follow the pattern established in the original 1990 study plan but with significant modifications to accommodate recent findings.

2. Objectives:

The following objectives are altered based on input from peer reviewers of the 1992 progress report and proposed revisions to the 1993 study program..

a. Estimate critical biological attributes (number, age, size) of both resident and migrant juvenile sockeye in overescaped and normal escaped sockeye salmon nursery lakes of the Kenai Peninsula and Kodiak Island.

b. Determine effects on smolt production and subsequent adult returns caused by large escapements resulting from fishery closures after the EVOS. These effects will be inferred by studying the changes in the rearing capacity of selected nursery lakes which were either affected or unaffected by the oil spill. Data used for these inferences include:

   (1) age and growth of juveniles and smolts;
   (2) nursery area nutrient budgets and plankton populations;
   (3) seasonal, diel, and vertical distribution of zooplankton species which are the known prey of sockeye salmon in Skilak, Kenai, and Tustumena Lake; and
   (4) seasonally available zooplankton biomass in these lakes and the relationship of this biomass to ambient temperature and light.

c. Identify potential alternative methods and strategies for restoration of lost use, populations, or habitat where injury is identified.

Although not included in the original study plan, the data collected inherently provides an opportunity to examine the feasibility of alternative restoration opportunities.

3. Methods:

Numbers of adult sockeye salmon that entered selected spawning systems outside PWS prior to and during 1989 have been estimated at weir stations or by sonar. This information was collected during projects routinely conducted by the ADF&G as part of their resource management program. Optimal escapement levels, which on the average should produce maximum sustained yield, have been based on either past relationships between spawners and returning progeny or the extent of available spawning and rearing habitat. The baseline program will continue at each site including but not limited to estimates of adult sockeye escapement and collection of scales for age analysis.

For each of the lake systems identified, the response (abundance, growth, and freshwater age) of rearing juveniles will be studied. Because of the significance and magnitude of the findings on Red Lake, and on Skilak/Kenai lakes, these studies will continue until observed effects on growth and the limnetic community of the lake ecosystems recovers to pre-spill conditions.

The timeline of the 1993 studies is outlined on Table 1. This table depicts the sampling schedule for the integrated limnological studies and fisheries studies on the Kenai Peninsula. The total number of juvenile sockeye in the Kenai Peninsula lakes will be estimated through hydroacoustic surveys conducted during all years up until recovery of the system is observed. Age and size information will be obtained from samples of juvenile sockeye collected from concurrent mid-water trawl netting surveys. Survey transect designs for hydroacoustic sampling and tow-netting have been established for Kenai and Skilak lakes (Tarbox and King 1989) and Tustumena Lake (Kyle 1992). Depending on densities of rearing juvenile sockeye salmon, estimates of fish densities will be made for each transect either by echo integration or by echo counting. Total fish population estimates will be computed, by summing transect populations, along with 95% confidence intervals (Kyle 1989). Additional studies of the vertical distribution of Skilak Lake sockeye will be conducted simultaneously with population estimates with two additional sampling periods for vertical sampling only in August and November (FY94).

Freshwater growth and age of sockeye salmon rearing juveniles from all study systems will be determined from scale and possibly otolith measurements made either by direct visual analysis of scales or using an Optical Pattern Recognition system. In cases where data are available (e.g., Kenai and Skilak Lakes and Tustumena Lake), growth of progeny from the 1989 spawning escapements will be compared with growth or size of progeny during prior years.

The total number of smolt migrating from each system will be estimated with a mark-recapture study using inclined plane traps after Kyle (1983) and King et al. (1991). Smolt will be captured in traps, sampled for age and size information, marked with Bismark Brown Y (a biological dye), and transported upstream of the traps and released for subsequent recapture (Rawson 1984). Periodic retesting will determine the capture efficiency of the traps under changing river conditions during the spring. Total population estimates (with 95% confidence intervals) will be made using catch efficiencies, and weekly number weighted smolt size and age information will be calculated using a computer spreadsheet developed by Rawson (personal communication, 1985). Smolt programs consistent with those for the study lakes are continuing for Tustumena Lake (Kyle 1992).

On the Kenai River, the smolt operation will require expansion to include the Russian River. This lake system apparently now is the dominant producer of sockeye salmon smolt and is upriver from

the current smolt project on the mainstem Kenai River. To determine the production of smolt from the Kenai River mainstem, estimates of smolt production from the Russian River lake system must be completed to separate normal Russian River production from the smolt production of sockeye salmon rearing in Skilak and Kenai lakes. These methods are being established to insure current projections of smolt production from the Kenai River lake systems are not an artifact of some unknown sampling bias.

In the two Kenai Peninsula lakes, late fall sampling of fry will be conducted. The reason for the additional sampling period is that approximately 50% of the weight gain from fry to smolt in the Kenai River system occurs outside of the current sampling regime. If poor survival is occurring because of limitations in rearing habitat quality during this period, these data are crucial for determining the validity of fry density causing decreased over-wintering survival. Based on peer review comments, hydro-acoustic studies of fry abundance will continue into the fall (FY94) period, to track and sample the juvenile fish until cold weather prevents further studies. This is based on the assumption that most of the density dependent mortality occurs in early winter.

Studies on Kodiak Island will be reduced because of recent findings. These include elimination of the smolt weir counts on Red River; relying on mark/recapture studies with smolt traps will be used to estimate smolt abundance in 1993. In 1992 the hydro-acoustic surveys were eliminated on these lakes because of interference of Stickleback with the population estimates. Samples of fall fry for age, weight, and length will continue to be collected. Akalura Lake studies will be continued over the 1993 field season because variations in smolt abundance in two most recent years correlate with decreased zooplankton biomass (preliminary analysis, 1992 zooplankton data). Additional data collection is warranted to determine if this variation is denisty dependent or density independent.

Limnological data will be collected to monitor the response of the lakes to high juvenile rearing densities and their recovery once escapement levels decline. Table 1 provides a timeline of these studies and reflects the integration with the fisheries investigations previously discussed. These data will be used to estimate carrying capacity parameters of euphotic volume, nutrient budgets (carcass enrichment), and zooplankton biomass, body-sizes, and composition shifts. Approximately six limnology surveys will be conducted at two stations, to determine zooplankton species abundance and body-sizes, nutrient chemistry, and phytoplankton abundance for Kenai/Skilak, Tustumena, Red, and Upper Station lakes. Methods for limnological studies are detailed in Koenings et al. (1987).

In cases where seasonal data are available (i.e. Kenai, and Skilak lakes), limnological parameters taken during residence of the juveniles from the 1989 spawning escapements will be compared to parameters within these systems during prior years.

Although in the Kenai River system smolt enumerations and fall fry estimates during 1991 and the spring of 1992 produced very low numbers, zooplankton biomass estimates in Skilak Lake, the major sockeye salmon producer, has not undergone similar levels of decline. To further understand the mechanism that may regulate the survival of sockeye salmon juveniles in this lake, early spring tow netting for juvenile salmon was conducted. Failure to collect significant numbers prompted limited distribution studies of juvenile sockeye in the lakes by use of sonar. These data indicated concentrations during the day near 40 meters but in very low abundances (Schmidt and Tarbox 1992). These findings prompted limited vertical sampling of the zooplankton community to determine depth distribution. During the day, most of the zooplankton biomass was concentrated at

the same depth as the fish with increased surface concentrations during the night. Since light extinction during the spring occurred near 15 meters in this lake and the lake was isothermal at 2.5 degrees C, this distribution pattern seemed peculiar. Since sockeye salmon are principally sight feeders, this indicated that much of the biomass was unavailable for feeding. The control lake, Tustumena, indicated that the same species of zooplankton did not exhibit a similar vertical distribution. Pearre (1979) and Enright (1977) discussed possible causative mechanisms of various patterns of vertical distribution. One possible mechanism that would explain the difference is food satiation. By having heavy cropping of the zooplankton community, the zooplankton respond by no longer competing for limited food resources and are able to sustain sufficient nutrition with relative minor amounts of time at the depths that produce phytoplankton. At these depths they are also susceptible to sight feeding predators (sockeye salmon). Thus although the high turbidity and cold temperatures of Tustumena produce more limited biomass of zooplankton, their continual presence in the surface light layer makes them much more vulnerable to feeding sockeye. We are also examining whether the egg bearing component of the population of zooplankton is being cropped at higher rates that may cause a loss of needed lipids for overwintering survival of sockeye juveniles.

To test these hypotheses, much more intensive sampling of the diel and seasonal distribution of plankton in the glacial lakes of the Kenai Peninsula is required. Although these could be completed by increased sampling with vertical plankton tows, the costs would be prohibitive if an accurate map of the temporal and vertical presence of zooplankton were to be obtained. Therefore we proposed in a supplemental submission in July, 1992, to use a towable optical zooplankton counter . Because of the limited number of species and size distribution, we believe this device would provide an effective method of obtaining this data. Because this device has had limited use in freshwater and has had no use in glacial conditions, the application has some risk of failure. However, recent modifications to the device which should allow its use in high turbid water conditions suggest it would be effective under our conditions (Jim Snow, Focal Technologies, Personal Communication, 1992). Fall studies were not able to be conducted in 1992 because of purchasing delays. The equipment is planned for deployment early in 1993. A minimum of four sampling periods will be sampled and will consist of an early spring sampling period prior to smolt outmigration, an early summer period, a late summer period, and a pre-freeze up sampling period. These data will be coupled with sampling rearing juvenile sockeye salmon fry in the lakes by means of trawl net developed by Biosonics, Inc., capable of sampling differential depths. The collected fish will be sampled for AWL, lipid content, and stomach contents. These data will allow us to relate temporal spatial variation in abundances of predator and zooplankton prey with condition of the predator sockeye fry prior to the overwintering period.

Sampling will be performed along a subset of the transects established for fall fry fish sonar estimates in these lakes. Sampling depths will vary from the surface to the lower established limits of substantial zooplankton biomass. The species composition will be estimated using vertical net plankton tows representative of the area sampled by the optical plankton counter. Sample sizes will be determined by estimating the variance from a subset of the initial samples collected by the vertical tows. Species or life stage composition of zooplankton in the optical tow counts will be determined by comparing the length frequency data to those obtained from net samples.

In Skilak lake and Tustumena lake at each of these four sampling periods, zooplankton and sockeye salmon diel migration will be estimated at one location. This will involve continuously sampling with the OPC over various depths and a concurrent hydroacoustic survey for one 24 hour cycle.

The above data will be integrated with the other information to develop a seasonal model of food availability within the photic zone of the lake to predict fish biomass production from these systems. The studies will begin in early spring, 1993, and continue through a minimum of one calendar year.

The holistic approach proposed here involves several evaluation procedures to assess the effects of sockeye salmon overescapement. First, fresh-water production from the 1989 escapements will be assessed in Kenai/Skilak, Red, Akalura and Upper Station lakes. This will be accomplished through analysis of growth, freshwater survival (in particular over-winter survival), and freshwater age of sockeye smolt populations. Any anomalies will be determined by analysis of freshwater growth recorded on archived scales, historical freshwater age composition, and modelled freshwater survivals; and from results of previous studies as well as the 1991 smolt characteristics from each of the study systems. Also, planktonic food sources will be assessed through estimation of zooplankton prey biomass and diversity of species. Some of these analyses have been completed (Schmidt and Tarbox 1992).

Second, future sockeye salmon production from the 1989 parent year and subsequent parent years will be estimated based on spawner/recruit relationships incorporating a brood-year interaction term. Losses of adult sockeye production from subsequent parent years may result from negative effects of progeny of the 1989 escapement on the lake's carrying capacity. The spawner/recruit relationships will be estimated from historical stock specific return data (where available) and generalized spawner/recruit data scaled to the carrying capacity parameters (i.e., euphotic volume and zooplankton biomass) of the nursery lakes where stock specific return data are not available (Geiger and Koenings 1991). If it is determined that in any of the affected systems, the density dependent effects are occurring outside of the traditional models, the effects will be isolated by examining a broader time window of the rearing life history of these species.

Third, experimental and empirical sockeye life history/production models (Koenings and Burkett 1987, Koenings et al. 1989) will be used to compare salmon production by life-stage at escapement levels consistent with management goals to the 1989 escapements. These models will be refined by use of food availability data obtained through the vertical sampling studies initiated in 1992. Additionally, in the case of the Kenai system, the 1989 escapement effects will be viewed independently of the effects on previous brood years with high escapement.

Consult Schmidt and Tarbox (1992) for further discussion of analysis and methods used to date in progress reports on these investigations.

4. Alternatives

As this study is not a restoration project, the alternative is not collection of the data proscribed in this proposal and consequently limit the damage assessment to the data collected by normal operations of the Department of Fish and Game. The net result of this alternative (no data collection) would limit the public from understanding the causes of variations in future fish returns and provide reduced ability to forecast changes in commerical and sport fishing opportunities. This would also result in lack of data to support any rationale approach to restoration of fish populations which are projected to have major declines in the near future.

5. Location

These studies are located on Kodiak Island and the Kenai Peninsula. Study site locations are identified in Figures 1 and 2. Detailed maps of lakes and sampling locations are provided in Schmidt and Tarbox (1992).

6. Benefits:

The benefits of these studies are to provide the public with a definition of the loss of resources caused by over-escapement of sockeye salmon into sockeye salmon systems on the Kenai Peninsula and Kodiak Island. By understanding the causal mechanism of the collapse in sockeye salmon smolt production in these systems, these data provide valuable information for future fisheries management and provide direction for effective mitigation and recovery strategies for damage obtained. The resources affected have had annual economic value in excess of $100 million dollars in direct commercial value and have had major economic benefit to the sport fishing industry and importance to subsistence and personal use fishers on the Kenai Peninsula.

7. Technical Support:

Administrative support is provided by the Administrative Division, Habitat Division, FRED Division, and Commercial Fisheries Division staff of the Alaska Department of Fish and Game. The project leaders and their assistants are not funded by this project and are supported with general funds from the State of Alaska. Most laboratory analyses are conducted by the FRED limnology laboratory in Soldotna. These studies are integrated with ongoing studies by the Commercial Fisheries Division and FRED Division on Kodiak Island and the Kenai Peninsula. These studies have different objectives, i.e. to manage, enhance, and rehabilitate common property salmon fisheries, but use the same techniques and data collection methods. Consequently the EVOS investigations have been integrated into the normal operations of these Divisions for efficiency in completing the objectives of these studies and the general mission of these agencies.

8. Contracts:

Technical support for specialized analyses are conducted by reciprocal service agreements with the University of Alaska at Palmer (lipid analysis) and Fairbanks (Nitrogen 15 analysis). These contracts were issued in 1992 to provide specialized analysis not routinely used by the FRED Limnology laboratory. These contracts were initiated after the project leader compared the cost effectiveness of internalizing the costs to the project and obtained price quotations for non-Alaska laboratories with the capability of conducting these analyses.

9. Mitigation Measures:

As this is a continuation of a damage assessment project, no mitigation measures are required.

10. Literature Cited:

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C. Schedules and Planning

The studies described are generally continuations of work in progress. Table 1 provides a schedule for field data collection activities and subsequent data analysis. Laboratory analysis of field samples continues 12 months a year and will be in progress throughout the study period. These analysis include limnological zooplankton samples, water quality samples, juvenile fish scale and otolith analysis, weight/length determinations of juvenile fish, and lipid and N15 analysis of fish tissue. Biometric analysis continues year round on these studies with approximately 6 man months of time dedicated to this specific study.

Field data collection efforts begin in mid April for field deployment in May for the smolt, juvenile, and lake limnology sampling efforts. These continue throughout the summer and are completed when the lakes form an ice cover at approximately December 1st. Smolt sampling schedules are based on historical timing data obtained in previous studies. Lake fall fry biomass estimates occur in the month of September. Sampling of vertical distribution of fish, zooplankton, and related water quality and physical data are collected at preset intervals throughout the summer. Data are entered into computer data bases in early fall through the remainder of winter as analysis of laboratory samples are completed. Reporting activities and data summarization continues throughout the year with the primary effort occurring in September through December. September 30th is the due date for completion of the annual preliminary status report. This report will describe data collected and analysis completed to date with limited preliminary reporting of findings. Three of these reports have been issued to date. Final report for these studies will be completed within 12 months after the completion of field work. Final field studies will be completed one year after recovery of the

affected sockeye salmon populations and their rearing habitat to estimated pre-spill conditions. The reporting schedule is as follows:

Field Data Collection	May-December, 1993 *
Progress Report for FY93	Sept. 30, 1993
Draft Final Report for FY 93	March 1, 1994 *
Final Report for FY 93	June 1, 1994 *

* Part or all of these studies will be completed in the following fiscal year (FY94).

The final report schedule would occur only if studies are terminated at the end of the 1993 field season.

D. Environmental Compliance/Permit/Coordination Status

The studies proposed provide for data collection and field sampling programs. As such no environmental effect of these programs occurs beyond that of traditional fisheries management data collection activities and is within existing collecting permits or Federal special use permits issued to the Department of Fish and Game for scientific data collection activities. No other permits or other coordination activities are involved.

E. Performance Monitoring

The performance monitoring of this project is monitored through the checks and balances of the State of Alaska accounting system within the Commercial Fisheries, Habitat, FRED and Administration Divisions of the Department of Fish and Game and the Department of Administration. Contractual compliance, personnel hiring, OEO compliance, and other administrative provisions are within the State of Alaska hiring and administrative chains of command and covered in standard operating procedures and administrative regulations. Replacement personnel are readily available by reassignment from over 30 permanent and seasonal staff within the commercial fisheries and FRED divisions of the Alaska Department of Fish and Game in Soldotna and Kodiak, when temporary problems are encountered. Filling new position follows state hiring guidelines when permanent vacancies occur. Project time frames for reports and analysis are maintained through proper planning and integration of these activities within the existing administrative structure of the FRED and Commercial fisheries divisions. This project is one of over fifteen currently maintained by the FRED division limnology section and is administered accordingly. Quality control of the laboratory is conducted routinely following methods outlined in the laboratory manual referenced in this report. The laboratory is rated annually by the USGS nationwide laboratory rating system by conducting tests on blind samples provided by this group. Replicates are routinely run to cross check analytical techniques.

The scientific and technical aspects of the study are subject to internal review within FRED and the Commercial Fisheries divisions. Publications are submitted through an internal peer review process with the major findings submitted to peer review journals. Reports, work plans and study design are subject to the peer review process established by the EVOS Board of Trustees and Chief Scientist office. This year technical aspects of the studies findings to date and future plans were reviewed by a panel of international sockeye salmon researchers in a special half day session of the Kokanee and Sockeye Salmon workshop sponsored by the Northern Pacific International Chapter of the American Fisheries Society at Vancouver, B.C. in March, 1992. Interim annual status reports will be generated with publications being provided in peer review journals and scientific symposia as significant findings are obtained. The final report will be issued upon completion of the final year of field data collection. Optionally, a final report may be generated in FY94 along the schedules provided.

F. Personnel Qualifications

Principal Investigator

Dr. Dana Schmidt, Principal Limnologist, Soldotna, AK.

Dr. Schmidt will be the primary author of Kodiak studies and limnological investigations on the Kenai Peninsula. Dr. Schmidt has been the Regional Research Biologist for the Commercial Fisheries Division of the Alaska Department of Fish and Game in Kodiak for over 6 years and supervised all Kodiak Island and the Aleutian Island/Alaska Peninsula sockeye salmon research. He was co-principal investigator in the past with Dr. J. Koenings. He is the primary author of the 1991 and 1992 status reports on these investigations.

Mr. Ken Tarbox, Area Fisheries Research Biologist, Soldotna, AK.
Mr. Tarbox continues as the principal author and investigator of juvenile and smolt studies on the Kenai Peninsula. He has authored numerous reports and has supervised juvenile salmon studies on the Kenai Peninsula major sockeye salmon systems.

Numerous other staff of ADF&G provide assistance in completing these studies.
Primary staff include:
Project Biometrician: Stan Carlson
Kodiak area adult and smolt investigations: Bruce Barrett
Kodiak limnological investigations: Gary Kyle and Steve Honnold
Kenai Peninsula limnological investigations: Gary Kyle and Jim Edmundson
Kenai River smolt investigations: Bruce King

G. Budget

A summary budget for all components and tasks is attached along with detailed budgets for the various project components.

Table 1. Studies of the Kenai River overescapement for calendar year 1993. **NRDA STUDIES- 1993**

	January	February	March	April	May	June	July	August	September	October	November	December
Kenai Smolt												
Russian R. Smolt												
Kasilof Smolt												
Kenai Hydro- pop est												
Skilak Hydro- pop est												
Skilak Hydro- diel dist												
Tustumena Hydro-pop est												
Skilak Growth												
Skilak Lipid												
Skilak Stomachs												
Kenai Growth												
Kenai Lipid												
Skilak Limno												
Kenai Limno												
Skilak Diel Zoo												
Kenai Diel Zoo												
Tustumena Diel Zoo												
Other Zoo												
Description of Projects:												

Growth=Collection and analysis of age, weight, and length data from juvenile rearing sockeye; Lipid: Collection and analysis of juvenile sockeye salmon % lipid content; Limno=Normal limnological data collection sequence .
Diel Zoo=Optical Plankton Counter sampling with vertical tow net calibration of zooplankton communities; Stomachs= Stomach content analysis of juvenile sockeye salmon;
Smolt=Mark/recapture population estimates of migrating smolt with age/weight/length determinations; Hydro-diel est= Diel Vertical Distribution of juv. sockeye with hyroacoustics; Hydro- pop est= Population estimate juv. sockeye.

Field activities Construction, preseason activities Data analysis

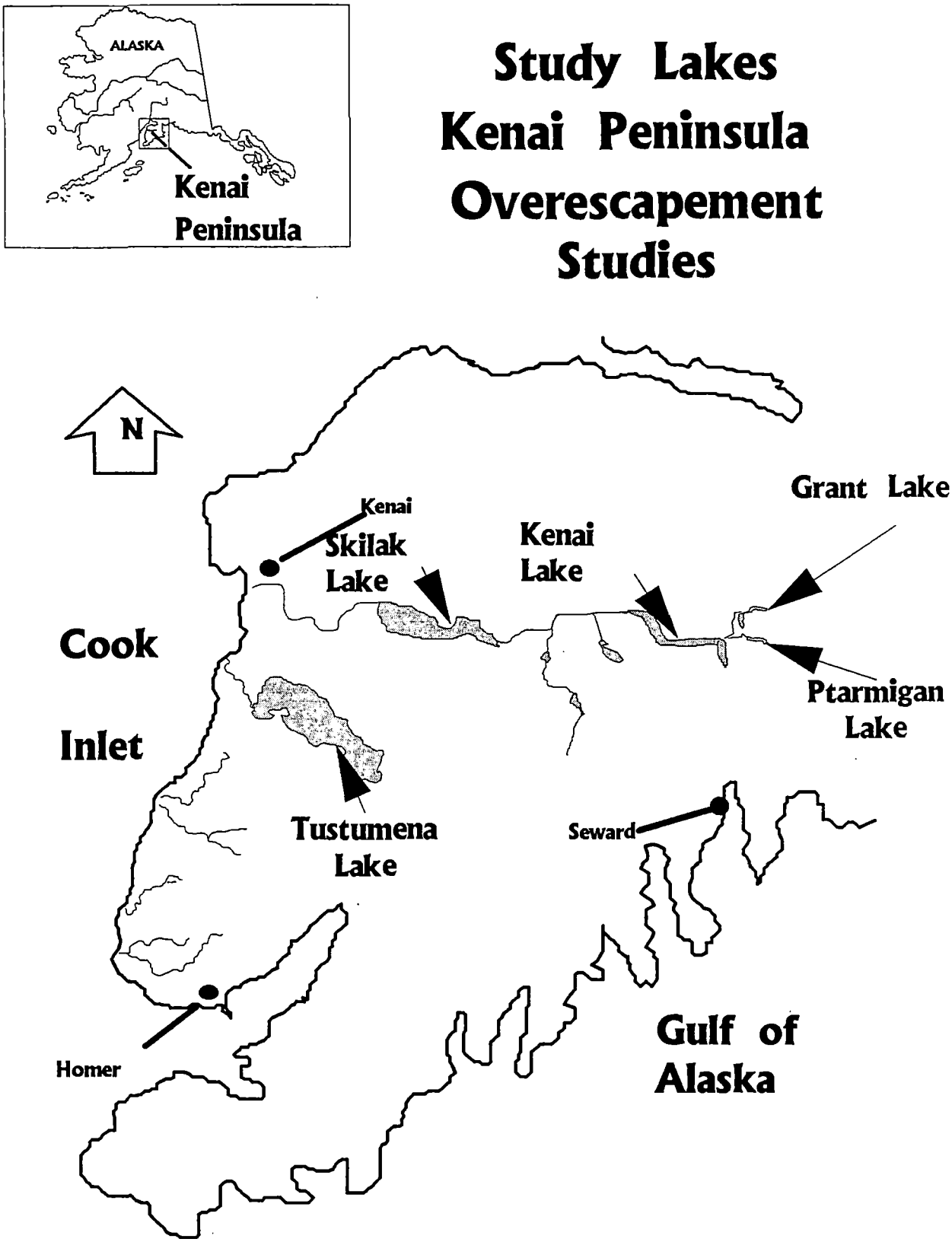

Figure 1. Location of study lakes within the Kenai River drainage, Kenai Peninsula, Alaska.

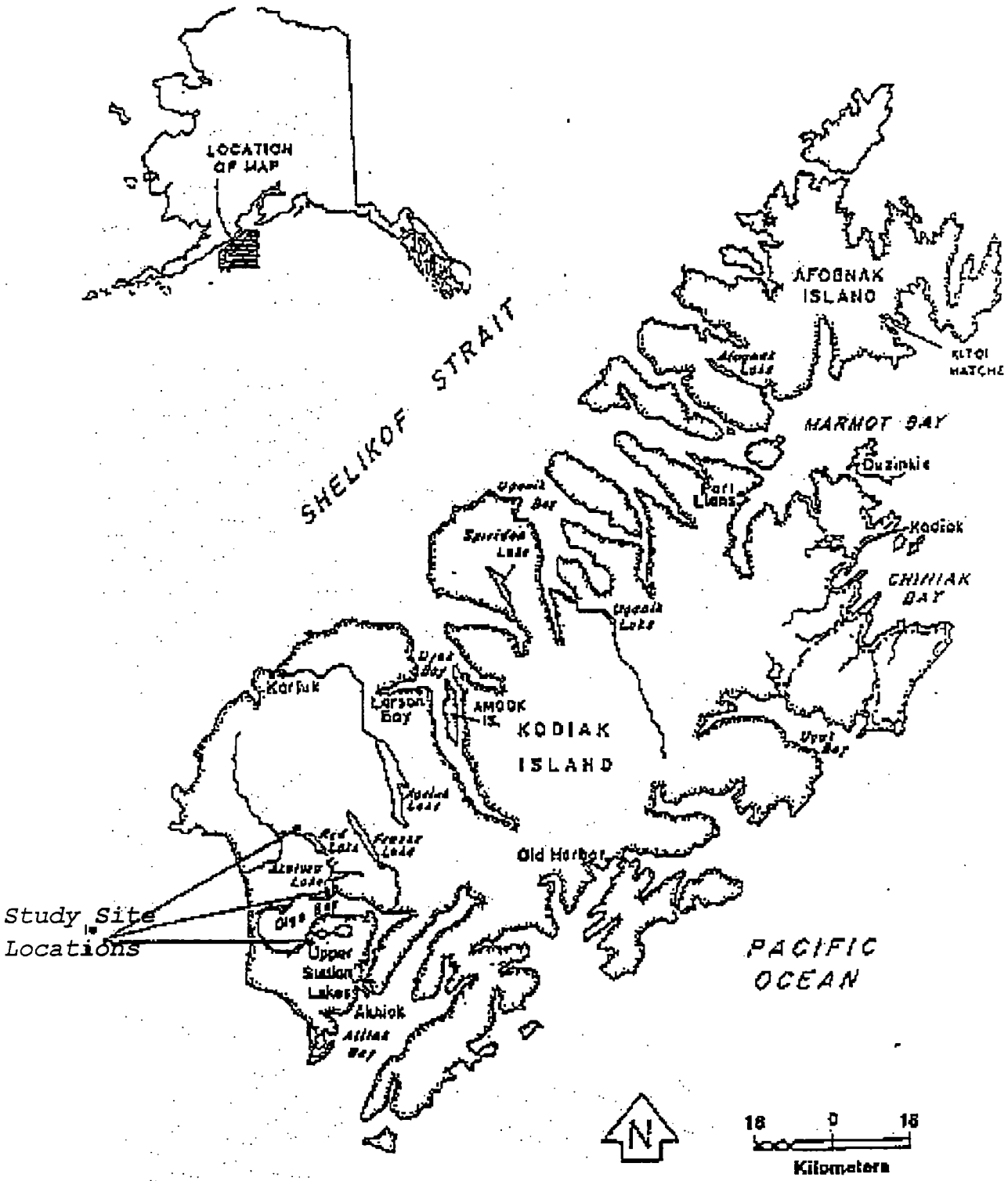

Figure 2. Location of Red, Akalura, and Upper Station lakes on the southern end of Kodiak Island.

Project Description: This project is a continuation of the effects of sockeye salmon overescapement on river and lake ecosystems on Kodiak Island and the Kenai Peninsula. Recent smolt numbers from the Kenai River and from Red River on Kodiak Island suggest major decreases in future sockeye salmon returns to both areas. These studies will monitor future smolt outmigrations and the density of fry rearing in the nursery lakes. In addition, detailed investigations will be conducted to determine what factors, both biotic and abiotic, may have contributed to the decline in production. Budget reflects major work changes based on spring 1992 preliminary findings and results from a sockeye salmon synthesis meeting.

Budget Category	Approved** 1-Oct-92 28-Feb-93	Proposed* 1-Mar-93 30-Sep-93	Total FY 93	FY 94	FY 95	FY 96	FY 97	Sum FY 98 & Beyond
Personnel	$118.9	$465.1	$584.0	$400.0	$375.0	$200.0	$100.0	$100.0
Travel	$4.0	$7.5	$11.5	$10.0	$10.0	$10.0	$5.0	$5.0
Contractual	$49.4	$63.9	$113.3	$100.0	$75.0	$50.0	$20.0	$20.0
Commodities	$16.1	$54.7	$70.8	$50.0	$40.0	$30.0	$15.0	$15.0
Equipment	$36.1	$20.5	$56.6	$35.0	$30.0	$25.0	$10.0	$10.0
Capital Outlay	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Sub-total	$224.5	$611.7	$836.2	$595.0	$530.0	$315.0	$150.0	$150.0
General Administration	$19.8	$74.2	$94.0	$67.0	$61.6	$33.5	$16.4	$16.4
Project Total	$244.3	$685.9	$930.2	$662.0	$591.6	$348.5	$166.4	$166.4
Full-time Equivalents (FTE)	2.4	9.4	11.8					

Amounts are shown in thousands of dollars.

Budget Year Proposed Personnel:	Months Budgeted	Cost
Position		
7 Kodiak commfish positions	19.7	$86.0
15 Kenai-Russian River positions	46.5	$158.4
10 FRED positions	42.0	$185.1
1 Analyst/Programmer IV	1.2	$6.7
1 Analyst/Programmer II	0.8	$3.1
1 Publication Specialist II	0.8	$3.3
1 Program Manager	3.0	$22.5

FY 93 is a transition year from the previously used oil fiscal year to the federal fiscal year. This new project also includes proposed funding for January and February, 1993.

Comment

* FY93 is a transition year from the previously used oil fiscal year to the federal fiscal year.

** If not funded in FY94, $97.0K will be needed for analysis of samples collected in Fall 93 and final report preparation.

Project Number: 93002
Project Title: Sockeye Salmon Overescapement
Agency:AK Dept. of Fish & Game

FORM 2A
PROJECT
DETAIL

93003

DETAILED RESTORATION PROJECT DESCRIPTION

Project Title:	SALMON EGG TO PREEMERGENT FRY SURVIVAL
Project ID#:	93003
Project Type:	Fish and Shellfish
Project Leaders:	Sam Sharr, Alaska Dept. Fish and Game Jim Seeb, Alaska Dept. Fish and Game Jeep Rice, National Marine Fisheries Service
Lead Agency:	State of Alaska, Department of Fish and Game, Division of Commercial Fisheries
Cooperating Agency:	National Marine Fisheries Service
Project Cost:	FY93 $686.0 FY94 $765.0 FY95 $558.2 FY96 $359.5
Start Date: March 1, 1993	Finish Date: September 30, 1993
Geographic Area of Project:	Prince William Sound, Alaska

Project Leaders:

_____ _____
Sam Sharr ADF&G

_____ _____
Jim Seeb ADF&G

_____ _____
Jeep Rice NMFS

Program Managers:

_____ _____
Joe Sullivan ADF&G

_____ _____
Bruce Wright NMFS

A. INTRODUCTION

Field evidence collected during the Natural Resource Damage Assessment (NRDA) of the March 1989 *Exxon Valdez* oil spill (EVOS) detected elevated mortalities in pink salmon *Oncorhynchus gorbuscha* eggs/embryos with indications of possible genetic damage as a result of exposure to oil during early developmental life-stages. The consequences of this putative damage include physiological dysfunctions which may result in functional sterilization of individuals and substantially reduced reproductive capacity from wild pink salmon populations. If verified in the laboratory, this genetic damage would constitute a major new discovery of an oil pollution effect that has been suspected. An increase in physiological dysfunction above that which would normally occur results in a reduction in production potential. A persistent decline of this nature would render present restoration efforts inadequate as historic spawning escapement levels would be insufficient to sustain a harvestable wild pink salmon population. The purpose of this study is to continue to monitor the recovery of pink salmon eggs and fry in the field, provide laboratory verification of the field results presented by Sharr et al. (1991), and test the hypothesis that exposure of pink salmon to a polluted incubation habitat will result in the functional sterilization of these animals at sexual maturity. This study will (1) survey the same streams examined during the NRDA process for pink salmon eggs and preemergent fry in order to monitor recovery, (2) collect pink salmon gametes from oiled and non-oiled streams in western Prince William Sound (PWS) and incubate them under controlled conditions to evaluate the effect of physical stream characteristics upon the damages observed in the field, (3) utilize controlled laboratory exposures to fertilized eggs in a simulated inter-tidal gravel environment in order to mimic actual environmental exposures (link NRDA Study FS2), and (4) examine embryos and fry from both the field and laboratory work for presence of genetic aberrations.

Pink salmon eggs and fry incubating in the oiled intertidal spawning areas in PWS in 1989, 1990, 1991, and 1992 appear to have been adversely affected by EVOS. Oil was deposited in layers of varying thickness in the intertidal portions of streams utilized by spawning pink salmon during the spring of 1989. Pink salmon eggs deposited in 1988 (1988 brood year) emerged as fry through the oiled spawning gravels during the spring of 1989 and began feeding on oiled plankton. These fish showed decreased growth due to oiling (Wertheimer 1991). Although gross oil levels decreased during the summer of 1989, contamination in the intertidal zone was still evident. The pink salmon eggs deposited during the late summer of 1989 (the 1989 brood year) were exposed to intra-gravel contamination from late August 1989 through mid-May 1990. Sharr et al. (1991) detected elevated pink salmon egg mortalities in the intertidal zones of oiled streams while no difference between oiled and non-oiled streams was detected above mean high tide. Elevated egg mortalities in oiled streams were again detected in the 1990 brood year, but only in the highest intertidal spawning zone. Visual observations indicated that the majority of the remaining oil was deposited in this zone. Spawning areas lower in the intertidal zone seemed to be recovering as egg mortalities in these areas were not statistically different from non-oil impacted streams.

Surprisingly, Sharr et al. (1991) found increased egg mortalities in oiled streams during the fall of 1991 survey. Furthermore, significant differences in egg mortality occurred at

all tidal zones, including the area above mean high tide. Clearly, the elevated egg mortalities in the oiled streams were not the direct effect from recent oiling. The 1991 adult returns were the progeny of the 1989 brood year, the group with the highest exposure to intra-gravel oil (the 1989-90 incubation period). We hypothesize that the elevated egg mortalities in 1991 may be the result of genetic damage acquired during development after fertilization in 1989. Elevated egg mortalities at all tidal zones in oiled streams were again detected during the fall of 1992 survey (Sharr et al. in prep.). This result supports the genetic damage hypothesis since increased egg mortalities were detected in the highest intertidal zone in 1990.

This genetic damage hypothesis is consistent with previous laboratory experiments on the effects of crude oil on early life stages of fish and with other NRDA field observations. Long term intra-gravel oil exposures (7-8 months) to freshly fertilized eggs provide embryos sufficient time to accumulate polynuclear aromatic hydrocarbons (PAH's) from very low aqueous concentrations of crude oil. PAH's are abundant in crude oil and are potent clastogens (i.e. capable of breaking chromosomes). Mironov (1969) observed reduced survival of fish eggs and larvae exposed to very low aqueous doses (1 ul oil/l seawater) of oil. Moles et al. (1987) confirmed that pink salmon eggs take up PAH's and demonstrated that the uptake was much greater in an intertidal environment than in strictly freshwater conditions. Biggs et al. (1991) found greater numbers of chromosome aberrations in larval herring which incubated in oiled areas than in non-oiled areas. It is logical that the same type of damage may have occurred in pink salmon, and this damage could have affected the reproductive fitness of a significant proportion of exposed individuals.

Genetic damage induced by genotoxins can be classified into two general categories: damage to the DNA molecule itself caused by nucleotide base substitutions, deletions, or additions (microlesions); and changes in chromosome number or structure (macrolesions). Chemical agents that induce mutations in DNA are also likely to produce cytologically recognizable chromosome damage expressed as structural changes or "aberrations" (Evans 1976). Flow cytometry is a cytogenetic technique that detects the visible effects of DNA macrolesions and will be the primary method used in this study for detecting genetic damage.

Increasing concern about the effects of chemicals in the environment has lead to a proliferation of assays developed to assess their genotoxic potential (reviewed in Landolt and Kocan, 1983). Flow cytometry has become an established method for measuring the physical and chemical characteristics of cells and has been used to detect clastogenic effects of environmental toxicants in several species (McBee and Bickham 1988, Bickham 1990, Lamb et al. 1991). This method allows for rapid and sensitive processing of large numbers of cells per individual and for timely analysis of many samples. The ability to quantify the cellular characteristics for many individuals in a short period of time greatly reduces lab costs over traditional cytogenetic analyses while providing greater statistical power for hypothesis testing.

Information gained from this study will provide resource managers insight to the magnitude and persistence of damages sustained by wild pink salmon due to EVOS.

Efforts to restore damaged pink salmon populations depend upon the fishery manager's abilities to identify sources of reduced survival and to monitor their persistence. Information on the potential of long term oil exposures to cause genetic damage is needed so spawning escapement goals can be reevaluated and adjusted if necessary. In addition, verification of the genetic hypothesis would provide the first evidence that reproductive capacity of fish exposed to chronic or acute sources of oil pollution would be compromised.

B. PROJECT DESCRIPTION

This project is composed of three parts: (A) a recovery monitoring component which will continue to collect field information on pink salmon eggs and preemergent fry in order to observe recovery in the natural systems, (B) a laboratory fertilization component that will expose fertilized eggs from oiled and unoiled streams in Prince William Sound to identical incubation environments, and (C) a laboratory oil exposure component that will expose fertilized eggs to an incubation environment contaminated with crude oil, rear surviving fry to maturity, and check their gametes for viability. Components B and C work together to verify the 1989 field findings of Sharr et al. (1991). Differences in survival between groups in component B will be unrelated to incubation environment indicating problems with gamete quality. Differences in gamete viability between groups in component C will be related to oil exposure, and demonstrate the probable cause for effects observed in component B.

1. Resources and/or Services

This study will investigate pink salmon *Oncorhynchus gorbuscha* in Prince William Sound, Alaska, and pink salmon from Lover's Cove Creek in southeastern Alaska.

2. Objectives

a. Component A - Recovery Monitoring of Injury to Pink Salmon Eggs and Preemergent Fry in Prince William Sound

(1) Estimate the density, by tide zone, of preemergent fry in 48 streams and eggs in 31 streams using numbers of live and dead eggs and fry.

(2) Estimate egg mortality and overwinter survival of pink salmon eggs in both oiled and unoiled (control) streams.

(3) Assess any loss in adult production from changes in overwinter survival using the results of NRDA F/S Studies 1, 2, 3, and 4.

b. **Component B - Verification of Injury to Pink Salmon Gametes in Prince William Sound**

(1) Determine whether the increased pink salmon egg mortalities observed in oiled streams by Sharr et al. (1991) can be attributed to the physical characteristics of the study streams.

c. **Component C - Laboratory Verification of Injury to Pink Salmon Eggs and Preemergent Fry Exposed to Oiled Incubation Substrate.**

(1) Determine survival, genetic damage, hydrocarbon uptake, mixed function oxidase activity, and sublethal teratogenic effects from long term exposures to oil in eggs exposed from fertilization to emergence.

(2) Determine growth characteristics from each exposure group from juvenile stage to maturity.

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

d. **Combining Field Observations and Laboratory Results.**

(1) Determine if the elevated egg mortalities in 1989 and 1990 were potentially caused by oiling in the environment.

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

3. Methods

a. **Component A - Recovery Monitoring of Injury to Pink Salmon Eggs and Preemergent Fry in Prince William Sound**

(1) Data Collection

There are approximately 900 anadromous fish streams in PWS. Preemergent fry sampling from some of these streams has historically provided a pink salmon abundance index which was used to forecast future returns. In recent years, 25 index systems considered representative of pink salmon producing streams have been sampled. Sampling had been performed on as many as 45 streams prior to 1985. This study is designed to compare rates of mortality and abundance among areas with various levels of oil impacts.

Sampling will consist of egg deposition surveys performed from late September to mid-October and preemergent fry sampling conducted from mid-March to mid-April. Streams known to have sustained no oil impact, some oil impact and visibly obvious impact will be included in both the egg and fry sampling programs.

Egg sampling will be conducted in the fall on 31 streams (Figure 1). Fry sampling will be conducted in the spring on 48 streams (Figure 2). These 48 streams will include the 31 streams in the egg sampling program as well as 17 additional streams. The additional streams are those which have traditionally been sampled as part of the historic PWS preemergent index program used to forecast adult returns. Funding for sampling of the preemergent index streams is provided by ADFG and is independent of this restoration project.

The 31 streams common to the egg and fry sampling programs were selected using the following criteria:

1. Adult salmon returns were expected to be great enough to indicate a high probability of success in egg and fry sampling.

2. Egg and fry sampling had been done in past years.

3. Streams with low to no oil impact, i.e., controls, were selected in the immediate vicinity of high oil impact streams to help account for possible variability in egg and fry survival due to different environmental conditions.

Twenty eight of the 31 streams are located in the western half of PWS in close geographic proximity to each other and in the area where oil impacts were greatest. Twelve experienced oil impacts ranging from light to heavy. Most of the 31 selected streams which sustained suspected or obvious oil impact were not sampled for either eggs or fry prior to the EVOS. Among the 12 streams where oil was visibly present in 1989, one had a history of egg sampling and four had a history of fry sampling.

Sampling methods are identical for the preemergent fry and egg sampling and are modeled after procedures described by Pirtle and McCurdy (1977). On each study stream, four zones, three intertidal and one above most tidal influence, will be measured from the mean low tide mark using tide computer generated tide tables and a surveyors level. Boundaries between zones will be marked with stakes. The zones are 1.8-2.4 m, 2.4-3.0 m, 3.0-3.7 m above mean low water, and upstream of mean high tide (3.7 m). Separate linear transects 30.5 m in length will be established for egg and preemergent fry samples in each zone (one transect for each type of dig in each zone). The transects will run

diagonally across the stream. To insure continuity of transects between egg and fry sampling between years, transect locations are marked with stakes or cairns and carefully photographed from at least two perspectives. To minimize site effects, fall egg and spring fry sampling transects must be located in the same section of stream yet must not overlap, if fall egg sampling is not to influence perceived abundance of fry during spring sampling. To minimize overlap yet allow sampling at the same sites for both eggs and fry, the downstream end of egg sampling transects is located against one bank of the stream and the downstream end of the fry sampling transect is located at the same stream location but against the opposite bank. Fourteen 0.3 m^2, circular digs (56 per stream) will be systematically made along each transect using a high pressure hose to flush eggs and fry from the gravel. Eggs and fry will be caught in a specially designed net.

The following data will be collected for each tide zone transect during both egg and fry sampling:

1. The sample date.
2. The sample tide zone.
3. The start and stop time for each tide zone transect.
4. Numbers and condition (live or dead) of fry and eggs by species for each dig.
5. A subjective estimate of the overall percent yolk sac absorption for fry in each dig sample.

Data will be entered from "Rite in the Rain" books into a Lotus spreadsheet for editing and summarization.

Pink salmon eggs will be separated from chum *O. keta* and coho *O. kisutch* salmon eggs by their smaller size. Chum salmon eggs will be separated from coho salmon eggs by their greater development and different coloration. An egg will be considered dead if it is opaque or discolored with concentrations of lipids. Pink salmon fry will be differentiated from chum salmon fry by their smaller size and lack of parr marks. Sampling will often kill fry (especially newly hatched fry), so fry will only be considered dead if decomposition is evident.

(2) Data Analysis

Numbers of live and dead preemergent fry and eggs will be summarized by date, stream, level of hydrocarbon impact, and stream zone. Densities of live eggs for stream i, zone j in m^2 (E_{ij}) will be estimated by:

$$\hat{E}_{ij} = \frac{\Sigma LE_{ijk}}{0.3n_{ij}} \quad , \tag{1}$$

where LE_{ijk} is the number of live eggs found in the k^{th} dig, in stream i, zone j, and n_{ij} is the number of digs from stream i, zone j. Densities of dead eggs as well as dead and live fry will be calculated using the same estimator with appropriate substitutions.

Pink salmon egg mortality will be estimated for each stream using the following relationship:

$$\hat{M}_{ij} = \frac{\Sigma(DE_{eijk} + DF_{eijk})}{\Sigma(LE_{eijk} + DE_{eijk} + LF_{eijk} + DF_{eijk})} \quad , \tag{2}$$

where DE_{eijk}, DF_{eijk}, LE_{eijk}, and LF_{eijk} are the number of dead eggs, dead fry, live eggs, and live fry for the k^{th} dig from stream i, zone j, collected during egg dig e, respectively.

The Arcsin square root transformation will be examined as well as the Logit transform of egg mortality [ln (odds)].

$$Logit_{ij} = \ln\left[\frac{\Sigma(DE_{eijk} + DF_{eijk})}{\Sigma(LE_{eijk} + LF_{eijk})}\right] \tag{3}$$

Pink salmon egg to preemergent fry survival will be estimated as:

$$\hat{S}_{ij} = \frac{(\Sigma LF_{fijk}) / n_f}{\Sigma(LE_{eijk} + DE_{eijk} + LF_{eijk} + DF_{eijk}) / n_e} \quad , \tag{4}$$

where LF_{fijk} is the number of live fry for the k^{th} dig f from stream I, zone j, collected during fry dig f, and n_e and n_f are the number of digs for stream i, zone j for egg dig e and fry dig f.

Differences in egg mortality and survival will be examined using a mixed effects two-factor experiment with repeated measures on one factor (Neter et al. 1990):

$$Y_{ijk} = \mu_{...} + O_i + Z_j + (OZ)_{ij} + S_{k(l)} + e_{(ijk)}. \quad (5)$$

The two treatments will be extent of oiling, (O_i, 2 levels; oiled and unoiled), and height in the intertidal zone (Z_j, 4 levels; 2.1, 2.7, and 3.4 m above mean low water, and upstream) both fixed effects. The data will be blocked by stream ($S_{k(i)}$), a random effect nested within extent of oiling. The interaction of extent of oiling and height in the intertidal zone will also be examined. Equality of variances will be tested using the F_{max}-test (Sokal and Rohlf, 1969), while normality will be visually assessed using normal quantile-quantile and box plots (Chambers et al. 1983). If the data appear to be non-normal, data transformations will be examined. If a significant difference due to oiling is detected ($\alpha = 0.05$), four contrasts (oil vs. unoiled for the four stream zones) and corresponding Bonferroni family confidence intervals ($\alpha = 0.10$ overall) will be estimated.

Extent of oiling for analysis will be based on visual observations of streams (NRDA F/S Study 1 and 2) and the hydrocarbon results from mussel samples (NRDA F/S Study 1). Different groupings of oiled and unoiled streams will be analyzed, if evidence of oiling is not consistent.

b. Component B - Verification of Injury to Pink Salmon Gametes in Prince William Sound

(1) Experimental Design

The experiment will assess the effects of the physical characteristics of the study streams upon the observed results. This will be accomplished by collecting pink salmon gametes from oiled and non-oiled streams and rearing the resulting embryos in a controlled laboratory environment.

This experiment will provide information to help determine whether the results observed in NRDA Study FS2 can be attributed solely to the physical characteristics of the study streams. In this experiment we will collect gametes from 8 oiled and 8 non-oiled streams from southwestern PWS, make intra-stream crosses, and incubate the resulting embryos in a controlled laboratory environment. Egg mortality will be compared between the oiled and uncontaminated streams. If no difference is observed in this experiment and a significant difference in egg mortality is detected between oiled and non-oiled streams during the recovery

monitoring portion of this study during the fall of 1993 egg sampling, it can be stated that the physical characteristics of the study streams played a role in the results of the previous egg mortality studies.

Gamete collection and fertilization procedures will occur over a four day period to obtain data from 8 oiled and 8 non-oiled streams. Gametes from 30 male and 30 female pink salmon will be collected from 2 oiled and 2 control streams during each sampling day. The gametes will be flown to the Armin F. Koernig hatchery where a random gamete pool will be assembled for each stream in a timely manner. The construction of the random gamete pool is described in the fish culture section of this proposal. A minimum of nine randomly selected aliquots of approximately 500 embryos each will be collected from each intra-stream pool, placed into separate incubating vessels, and randomly placed into a common incubator (Heath Incubator).

Incubating embryos will be periodically screened for dead eggs and hatching success. Samples of sperm from each male used to build the embryo pools will be cryopreserved for future analysis if required. Embryo samples will also be collected and preserved for future examination by flow cytometry, MFO, and histopathology. The experiment will be terminated prior to swimup at which time all larvae will be killed.

(2) Data Analysis

The data will be analyzed as a fixed-effects generalized randomized block design:

$$Y_{ijk} = \mu + B_i + O_j + \epsilon_{ijk} \qquad (6)$$

where Y_{ijk} is egg mortality for sample day i, oil contamination level j, and stream k; μ is the model mean; B_i is sampling day a blocking variable; O_j is the level of oil contamination (oiled or not oiled); and ξ_{ijk} is random error. The relative power of the test was estimated. The sample size was considered sufficient to detect a difference of less than 1.5 standard deviations at $\alpha = 0.05$ and 95% power (Neter et al. 1990). A test with high power is needed to protect against arriving at the conclusion that all observed damages could be attributed to the physical characteristics of the streams when in actuality significant damages due to oil were present.

The assumption of constant error terms will be tested using the F_{max}-test (Sokal and Rohlf 1969) while normality will be visually assessed using

scatter plots, box plots, and normal probability plots (Chambers et al. 1983). Appropriate transformations will be used to alleviate variance and normality concerns if they are detected. All suitable comparisons will be made using Bonferroni family confidence intervals. The SAS (SAS Institute Inc. 1988) General Linear Models Procedure will be used to analyze the data.

(3) Egg fertilization and incubation

Gametes will be randomized as described below, and embryos will be incubated in Heath incubators located at the Armin F. Koernig hatchery in Prince William Sound. Each incubator tray will have an independent water supply from a common water source.

c. Component C - Laboratory Verification of Injury to Pink Salmon Eggs and Preemergent Fry Exposed to Oiled Incubation Substrate.

(1) Experimental Design

This component is comprised of two experiments used to identify population and individual biological effects of oil exposure. The first experiment measures differences in biological response to various concentrations over two brood years. It will be a controlled simulation which incorporates our observations of field conditions. This study will span two generations in order to verify the findings of Sharr et al. (1991). The first generation will verify the 1989 and 1990 findings while the second generation will provide evidence to confirm the functional sterility hypothesis. This study will also provide samples of known oiling history for examination of genetic material through the use of flow cytometry.

The second experiment measures differences in survival to emergence between families incubated in a variety of oiled substrates. The existence of significant differences in emergence rates between families under differing conditions would demonstrate that oiling influences the genetic structure of pink salmon populations.

a. Study 1

This experiment examines the effects of six levels of oiled incubation substrate on responses to various life history stages across two generations (P1 and F1). The experimental design will be applied to both the 1992 and 1993 brood years of pink salmon. Responses measured in the first generation will include survival to eyeing, survival to emergence, hydrocarbon uptake, survival to maturity, growth to maturity, and fecundity. Responses measured in the second generation will include fertilization rate and number of defective progeny. Samples for use in

flow cytometry will be collected from first generation eyed eggs, emergent fry, juveniles (approximately 6 grams in weight), and mature adults. Second generation eyed eggs and emergent fry will be similarly sampled.

Gametes from 48 male and 48 female 1992 brood year pink salmon will be collected, randomly mixed into a common embryo pool, and divided into 48 aliquots of approximately 1500 eggs each. The 48 aliquots will then be randomly assigned to one of the 6 oiled gravel treatments (8 aliquots per treatment). The individual aliquots will be incubated in individual pipe incubators filled with oiled gravel. Groups incubated in oiled gravel will be sampled at each major developmental stage; eyeing, hatching and emergence. Samples will be randomly removed from the incubators for genetic, mixed-function oxidase (MFO), histopathological, and hydrocarbon analysis. Fry will be counted and inspected upon emergence and then moved to saltwater netpens. Fry from two of the oiling levels will be eliminated at the time of transferring to saltwater pens to reduce the dimension of the study. Water samples collected in conjunction with the embryos will be used to establish oil dosages in each incubator. Intra-group pairings will be made for each of the four remaining first generation treatment groups. Confining the experiment to within group pairings simulates the natural homing characteristics of pink salmon and the relatively low levels of genetic interchange thought to occur between streams in the wild. Second generation pairings will again use a randomly mixed common gamete pool utilizing equal numbers of males and females. These gametes will not be incubated in an oiled environment hence any observed increases in mortalities or defective individuals can be attributed to oiling effects upon the first generation. These eggs will be incubated through hatching. Flow cytometry will be used to examine tissues from eggs and larvae to detect cytogenetic defects. Number of defective progeny will be compared between treatment groups. The experiment will be repeated for the 1993 brood pink salmon.

b. Study 2

The second study will determine if there is evidence of differential gamete survival to emergence between ten randomly paired families for five different treatment regimes. The treatments will be a combination of oiling concentrations (C_i) from study 1 and duration of exposure as follows: 1) control; 2) C_2 through eyeing; 3) C_2 through emergence; 4) C_4 through eyeing; and 5) C_4 through emergence. The fertilized gametes from a randomly selected pair of pink salmon (family) will be divided into 15 aliquots of approximately 100 eggs each. The aliquots will then be randomly assigned one of the five treatments (3 aliquots per treatment). Ten family groups will be created and assigned in this manner. The individual aliquots will be incubated in pipe incubators. All fish culture

practices such as location on water distribution lines will be randomized between families. Families will be incubated until emergence when they will be inspected, counted, and terminated.

(2) Data Analysis

a. Study 1

The data from each generation in Study (1) will be analyzed as a fixed-effects one factor design with six levels of oil concentration:

$$Y_{ij} = \mu + C_i + \epsilon_{ij} \qquad (7)$$

where Y_{ij} is the j^{th} response to oiling concentration i; μ is the model mean; C_i is the level of oil concentration; and ϵ_{ij} is random error. The power of this test was estimated using data from past pink salmon incubation studies (Wertheimer 1985). These data indicated the ability to detect a difference of less than 10% in survival to emergence at $\alpha = 0.05$, 90% of the time.

Approximately 50-100 samples (individuals, blood, or sperm) will be collected for genetic analysis by flow cytometry at eyeing, hatching, emergent fry, juveniles (roughly 6 gm in weight), and spawning adults from each treatment group in the first generation. Second generation individuals will be similarly sampled at eyeing through emergence. The individual samples will be processed to obtain the mean, variance, and coefficient of variation of genetic material for each individual. Differences in genetic material will be tested using the model described by equation 7.

The assumption of constant error terms will be tested for all analysis using the F_{max}-test (Sokal and Rohlf, 1969) while normality will be visually assessed using scatter plots, box plots, and normal probability plots (Chambers et al. 1983). Appropriate transformations will be used to alleviate variance and normality concerns if they are detected. All suitable contrasts will be made using Bonferroni family confidence intervals. The SAS (SAS Institute Inc., 1988) General Linear Models Procedure will be used to analyze the data.

b. Study 2

A mixed-effects model will be used to test for differences in survival between families for the five treatments:

$$Y_{ijk} = \mu + F_i + T_j + \epsilon_{ijk} \quad (8)$$

where Y_{ijk} is the survival of aliquot k for family i and treatment j; μ is the overall mean; F_i is the family effect; T_j is the oil concentration and duration combination; and $\epsilon_{jk(i)}$ is the random error. The power of this test was again estimated using data from past pink salmon incubation studies (Wertheimer 1985). These data indicated the ability to detect a difference of less than 10% in survival to emergence at $\alpha = 0.05$, 80% of the time.

The assumptions of constant error terms and normality will be tested using the methods utilized in study 1. All appropriate contrasts will be made using Bonferroni family confidence intervals. The SAS (SAS Institute Inc. 1988) General Linear Models Procedure will be used to analyze the data.

(3) Development of Dose Response Curves

Dosing levels in Studies 1 and 2 of Component C will be established by analyzing hydrocarbon concentrations in incubator effluent and food with gas chromatograph and mass spectroscopy (GC/MS) at each major developmental stage. Effluent samples for the GC/MS will be collected and pooled from each of the pipe incubators in an oiling concentration-duration of exposure treatment. It will not always be necessary to sample all of the treatment cells in the experimental design as the number of uniquely exposed treatment groups changes with embryo development. For example, at eyeing there are 6 uniquely exposed groups since all exposures have been made for the same amount of time at 6 different oil concentrations; however, at emergence there are 11 uniquely exposed treatment groups, different concentrations have been applied over 2 different durations. Additional effluent samples will be collected at each major developmental stage for spectrophotofluoremetry to provide estimates of variability between incubators within a treatment cell. Oil concentrations in incubator gravel will be obtained from spectrophotofluoremetry and related to levels observed in streams sampled under NRDA. Each treatment cell with a unique exposure level will be sampled at least 3 times for tissue hydrocarbon concentration. Samples will be collected at all stages from eyeing to 6 weeks after emergence.

(4) Fish Culture

All experiments in component C will be performed at The National Marine Fisheries Research Station at Little Port Walter (LPW) in southeastern Alaska. Mature pink salmon gametes will be collected from intertidal spawners in Lover's Cove Creek located near the facility.

a. Incubation

Gametes will be randomized as described below. Pipe incubators will be used to simulate in stream incubation. These incubators will be constructed from 30 cm sections of 16 cm polyvinylchloride pipe. The pipe will be stood on end, sealed, and fitted with a water intake at the bottom. The pipe will then be filled with appropriately treated gravel. This design allows water to upwell through the gravel and out an outlet fitting at the top of the incubation pipe.

Fertilized eggs will be laid on top of the gravel to incubate. Upon hatching, the alevins will be permitted to burrow into the substrate. Eggs will be exposed to saltwater for 4 hour intervals every 12 hours during incubation to simulate intertidal incubation. Emerging fry will be removed to saltwater netpens.

b. Culture to maturity in Component C

All fry will be raised to maturity using standard hatchery procedures. They will be fed a commercial diet, vaccinated against *Vibrio anguillarum*, and treated with antibiotics as needed. Maturing fish will be fed a commercially available brood diet.

The remaining treatment groups in study 1 (2 oil concentration levels will be eliminated at emergence) will be reared in separate netpens until they are 6 g at which time they will be tagged with passively induced transponders (PIT tags). PIT tags provide individual fish with unique identification codes which can be interrogated without harming the fish. Approximately 300 fish from each treatment group will be tagged. Each set of tagged fish will be split into two equal size groups and placed into one of two netpens. Each netpen will contain fish from all treatment groups. One netpen will be kept at LPW while the other will be maintained 5 km to the north at Osprey Bay to ensure survival of the experiment. Fish will be counted and measured for length and weight each fall and spring to establish survival and growth rates during the experiment.

c. Flow Cytometry

Flow cytometry will be used to analyze the DNA content of whole embryos and individual tissues (e.g., liver, kidney, gonad, gill) as called

for at the appropriate test points in experiments performed under components B and C (e.g., Kocan and Powell 1985, McBee and Bickham 1988). All analyses will be made on fresh tissues prepared no more than 24 hours prior to flow cytometry analysis.

Suspensions of stained nuclei will be produced for DNA content analysis using nuclear isolation medium (NIM) (0.9% NaCl, 10 mM Tris, 2 mM $CaCl_2$, 2 mM $MgCl_2$, 0.1% Noniodet P-40, 106 mM $MgSO_4$, and 1 mg/100ml DAPI (4,6-diamidino-2-phenylindole dihydrochloride)) (e.g., Thornthwaite et al., 1980, and Seeb et al. 1988). Embryos and tissue samples will be placed into 1.5 ml microcentrifuge tubes containing 1 ml of NIM. Samples will be cut 3-4 times with scissors, allowed to incubate at 2-3 ^{oC} for 15 min, and filtered through a 70 μm nitex nylon filter to remove debris and clumped cells. Stained nuclear suspensions will be refrigerated overnight for flow cytometry analysis the following day. Samples will be analyzed using a PARTEC PAS II flow cytometer with optical filters for DAPI excitation and ACQCYTE data acquisition and MULTICYCLE DNA analysis software (Phoenix Flow Systems Inc. 1991) following the methods of Lamb et al. (1991).

d. Randomization of Gamete Pools

The randomized embryo pool used in Components B and C will be created by (1) spawning the females into a common container, (2) randomizing the eggs within the container, (3) dividing the eggs into aliquots, (4) fertilizing each aliquot with an individual male, and (5) again recombining all fertilized aliquots into a composite embryo pool. The aliquots used in the experiment will then be randomly drawn from the composite embryo pool.

4. Alternatives

Several short-term cytogenetic assays exist in addition to flow cytometry for evaluating the potential genotoxic effects of chemicals and compounds. These methods are designed to identify four general types of genetic changes: DNA microlesions and macrolesions, primary DNA damage, and morphologic changes in target cells (Brusick 1987). Of these, assays for the detection of DNA macrolesions and primary DNA damage are generally accepted as being standard for identifying genotoxic agents.

The recently developed sister chromatid exchange (SCE) measurement has become a common technique for cytogenetic assays of primary DNA damage (Hsu 1982). The micronucleus test (MNT) and anaphase aberration (AA) counts have become standard measures of DNA macrolesions (Evans 1976). These techniques are capable of detecting and quantifying subtle chromosome changes. However, isolation of metaphase and anaphase chromosomes for visual scoring is required.

The techniques for chromosome isolation can be technically involved and are not standardized between laboratories. Visual scoring of the desired endpoints can be somewhat subjective. The time involved for isolating and scoring chromosomes limits sample sizes to 100-200 cells which reduces statistical accuracy and precision.

The need for increased sample sizes cannot be solved by conventional cytogenetic techniques and has been the motivating force behind development of flow cytometry for cytogenetic testing (Deaven 1982). Flow cytometry allows analysis of large numbers of cells (10^3-10^5) greatly increasing statistical power. Sample preparation and measurement are reproducible, accurate, and can be completed in several minutes versus several hours for visual microscopic scoring (Otto and Oldiges 1980). Flow cytometry has been demonstrated to be as sensitive as the AA test for detecting structural chromosome aberrations in dividing cells (Kocan and Powell 1985) and therefore provides a useful technique for *in vivo* analysis of DNA macrolesions.

Flow cytometry analysis provides a more comprehensive measure of genetic damage than traditional cytogenetic techniques and can demonstrate the fate of chromosome/chromatid damage in subsequent generations of cells. For example, comparisons of G_1 DNA content, G_1 coefficient of variation, or presence of aneuploid cell populations can be used to test for the presence of chromosome damage (Cram and Lehman 1977; Bickham et al. 1988). Changes in the proportions of cells within the cell cycle may reflect a cytotoxic effect of a substance (Fertig and Miltenburger 1989). Once flow cytometry has demonstrated the presence of genetic damage it may be useful to apply traditional cytogenetic techniques on a more limited scale to identify specifically what type of damage has occurred.

5. Location

Component A: Spring fry sampling will be conducted on 48 streams (Figure 1). These will include the 25 streams in the ongoing ADFG preemergent index program plus 23 additional streams. The additional streams are located in Central and Southwest PWS where most of the oiling occurred. Egg sampling will be conducted in the fall on 31 of the 48 streams sampled for preemergent fry (Figure 2). Streams included in the fry sampling program but not in the egg program are traditional fry sampling streams located on the eastern and northern shore of PWS. These streams are outside the area studied for oil impact effects.

Component B: The experiment designed to evaluate the effects of environment on egg mortality will collect gametes from streams in Western Prince William Sound and incubate the resulting embryos at the Armin F. Koernig hatchery in Southwestern Prince William Sound (Figure 3).

Component C: The experiments designed to test the effects of oiled incubation substrate on gamete viability will be performed at the National Marine Fisheries Service Laboratory at Little Port Walter, Baranof Island, southeastern Alaska (Figure 4).

All work dealing with the assessment of genetic damage will be performed at the Regional Fish and Game Office in Anchorage.

6. Benefits

Pink salmon are the most numerous of the salmon species which spawn in PWS. They act as a vital transport mechanism for energy and nutrients from the high seas to the nearshore and upland areas adjacent to over one thousand streams around the perimeter of the sound. Furthermore, wild pink salmon are the cornerstone of the fisheries industry which dominates the PWS economy. Sustained production of wild pink salmon populations is essential to the health and maintenance of many other fish, bird, marine mammal, terrestrial mammal, and human populations which reside in PWS.

Results of the Run Reconstruction Project (NRDA F/S Study 28) indicate that adult returns to the south western portion of the sound alone may still be hundreds of thousands of fish lower than expected annually as a result of chronic damage from increased egg mortalities in oiled streams and reduced growth and survival among juveniles rearing in oiled portions of the sound. This level of chronic population level damage may result in severe overexploitation and drastic reductions in spawning escapement to affected streams. Ultimately, in the absence of corrective measures, these populations may be in danger of extinction. This project will document the persistence of damage and alert fisheries managers, as well as restoration planners, to the needs for protection and rehabilitation of oil affected populations. Marine, freshwater, and upland ecosystems in and around affected streams will benefit as will local fisheries which ultimately depend upon the health of wild pink salmon populations.

7. Technical Support

Biometrician will ensure the study design will provide a reasonable chance of reaching a defendable conclusion.

Flow cytometry specialist will ensure proper tissue collection and preparation procedures, operate the flow cytometer, and assist in histogram interpretation and analysis.

A chemist is required to establish a dosing protocol, determine hydrocarbon concentrations, and evaluate results of hydrocarbon analysis.

8. Contracts

Contracts will be required for histopathological and mixed-function oxidase work. It is essential that the results of this controlled experimentation be consistent with the results gathered under NRDA.

9. Mitigation Measures

No mitigation measures are required for this project.

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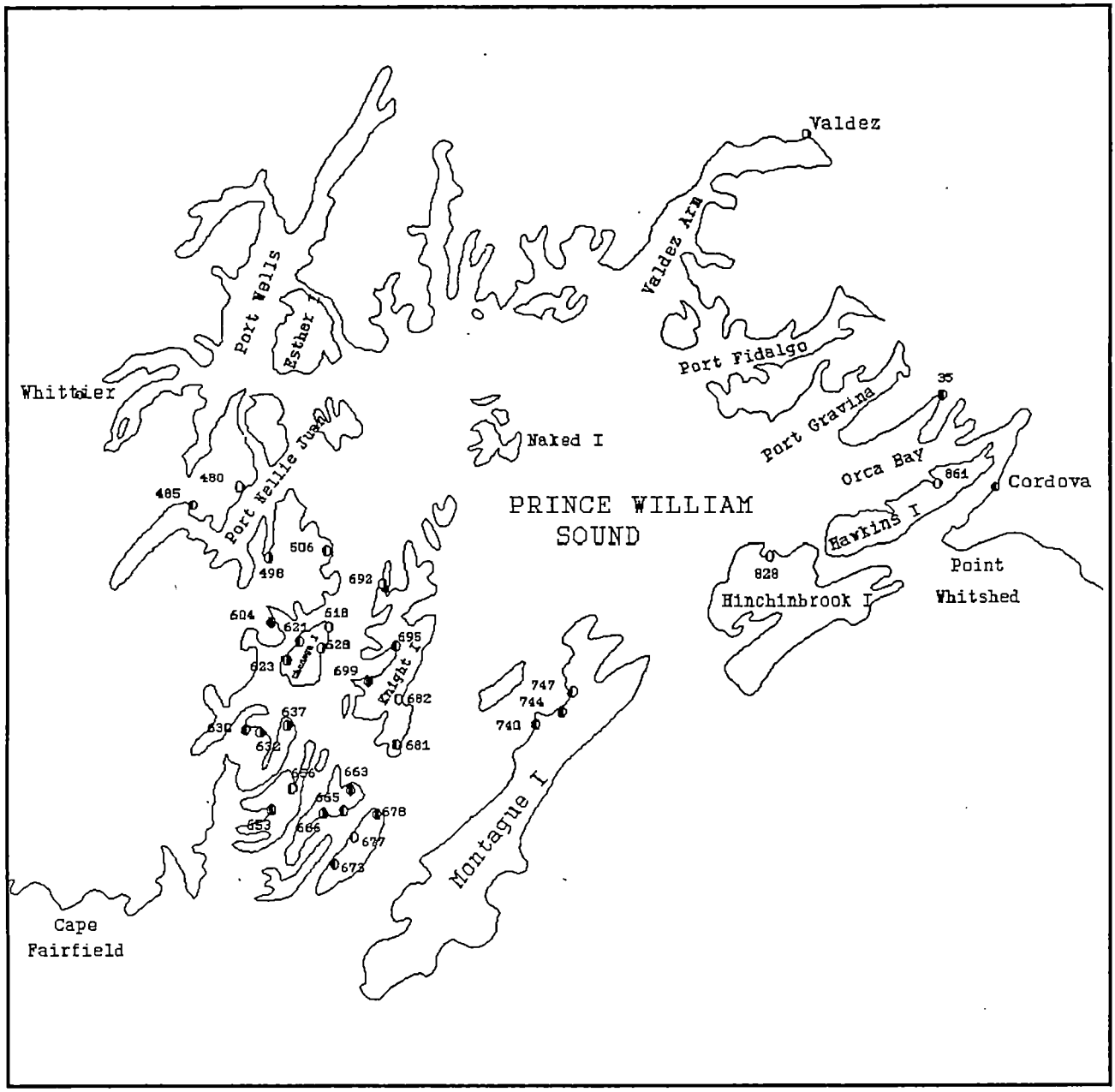


Figure 1. Location of streams to be sampled for egg deposition.

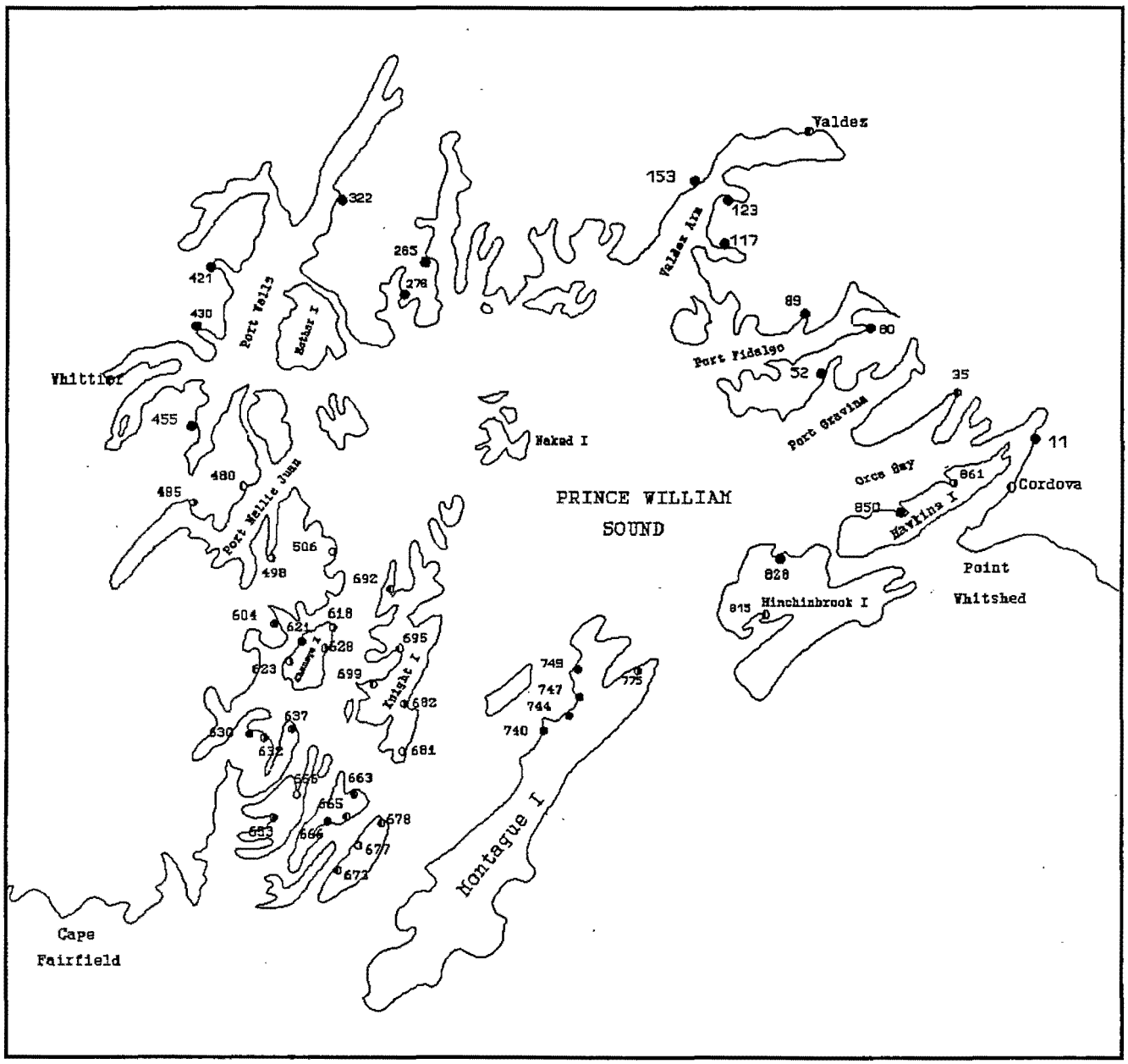


Figure 2. Locations of streams to be sampled for pre-emergent fry.

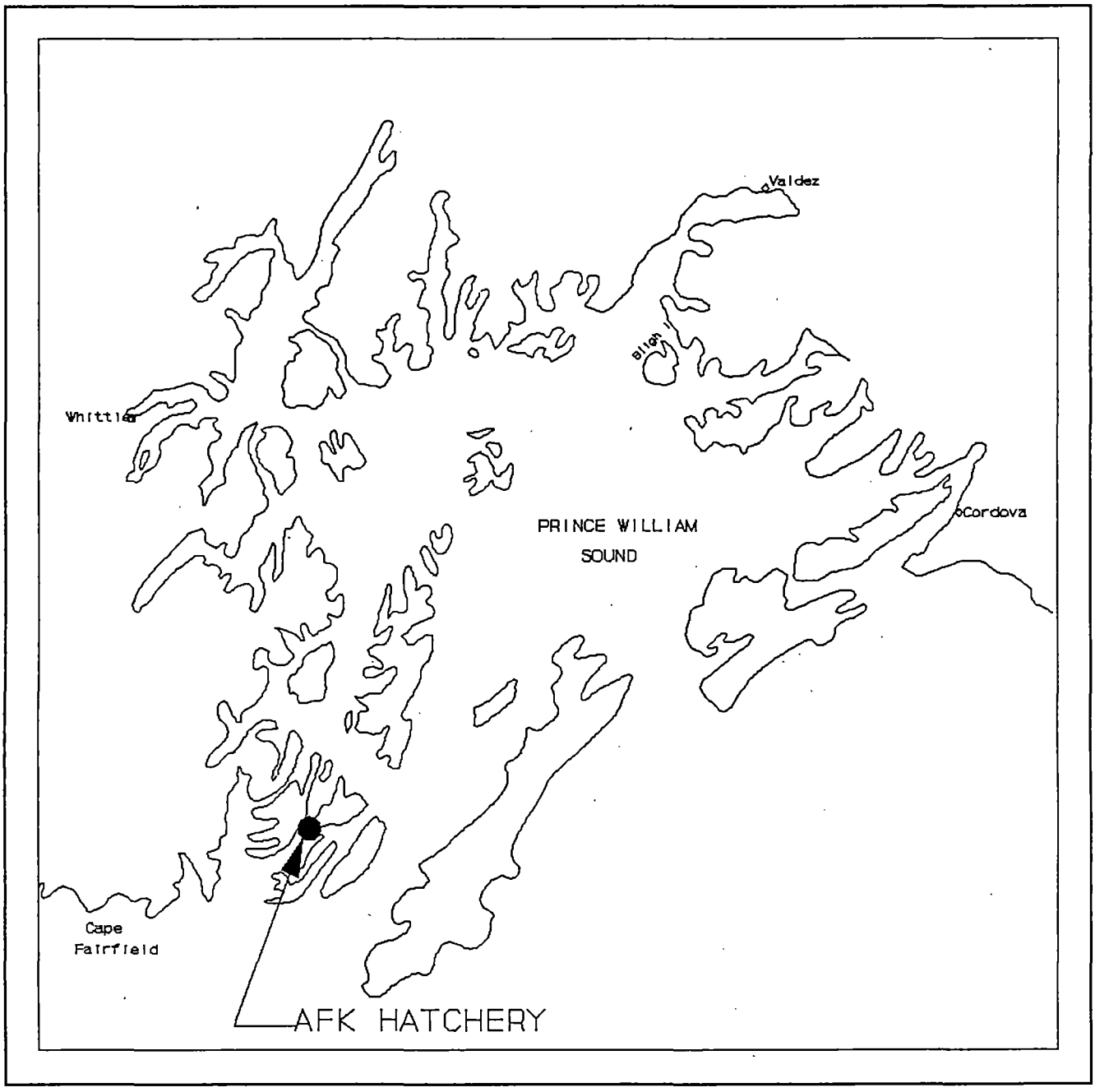


Figure 3. Location of the Prince William Sound Aquaculture, Armin F. Koernig (AFK) Hatchery where eggs will be incubated for Component B of this project.

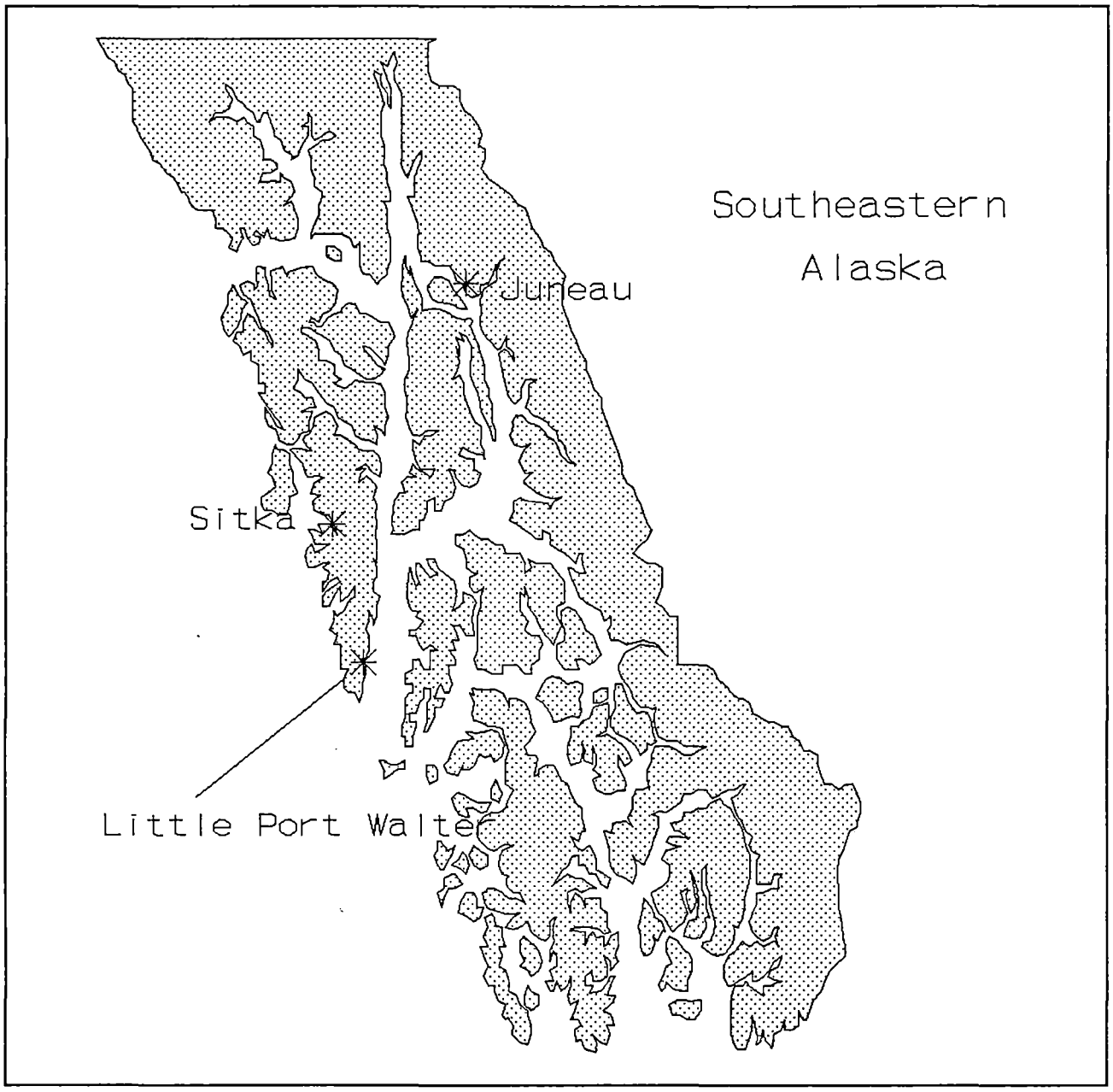


Figure 4. Location of the National Marine Fisheries Service, Little Port Walter facility in southeastern Alaska where Component C Studies will be performed.

C. SCHEDULES AND PLANNING

COMPONENT A - Recovery Monitoring of Injury to Pink Salmon Eggs and Preemergent Fry in Prince William Sound

Dates	Activity
15 Mar - 10 Apr 1993	Preemergent fry sampling on 48 streams.
1 May - 1 Sep 1993	Analysis and preliminary summarization of 1992 preemergent data.
15 Sep - 15 Oct 1993	Egg deposition sampling.
30 Oct - 15 Dec 1993	Analysis of egg data and annual completion report for egg and fry data.

COMPONENT B - Laboratory Verification of Injury to Pink Salmon Eggs and Preemergent Fry in Prince William Sound

Dates	Activity
1 Aug - 15 Aug 1993	Preparation for Experiment
15 Aug - 30 Aug 1993	Collect Gametes and make crosses from 16 streams
30 Aug - 15 Nov 1993	Monitor incubators and collect data
15 Nov 1993 - 30 Jan 1994	analyze data and prepare annual completion report

COMPONENT C - Laboratory Verification of Injury to Pink Salmon Eggs and Preemergent Fry in Prince William Sound

SAMPLE PERIOD	1992 BROOD YEAR	1993 BROOD YEAR
15 Mar - 15 Jun 93	Emergence sampling	N/A
15 Jun - 15 Sep 93	Analyze incubation data, PIT tag, prepare interim report	Set up incubators, spawn P1.
15 Sep 93 - 15 Mar 94	Continue rearing P1	Collect incubation, emergence data from P1
15 Mar - 15 Aug 94	Rear P1 to maturity, and spawn F1, prepare interim report	Analyze P1 incubation data, PIT tag P1
15 Aug 94 - 15 Mar 95	Incubate F1, collect gamete viability data	Continue rearing P1
15 Mar - 15 Aug 95	Analyze data set for brood year, prepare interim report	Rear P1 to maturity and spawn F1.
15 Aug 95 - 15 Mar 96	N/A	Incubate F1, collect gamete viability data
15 Mar - 15 Aug 96	N/A	Analyze data set for brood year, prepare final report

D. ENVIRONMENTAL COMPLIANCE/PERMIT/COORDINATION STATUS

Egg and preemergent fry sampling will require an ADFG Title 16 permit and an ADFG biological collections permit. Transport of wild gametes to the PWSAC hatchery on Evans Island, PWS will require an ADFG Fish Transport Permit for each stock and a permit Alteration may be required to rear and incubate the wild eggs at the hatchery.

E. PERFORMANCE MONITORING

This will be a joint project between ADFG and NMFS. ADFG will be the lead agency for overall program management and genetic damage determinations. ADFG will be responsible for data collection, gamete fertilization, and incubation in Components A and B. NMFS will be responsible for the oil exposures, chemistries, fish culture, and hydrocarbon end points in Component C. Both agencies will have statistical analyses responsibilities, particularly with the experimental designs. Both agencies will have joint responsibilities for meshing the lab and field results to reach a conclusion in the study.

For ADFG, principal investigator Sharr (Fisheries Biologist III) and his assistant Sharp (Fisheries Biologist II) will provide field results to date, help design the laboratory experiment, and insure that laboratory conditions and treatments simulate those observed in wild streams. Principal investigator Seeb (Principal Geneticist) will help design and provide genetics oversight for the laboratory rearing of wild embryos as well as the flow cytometry portions of the experiment. He will also supervise the collection and analysis of flow cytometry samples. Consulting biometrician Bue (Biometrician II) will conduct the experimental design and provide statistical oversight for the project. Sharr, Seeb, and Bue will cooperate in the data analysis and writing of project reports.

Most methods to be incorporated in the ADFG portions of this project have been used before, some for many years, all are now standardized and well documented in operational plans. ADFG project personnel including most of the project technicians have participated in sampling activities and laboratory rearing activities associated with Component A and portions of Component B. Persons supervising field sampling in Component A receive annual training at one or more area hatcheries with respect to speciating eggs and fry and making live and dead determinations. The principal geneticist and his staff have extensive laboratory fish culture experience and will be present at all times during the rearing experiment at AFK Hatchery. One member of the permanent Cordova ADFG staff has been an assistant principal investigator for this project in the past and could be called upon to temporarily resume those duties should the need arise. Additionally, several other members of the Cordova ADFG staff have participated in field sampling and aquaculture portions of the project in 1992 and prior years and could be called upon incase of personnel shortages.

For NMFS, overall supervision of this project will rest with NMFS GS-14 physiologist, principal investigator (Rice). The PI will be responsible for monitoring the progress of the project, provide quality control for the design and implementation, oversee the budget and review all interpretations in the products. In addition, the PI will supervise two primary task leaders: a GS-11 biologist (Heintz) assigned to LPW, and a GS-13 chemist (Short). The GS-11 biologist will direct field sampling and data collection, fish culture, and perform statistical analysis of the data. A GS-9 biologist will assist the GS-11 biologist in setting up the experiment and collecting data. Technicians will be required to perform detailed fish culture such as incubator maintenance and fish feeding. The GS-13 chemist is responsible for developing dosing techniques and analyzing samples for the presence of hydrocarbons, and interpreting the hydrocarbon analyses.

Data will be recorded in an Rbase database. There will be several data tables in the database, including "incubation", "rearing" and "spawning". The incubation table will include incubator number, number eggs seeded into incubator, and for each developmental stage: water chemistry, hydrocarbon concentrations, MFO presence, coefficient of variation for cellular DNA content, and number surviving to emergence. The key field that links the "rearing" table with the "incubation" table will be incubator number. The "rearing" table will also include PIT tag code, length and weight at each sample point. The "spawning" table will include the first generation incubator

number, second generation incubator number, second generation fertilization rate, first generation fecundity, survival to eyeing, hatching, and emergence.

Graphical summaries of data will be made using LOTUS 123, and statistical analysis will use SAS and MINITAB. All raw and summarized data and reports are stored as hard copy and electronically on diskettes in two separate locations at the NMFS Auke Bay Lab. Quality assurance and documentation of all databases structures will be reviewed by FS 30 (Database Management) personnel in Juneau and duplicates of all database documentation will be maintained in their files.

Biological samples for hydrocarbon, MFO, and DNA analyses will be clearly labelled both on the inside and outside of the container with indelible ink. Samples will be stored in freezers at the NMFS Auke Bay Lab.

Field activities will continue until injury to salmon eggs and fry can no longer be detected. Until field activities cease, the main product from this project will be an annual report which summarizes the results of the current-year egg and preemergent fry data. The most significant information on damages demonstrated in 1989 through 1991 will be written up as a close out report for the NRDA Study and will also be published in a juried journal. When restoration field work is complete, a follow up journal article may be appropriate if there have been findings which add significantly to or alter results reported from the NRDA study.

F. PERSONNEL QUALIFICATIONS

Fisheries Biologist III - Samuel Sharr

Mr. Sharr received a Bachelor of Science degree in biology from the University of Washington in 1968. He has been a research biologist for ADFG since 1979 and has worked on PWS salmon and herring since 1981. He assumed his present position as the ADFG, Division of Commercial Fisheries, Biologist III, PWS Area Finfish Research Project Leader in 1986. In this capacity, Mr. Sharr oversees all the salmon and herring research conducted by the Division of Commercial Fisheries in PWS. His involvement with the PWS salmon escapement aerial survey program dates from the early 1980's. Mr.Sharr has supervised a total re-edit of the historic aerial and ground survey data and designed a new RBASE data base for inseason escapement analyses. Mr. Sharr wrote the original operational plans for NRDA F/S Studies 1,2 and, 3 and has been the Principal Investigator for those projects since their inception.

Principal Geneticist - James E. Seeb

Jim Seeb earned a B.S. in Biology (1974) from the University of Puget Sound, an M.S. in Fisheries (1982) and a Ph.D. in Fisheries (1987) from the University of Washington. Jim has worked as a Fish Biologist for the Washington Department of Fisheries (1978-1980) and Pacific Fisheries Research (1980-1982), as a Graduate Research Assistant at the University of Washington (1982-1986), a Research Assistant Professor at the

University of Idaho (1987-1988), and as an Assistant Professor at Southern Illinois University (1988-1990). Presently, Jim is the Principal Geneticist for FRED Division of the Alaska Department of Fish and Game and has overall responsibility for fisheries genetic issues throughout Alaska. Dr. Seeb has published extensively in the Fisheries and Genetics Literature. He has worked with many fish species on numerous genetic topics including but not limited to genetic marking and its use to assess stock dynamics and management programs, genetic variation and postglacial dispersal of populations, and the use of genetic structure in the enforcement of fishing regulations, and the measurement of DNA content using flow cytometry.

GS-14 Physiologist - Stanley D. Rice

Received BA (1966) and MA (1968) in Biology from Chico State University, and Ph. D. (1971) in Comparative Physiology from Kent State University. Employed at Auke Bay Fisheries Laboratory since 1971 as a research physiologist, task leader, and Habitat Program Manager since 1986. Rice has researched oil effects problems since 1971, and has published over 70 papers, including over 50 on oil effects. Studies have ranged from field to lab tests, behavioral to physiological to biochemical studies, from salmonids to invertebrates to larvae to meiofauna. Rice has conducted and managed soft funded projects since 1974, including the Auke Bay Laboratory *Exxon Valdez* damage assessment studies since 1989. Activities since the oil spill have included leadership and management of up to 10 damage assessment projects, field work in PWS, direct research effort in some studies, establishment of state of the art chem labs and analyses in response to the spill, quality assurance procedures in biological-chemical-statistical analyses, establishment of hydrocarbon database management, servicing principal investigators and program managers in NOAA and other agencies with reviews and interpretations, provided direct input into agency decisions, interacted with other agencies in various ways (logistics coordination, critique experimental designs, interpret observations, etc.).

Biometrician II - Brian G. Bue

Brian Bue has a Bachelor of Science in Biology and a Bachelor of Science in Fisheries from the University of Alaska, Fairbanks. He also possesses a Masters degree in Fisheries with an emphasis on quantitative studies from the University of Alaska, Fairbanks. Brian has worked with the Alaska Department of Fish and Game from 1974 through present in many capacities. He has worked as a consulting biometrician on oil spill damage assessment projects since the first days of the *Exxon Valdez* spill.

GS-13 Chemist - Jeffrey Short

Mr. Short is an analytical chemist at the Auke Bay Laboratory (ABL), and leads the hydrocarbon analysis facility at ABL, which is one of the two laboratories analyzing *Exxon Valdez* NRDA hydrocarbon samples. Mr. Short holds a B.S. in biochemistry and an M.S. in physical chemistry from the University of California. He is principal investigator (PI) of NRDA project Subtidal Study #3, and was among the first scientists to collect samples 7 days after the spill: he was awarded both individual and

unit citations from NOAA for these efforts. Mr. Short has conducted extensive research on the effects of Alaskan crude oils to Alaskan marine biota over a period of 10 years prior to the *Exxon Valdez* oil spill.

GS-11 Fisheries Biologist (Research) - Ron A. Heintz

Ron Heintz has a Bachelor of Science in Ecology from the University of Illinois (1979), and a Masters degree in Fisheries from the University of Alaska, Fairbanks (1987). He has worked for the National Marine Fisheries Service since 1985 concentrating his efforts on salmon enhancement research. He is the principal investigator and co-investigator on several salmon genetics projects.

Fisheries Biologist II - Gary Miller

Gary Miller is the flow cytometry specialist for the Alaska Department of Fish and Game Genetics Laboratory in Anchorage. Gary has a Bachelor of Science in Fisheries Biology from the University of Washington, a M.S. in Zoology from Southern Illinois University - Carbondale, and is currently pursuing his Ph.D. from the University of Washington. He has worked periodically for the Alaska Department of Fish and Game since 1981. He has a strong background in genetics and developmental biology and has conducted research and co-authored projects in hybridization, polyploid induction, allozyme expression, and growth performance of triploid salmonids and other fishes. He has extensive laboratory experience with techniques including flow cytometry, protein starch gel electrophoresis, protein and molecular marker analysis, and fluorescent antibody testing of pathogens.

G. BUDGET

Personnel	$ 201.0
Travel	9.6
Contractual	65.4
Commodities	30.5
Equipagement	2.1
Capital Outlay	0.0
Subtotal	308.6
General Administration	34.7
Project Total	343.3

ADDITIONAL FUNDING

An additional 30.0 K will be provided by the Alaska Department of Fish and Game through normal operating funds. This amount is budgeted to cover the normal preemergent fry sampling program which has been conducted annually since 1961.

Project Description: This project continues to monitor pink salmon egg to pre-emergent fry survival in oiled and unoiled streams, it examines the effects of stream characteristics unrelated to oiling which may partially or completely explain mortality differences observed, and it provides laboratory verification that field results observed for eggs in 1989, 1990, 1991 are consistent lethal and persistent genetic effects of oil deposited in intertidal pink salmon spawning habitat. The number for this project in 1992 was R 60C.

Budget Category	Approved 1-Oct-92 28-Feb-93	Proposed* 1-Mar-93 30-Sep-93	Total FY 93	** FY 94	FY 95	FY 96	FY 97	Sum FY 98 & Beyond
Personnel	$134.0	$345.3	$479.3	$434.1	$408.8	$271.7	$0.0	$0.0
Travel	$27.0	$21.6	$48.6	$20.2	$11.0	$6.8	$0.0	$0.0
Contractual	$6.5	$194.0	$200.5	$176.6	$54.1	$38.1	$0.0	$0.0
Commodities	$0.0	$46.3	$46.3	$50.1	$30.5	$10.0	$0.0	$0.0
Equipment	$81.0	$18.3	$99.3	$15.3	$0.7	$0.0	$0.0	$0.0
Capital Outlay	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Sub-total	$248.5	$625.5	$874.0	$696.3	$505.1	$326.6	$0.0	$0.0
General Administration	$15.9	$60.5	$76.4	$68.7	$53.1	$32.9	$0.0	$0.0
Project Total	$264.4	$686.0	$950.4	$765.0	$558.2	$359.5	$0.0	$0.0
Full-Time Equivalents (FTE)	5.2	5.8	9.7	10.1	7.4	2.7	0.0	0.0

Amounts are shown in thousands of dollars

Budget Year Proposed Personnel:

Position	Months Budgeted	Cost	Comment
For details, see 3A & 3B forms			

* FY 93 is a transition year from the previously used oil year to the federal fiscal year.

** If not funded in FY 94, $115.5K is needed for data analyses and report preparation.

26-Mar-93

Project Number: 93003
Project Title: Salmon Egg to Pre-Emergent Fry Survival
Agency: AK Dept. of Fish & Game

FORM 2A PROJECT DETAIL

Project Description: The ADF&G portion of this project continues to monitor pink salmon egg to pre-emergent fry survival in oiled and unoiled streams, and it examines the effects of stream characteristics unrelated to oiling which may partially or completely explain mortality differences observed. The ADF&G genetics lab processes some samples directly and receives others from the NMFS portion of this study to provide laboratory verification that field results observed for eggs in 1989, 1990, 1991 are consistent lethal and persistent genetic effects of oil. The number for this project in 1992 was R 60C.

Budget Category	Approved 1-Oct-92 28-Feb-93	Proposed* 1-Mar-93 30-Sep-93	Total FY 93	** FY 94	FY 95	FY 96	FY 97	Sum FY 98 & Beyond
Personnel	$104.8	$201.0	$305.8	$254.8	$220.4	$147.9	$147.9	$591.6
Travel	$19.0	$9.6	$28.6	$11.0	$4.0	$3.8	$3.8	$15.2
Contractual	$3.5	$65.4	$68.9	$46.1	$54.1	$38.1	$38.1	$152.4
Commodities	$0.0	$30.5	$30.5	$22.5	$14.5	$10.0	$10.0	$40.0
Equipment	$67.0	$2.1	$69.1	$0.0	$0.4	$0.0	$0.4	$1.6
Capital Outlay	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Sub-total	$194.3	$308.6	$502.9	$334.4	$293.4	$199.8	$200.2	$800.8
General Administration	$15.9	$34.7	$50.6	$41.3	$36.9	$24.9	$24.9	$98.4
Project Total	$210.2	$343.3	$553.5	$375.7	$330.3	$224.7	$225.1	$899.2
Full-Time Equivalents (FTE)	4.7	2.7	6.9	6.6	5.4	2.7	2.7	10.8

Amounts shown are in thousands of dollars

Budget Year Proposed Personnel:

Position	Months Budgeted	Cost
1 Fisheries Biologist III	3.0	$20.0
1 Biometrician II	3.5	$21.5
1 Biometrician I	2.0	$9.5
2 Fisheries Biologist II	13.0	$45.1
2 Fisheries Biologist I	10.1	$52.0
1 Fish & Wildlife Technician III	2.2	$11.0
2 Fish & Wildlife Technician II	4.4	$22.0
1 Program Manager	1.0	$7.0
1 Analyst Programmer IV	1.1	$6.7
1 Analyst Programmer II	0.7	$3.1
1 Publication Specialist II	0.7	$3.1

Comment

* FY 93 is a transition year from the previously used oil fiscal year to the federal fiscal year. This project also includes proposed funding for January and February, 1993.

** If not funded in FY 94, $60.0K is needed for data analyses and report preparation.

26-Mar-93

Project Number: 93003
Project Title: Salmon Egg to Pre-Emergent Fry Survival
Sub-Project: Field Study and Genetics Lab
Agency: AK Dept. of Fish & Game

FORM 3A SUB-PROJECT DETAIL

1993

		Proposed
Travel:		
	Cordova and Anchorage (9 trips)	$6.5
	Cordova - Juneau (4 trips)	$3.1
	Per diem is included.	
Contractual:		
	Vessel charter for field sampling	$30.0
	Air charter for sampling and access to hatchery	$26.0
	Contracts for genetic analyses, hatchery space rental, flow cytometer maintanence	$9.4
Commodities:		
	Includes field sampling supplies ($8.0), some building materials for the incubator set up ($10.5), and laboratory supplies for genetic work ($4.0).	$30.5
Equipment:		
	Outboard motor and fry pump	$2.1

Project Description: The NOAA/NMFS portion of the egg mortality study provides laboratory verification that field results observed for eggs in 1989, 1990, and 1991 are consistent with immediate lethal effects as well as persistent genetic damage caused by oil deposited in intertidal pink spawning habitat.

Budget Category	Approved 1-Oct-92 28-Feb-93	Proposed* 1-Mar-93 30-Sep-93	Total FY 93	** FY 94	FY 95	FY 96	FY 97	Sum FY 98 & Beyond
Personnel	$29.2	$144.3	$173.5	$179.3	$188.4	$123.8		
Travel	$8.0	$12.0	$20.0	$9.2	$7.0	$3.0		
Contractual	$3.0	$128.6	$131.6	$130.5	$0.0			
Commodities	$0.0	$15.8	$15.8	$27.6	$16.0			
Equipment	$14.0	$16.2	$30.2	$15.3	$0.3			
Capital Outlay	$0.0	$0.0	$0.0	$0.0	$0.0			
Sub-total	$54.2	$316.9	$371.1	$361.9	211.7	$126.8	$0.0	$0.0
General Administration	$0.0	$25.8	$25.8	$27.4	$16.2	$8.0	$0.0	
Project Total	$54.2	$342.7	$396.9	$389.3	$227.9	$134.8	$0.0	$0.0
Full-time Equivalents (FTE)	0.5	3.1	3.6	3.5	2.0			

Amounts are shown in thousands of dollars.

Budget Year Proposed Personnel:

Position	Months Budgeted	Cost	$144.3	Comment
P. I. (Physiologist)-GS14	1.5	$12.4		
P. I. (Biologist)-GS11	7.0	$32.2	Contribution by NOAA/ABL for project design, hydrocarbon	
Biologist-GS9	7.0	$26.6	interpretation, etc. (P. I. GS14 and Chemist GS13 at 1	
(2) Technician-GS7	21.0	$67.2	month each) = $14.0K.	
NMFS Prog. Man. GS12	1.2	$5.9		

* FY 93 is a transition year from the previously used oil fiscal year to the federal fiscal year. This project also includes proposed funding for January and February, 1993. ** Total shown in FY94 to closeout work started in FY93 is $55.5.

26-Mar-93

1993

Project Number: 93003
Project Title: Salmon Egg to Fry Survival
Sub-Project: Experimental Verification
Agency: National Oceanic & Atmospheric Admin.

FORM 3A SUB-PROJECT DETAIL

		Proposed
Travel:	Anticipated travel among Cordova, Anchorage, and Juneau for inter and intra agency meetings among P. I. s, biometrics staff, and peer reviewers.	$12.0
Contractual:	Aircraft Charter	$12.6
	Hydrocarbon (GC/MS) spectrophotofluorometric analyses	$116.0
Commodities:	Building materials for incubation and rearing areas,	$3.8
	Fish food, fish vaccine and fish antibiotics	$6.0
	Laboratory and office supplies	$5.0
	Specialized software	$1.0
Equipment:	PIT tags for segregating fish from different treatment groups which are reared in a common pen.	$16.2

93006

A. Cover Page

1. Title: Site Specific Archeological Restoration

2. Project ID number: 93-006

3. Project type: Restoration management actions, archeology

4. Project leaders: Doug Reger, State of Alaska, Department of Natural Resources; John Mattson, U.S. Department of Agriculture, Forest Service; Ted Birkedal, U.S. Department of the Interior, National Park Service; Chuck Diters, U.S. Department of the Interior, Fish and Wildlife Service.

5. Lead agency: U.S. Department of the Interior, National Park Service (NPS)

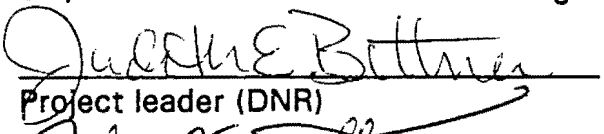
Cooperating agencies: Alaska Department of Natural Resources (DNR); U.S. Department of Agriculture, Forest Service (USFS); U.S Department of the Interior, Fish and Wildlife Service (USFWS).

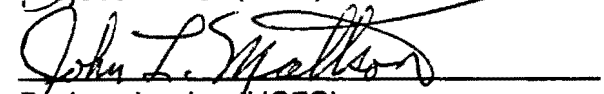
6. Cost of project: $260,100

7. Project start-up date: June 14, 1993

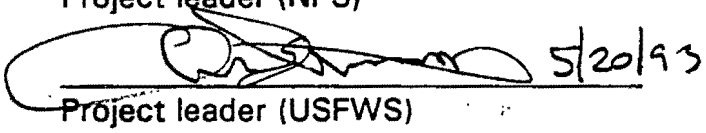
Project completion date: May 31, 1994

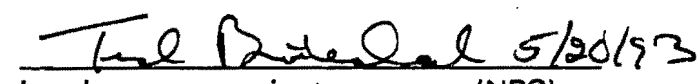
8. Geographic area of project: Prince William Sound, Cook Inlet/Kenai Peninsula, and Kodiak/Alaska Peninsula regions

9. 
Project leader (DNR)


Project leader (USFS)


Project leader (NPS)


Project leader (USFWS)

10. 
Lead agency project manager (NPS)

B. Introduction

A two-phase archeological restoration assessment of all existing and accessible oil spill response documentation has identified 24 known archeological sites as having been injured by oil contamination, clean-up activities, and/or vandalism as a result of the *Exxon Valdez* oil spill and to still be in need of appropriate restoration activities (Jesperson and Griffin 1992; McAllister n.d.). Of these three identified sources, cleanup activities and vandalism appear to have resulted in the most clear-cut cases of injury to archeological sites (e.g. loss or destruction of diagnostic artifacts, illegal excavation, disturbance of human remains). The effects of oiling are more problematical, but the available evidence indicates that oil penetration impairs the ability of radiocarbon samples to yield accurate dates and may alter archeologically-relevant soil chemistry.

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

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

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

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

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

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

These numbers represent the most conservative, statistically-derived estimate of injury endorsed by the "McAllister Panel." The next-lowest estimates put forward by Dr. Al Dekin's injury study are 338 and 155, respectively; statistically valid estimates, but based on what appear to be less valid assumptions about the nature and distribution of injury (Dekin, et al. 1992; McAllister n.d.).

The goal of this project is to ameliorate injury to archeological sites that were impacted by oiling, oil spill cleanup, or vandalism as a direct result of the *Exxon Valdez* oil spill event. The work planned for 1993 will begin this process.

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

C. Project Description (Phase I, 1993)

1. Resources and/or Services: The purpose of this project is to conduct site-specific restoration activities at injured archeological sites on federal and state lands, following basic Archaeological Resources Protection Act (PL 96-95, 43 CFR 7) procedures, the Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation, and standard archeological practices (see Appendix 1 for list of target sites). None of the planned work duplicates previous studies. The planned work is based on a careful review of the results of earlier injury investigations.

2. Objectives: General objectives of this restoration project include full injury assessment, emergency restoration, and establishment of monitoring controls and collection of samples. Each of the 24 archeological sites has previously been characterized as to the particular restoration activities necessary at that site (see Appendix 1).

The first step in this project will be to conduct site-specific restoration assessments at sites with documented injury, but where there is insufficient detail upon which to determine appropriate treatment (19 sites). The second step will be to carry out the indicated restorative action—either physical repair and/or data recovery. In many cases, the anticipated restoration treatments will be limited in scope and difficulty and the necessary restorative actions will be taken immediately upon completion of the assessment. A few may require carefully-planned return visits. This work will be carried out in a two-year split (1993 and 1994) to permit sufficient time for planning larger and more complex restorative measures and to take advantage of corrective feedback from the first year of the project. A total of 17 sites will be visited in 1993; the remainder will be deferred until the 1994 field season.

A concurrent restoration assessment, coordinated with the first, will address long-term injury resulting from oiling. Ten known sites that have been exposed to moderate to heavy oiling will be monitored for a period of 10 years to determine the effect of oil on radiocarbon samples, archeological soil chemistry, and protective site vegetation. Research assessments of this type are specifically authorized by Section 14(c) of ARPA when the nature and level of injury to

arc ogical sites remains uncertain or problematic. The results will alert future res..chers to any skewing effect the oil may have on archeological soil or radiocarbon specimens and make land managers aware of any residual threats to archeological sites (e.g. alterations or reductions in protective vegetative cover). The 10 sites selected for monitoring include 5 from the list of 19 sites with evidence of injury attributable to cleanup or vandalism and 5 additional sites that have been oiled, but presently have no documentation of other injury. These 5 sites bring the total number of known injured sites to 24, the number mentioned at the beginning of this proposal.

The results of all project work will be published in both technical and popular formats. At this time, no publications are planned for 1993 or 1994. If approved by the Trustees, publication of the Phase I report would occur in 1995.

3. Methods (Phase I, 1993): Three categories of injury restoration have been developed: (1) adequate investigation, assessment, and documentation of the original injury; (2) physical restoration of injury resulting from oil spill response activities, looting, and/or vandalism; and (3) monitoring of the direct effect of oiling (McAllister n.d.). In order that data collected by different agencies during the 1993 field season be comparable, the establishment of universal procedures has been determined appropriate. In order of priority, these procedures include:

a. Assessment of Injury

The field damage assessment should address and document in detail the locations, extent, and nature of injuries and the archeological resource injured (Hutt, et al. 1992:63-71). Documentation of the assessment is critical—complete field notes will be maintained.

An accurate map of the site, documenting its present condition, is necessary. This map should show topographic features, cultural features, the distribution of exposed artifacts, locations of test excavations, level of mean high tide, erosion exposures, and locations of looting, vandalism, and/or evidence of other injury. Site maps should <u>minimally</u> approach the accuracy standards and level of detail shown in the attached example (see Appendix 2). A permanent datum and a secondary reference point will be established.

The current status of injury will be documented. An accurate measure of the extent of the injury, both horizontal and vertical, will be made. Additionally, an estimate of the area which will be subject to site restoration will be conducted. If indicated, tests will be performed in the intertidal area for buried cultural material and oil contamination.

Relatively detailed profile drawings, with soil and *Munsell* color descriptions, will be obtained from stratigraphic exposures.

Excavations made and evidence collected, through sediment sampling, artifact collection, etc., will be provenienced in three dimensions in reference to the map datum, either by Cartesian coordinates or by azimuth, distance, and elevation. Details of methodology (excavation technique, screening, sampling, etc.) will also be documented.

A full photographic record of the current status of the site will be completed. This activity will include establishing photographic stations referenced to the site datum. Photo records (which may include video as well as still photographs) will document roll number, film type, frame number, subject, direction of view, date and time, and photographer.

A determination of archeological value and cost of restoration and repair will be made and a damage assessment report prepared.

b. Emergency Restoration

A variety of methods of direct physical restoration are provided for under ARPA regulations and were recommended by the Damage Assessment Panel (McAllister n.d.:8-12). Restoration conducted in 1993 may be considered to be of an emergency nature. More substantive restoration, if the need is demonstrated, may be deferred until 1994. The general field site damage assessment procedures outlined in the previous section are also applicable during restoration activities.

Restoration should include controlled recovery and analysis of any disturbed archeological resources. Restoration may also include clearing off the face of injury exposures and excavating small tests of adjacent deposits. Test excavations may be necessary to determine the full extent of the injury and to document the age and content of deposits.

Restoration of looter or vandal excavations by backfilling, ground contour reconstruction, and surface stabilization will include drawing of stratigraphic profiles. The limits of the disturbed deposits will be marked, such as by lining the hole with perforated plastic sheeting.

Restoration may also include stabilization of the archeological resource, by installation of physical barriers or other protective devices to protect the site from further disturbance, and cleaning or painting over graffiti.

Proposals for future (non-emergency) site restoration work need to be accurately plotted and keyed to the site status subsequent to the 1993 efforts. Estimates of the cost and the site area involved will be calculated.

c. Oil Monitoring and Sample Collection

Monitoring the direct effect of oiling will be accomplish through controlled collection of sediment samples. The means and methods below are derived from the recommendations of the Damage Assessment Panel (McAllister n.d.:6-8) and the 1991 investigations conducted by the State of Alaska (Reger, et al. 1992:5).

Samples will be recovered from three locations within or immediately adjacent to the site boundary: one in the low intertidal, one in the mid intertidal, and one in the upper intertidal. The sampling locations will be permanently marked on the ground and plotted on the site map. If indicated, samples may be collected from the above the high tide line.

Small sample units, each about 20cm square, will be excavated at each sample location. Two primary samples will be collected from each unit, one from approximately 10cm below the surface and one from approximately 10cm above the "sterile base." Similar duplicate samples will also be collected. Any artifacts or other archeological material encountered in the sample units will be collected, analyzed, and curated.

Chemically cleaned 250ml sampling jars will be used to collect the sediment samples. The primary and duplicate samples will be collected using sterile tools. [The collector should protect him/herself from this hazardous material.] A label noting the sample number, date, time, location (including three-point provenience), and collector will be affixed to each sample. Duplicate samples may be designated by the same sample number but with letter modifiers. The sample jars will be adequately sealed.

The Damage Assessment Panel (McAllister n.d.:7-8) recommended that a portion of each primary sample should be analyzed for total recoverable petroleum hydrocarbons and that portion of each primary sample should be analyzed for calcium, phosphate, and total organic carbon (see also Dekin, et al. 1992:48-53). Field tests for the presence of aromatic hydrocarbons may be conducted using a *Hanby* test kit [the U.S. Fish and Wildlife Service and the State Office of History and Archaeology have such kits].

d. Reports

Each individual, participating agency will be responsible for the preparation of reports on its assigned portion of the work. These reports will adhere to the Secretary of the Interior's Standards for Archeology and Historic Preservation and the style guide of *American Antiquity*. To facilitate the compilation of the individual reports into a single document, the participating agencies will meet to jointly develop and agree to a common report organization and format.

Before the end of September 1993 each agency will prepare and submit an interim report on the results of the season's fieldwork. These individual

reports will be compiled into a single document that will be introduced by a synthetic summary of the preliminary findings.

The preparation of a final report on the 1993 activities will await the completion of radiocarbon and other special analyses. These analyses, to be performed under contract, will take several months to complete, as will the curatorial work on the project's collected specimens and documentary record. A report on the curatorial work and the results of the special analyses will be incorporated into the final report. This report will be of publishable quality and undergo peer review prior to completion and submittal.

e. Curation of Collections

The collection of archeological specimens will be kept to the minimum necessary to accomplish the proposed work. These specimens will include both artifacts and associated scientific specimens (e.g., soil samples, pollen samples, faunal material, etc.).

Once study of these specimens is completed, those items that have not been subjected to destructive analysis (i.e., radiocarbon samples for dating) will be managed and preserved as a unified collection according to the professional museum and archival standards and practices outlined in the *Curation of Federally-Owned and Administered Archeological Collections*, 36 CFR Part 79. Curation is used here to refer to inventorying, accessioning, labeling, and cataloging collections. It also refers to the perpetual storage and maintenance of collections in using appropriate methods and containers, and under appropriate environmental conditions and physically secure controls.

All primary documentary records generated by the project, including those that will form the information base for the continued care and management of the archeological artifacts and specimens, will also be curated. These archival records of the project together with the artifacts and specimens will make up the collections that will be placed in permanent curatorial care.

The combined collections derived from the work of all four of the participating agencies will be placed in a single, federally-approved curatorial repository. The National Park Service, as the lead agency for the project, will arrange for the required curatorial services on behalf of the cooperating agencies by means of either a contract or a cooperative agreement.

This common repository will be in Alaska and must meet the standards for the long-term care and storage of archeological collections described in 36 CFR Part 79.9. It is estimated that the non-archival part of the collection will number approximately 1000 items.

pecial Analyses

The National Park Service will execute and administer all contracts for special analyses. Special analyses include the processing of radiocarbon dating samples and oil monitoring samples acquired in the course of the project.

g. Other Procurement Actions

Excepting the curation of archeological specimens and special analyses, all other procurement actions necessary to the accomplishment of the project will be the responsibility of each of the four individual participating agencies. This includes the purchase of basic supplies, equipment, and any services necessary to repatriation of human remains, cultural patrimony, or unassociated funerary items.

h. Consultation with Interested Native American Groups

The repatriation and/or reinterment of any disturbed Native American human remains and related cultural items (per ARPA and NAGPRA) will be provided for. Contacts and consultation with Native American groups as required by 36 CFR 800, ARPA, and NAGPRA shall be the responsibility of the individual participating agencies. No field work will be performed prior to the accomplishment of these contacts and consultation. This activity is best handled by the individual agencies because each has its own established lines of communication with interested Native American groups and the individual agencies will be in the best position to provide information on their detailed work plans and field schedules.

gen s responsible for developing and implementing an individual plan for k t .. will be conducted on the lands which they administer (for individual work plans see Appendix 3).

conduct site specific restoration activity at six sites documented as FG-046, AFG-081, AFG-098, KOD-427, SEL-178, and SEW-440. Full essment and emergency physical restoration will be performed at AFG-081 (includes repatriation of human remains), SEL-178, SEW-440. nains from KOD-427 will be repatriated and sediment samples for rocessing will be obtained from AFG-098.

irect work at three sites: SEW-004, SEW-077, and SEW-488. Full sment and emergency site restoration will be conducted at all three il monitoring sediment samples also being collected at SEW-488.

orm archeological restoration at three sites: AFG-043, SEL-188, and ill injury assessment and emergency physical restoration of vandalism ndertaken at AFG-043. Oil effects monitoring samples will be

collected at SEL-188. Full injury assessment, emergency physical restoration, and oil sampling will be undertaken at XMK-058.

USFWS will conduct work at five vandalism injured sites: AFG-026, AFG-027, AFG-028, AFG-143, and KOD-171. Restoration activities at these sites will consist of full damage assessment and emergency physical restoration.

4. Alternatives: The project will follow procedures set forth in Archeological Resources Protection Act regulations, the Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation, and standard archeological practices; other than no action, no alternative exists.

5. Location: The geographic area of the project includes the Prince William Sound, Cook Inlet/Kenai Peninsula, and Kodiak/Alaska Peninsula regions. The specific locations of the sites which will be part of this project are subject to confidentiality restrictions. No restoration work will be conducted outside of federal or state land. In cases where there is multiple agency ownership of a particular site, the designated lead agency for that site will conduct the work. If part of the targeted site is in private ownership, all restoration work will be restricted to the agency-held portions of the site. The participating agencies may enter private land to gather information relative to the production of an overall site map, provided that the agency has obtained the express permission of the land owner.

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

7. Technical Support: In addition to qualified archeological field personnel, C14 dating, sample hydrocarbon analysis, and permanent curation of collected material (per 36 CFR 79), will require technical support.

8. Contracts: Contracts for C14 dating, hydrocarbon analysis, and permanent curation of collected material are necessary to provide technical support not available in house. These contracts will be administered by the National Park Service, according to Federal contracting procedures. Contracts for film processing, report duplication, air charter, boat charter, and repatriation expenses will be administered by the individual agencies, according to the appropriate contracting and procurement procedures.

9. Mitigation Measures: The project itself, which will adhere to procedures set forth in Archeological Resources Protection Act regulations and the Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation, will provide mitigation in the form of archeological data gathering and physical restoration/stabilization. Final physical restoration will include backfilling, stabilization, and/or revegetation of looter disturbances and archeological tests.

10. Literature Cited:

Dekin, Albert A. Jr., et al.
1992 *Exxon Valdez Oil Spill Archaeological Damage Assessment.* Draft report (53-0109-1-00325) submitted to U.S.D.A. Forest Service by the Research Foundation of the State University of New York at Binghamton.

Hutt, Sherry, Elwood W. Jones, and Martin E. McAllister
1992 *Archeological Resource Protection.* The Preservation Press, National Trust for Historic Preservation, Washington, D.C.

Jesperson, Michele M., and Kristen Griffin
1992 *An Evaluation of Archaeological Injury Documentation, Exxon Valdez Oil Spill.* Prepared at the direction of the CERCLA Archaeological Steering Committee, Anchorage.

McAllister, Martin E.
n.d. *Monetary Damage Assessment for Archeological Injuries Documented in the Exxon Valdez Oil Spill Response Records.* Report submitted to Alaska Regional Office, U.S. Department of the Interior, National Park Service, Anchorage, Alaska. Archaeological Resource Investigations, Duluth, Minnesota.

Reger, Douglas R., J. David McMahan, and Charles E. Holmes
1992 *Effect of Crude Oil Contamination on Some Archaeological Sites in the Gulf of Alaska, 1991 Investigations.* Office of History and Archaeology, Alaska Division of Parks and Outdoor Recreation, Anchorage.

U.S. National Park Service
1992 *Environmental Assessment, Site Specific Archeological Restoration, Exxon Valdez Oil Spill Trustees Restoration Project Number 93006.* Alaska Regional Office, December.

D. Schedules and Planning

Each agency will be responsible for arranging their own logistics, including transport, housing, and food. Such logistical arrangement may be integrated with other projects or with other agencies.

1. June 14, 1993—Consultation under the National Historic Preservation Act and the Native American Graves and Repatriation Act and preparation of work plans and research designs should be completed.

2. June 14, 1993—Start of field work for site specific archeological restoration project. The dates of each agency's work is dependent upon logistical factors and other mandates, but will take place within the period of June 14-September 30, 1993.

3. September 30, 1993—Completion of interim field reports, from each agency and the overall project.

4. February 28, 1994—Draft final Phase I-1993 report will be completed.

5. May 31, 1994—Final Phase I-1993 report will be delivered.

E. Environmental Compliance/Permit/Coordination Status

The National Park Service (NPS), as lead agency, has prepared an environmental assessment which evaluates the site specific archeological restoration proposal (USNPS 1992). The NPS has determined that the proposed action will benefit natural and cultural resources with a minimum potential for adverse effect as documented by the environmental assessment. The restoration activities, which seek to repair archeological sites injured by the *Exxon Valdez* Oil Spill, will provide for the salvage of archeological artifacts and information from these sites and will aid the restoration of soils and vegetation on disturbed archeological sites.

The proposed project is subject to the provisions of the National Historic Preservation Act, the Archeological Resources Protection Act, and the Native American Graves and Repatriation Act. The project will be carried out in conformance with the consultative processes and standards demanded by these legislative mandates. Coordination between project agencies, and consultation and/or coordination with Native village and regional organizations will be accomplished as necessary.

The Army Corps of Engineers will be consulted, as appropriate, regarding the projects's potential to affect water resources. The project will also be coordinated with the State of

Alaska Division of Governmental Coordination and the appropriate district coastal management programs to ensure consistency with Alaska coastal zone management program.

The proposed action complies with the Endangered Species Act, the Marine Mammals Protection Act, and Executive Orders 11988 and 11990.

There will be no restriction of subsistence activities as documented by the Alaska National Interest Lands Conservation Act, Title VIII, Section 810(a) Summary Evaluation and Findings.

The proposed action does not constitute a major federal action affecting the quality of the human environment. Therefore, in accordance with the National Environmental Council on Environmental Quality (40 CFR 1508.9), an environmental impact statement will not be prepared for the project (see attached FONSI, Appendix 4).

F. Performance Monitoring

Each agency responsible for meeting the objectives and milestones of their individual work plan. The project manager (NPS) will monitor progress and report in writing to the Trustees through the Restoration Team on a monthly basis.

The draft final report(s) shall be subject to peer review in accordance with the procedures set forth by the *Exxon Valdez* Trustee Council.

G. Personnel Qualifications

Resumes of the project leaders and key personnel, have been provided by each of the cooperating agencies (see attached, following).

RESUME

Douglas R. Reger
Archaeologist II
Office of History and Archaeology
Alaska Division of Parks and Outdoor Recreation
P.O. Box 107001
Anchorage, AK 99510-7001

1981 PhD. - Anthropology, Washington State University

PROFESSIONAL EXPERIENCE:

1964	Field and museum assistant, U. of Alaska, Fairbanks
1965	Field assistant, U. of Alaska, Fairbanks
1966	Field assistant, Alaska Methodist U.
1966-67	Laboratory/research assistant, Alaska Methodist U.
1969	Short field surveys, Cordova and Katmai, AK
1970	Field School instructor, Alaska Methodist U., Tangle Lakes
1970-71	Excavated site 49KEN-029, near Kenai, AK
1971	Salvage archaeologist, Alyeska Pipeline Project
1971-74	Teaching assistant, Washington State U.
1972	Assistant Highways archaeologist, Washington State U.
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, Office of History and Archaeology, Alaska Division of Parks

PUBLICATIONS / REPORTS

1972 *An archaeological survey in the Utopia area, Alaska*, Anthropological Papers of the University of Alaska, 15(2), with Richard D. Reger

1974 *Prehistory of the northern Kenai Peninsula*, In Prehistory of the North American Subarctic: the Athapaskan Question, edited by J.W. Helmer, S. VanDyke, and F.J. Kense, U. of Calgary, p. 16-21

1977 *An Eskimo Site near Kenai, Alaska*, Anthropological Papers of the University of Alaska, 18(2): 37-52

1983 *Norton: a changing southeastern boundary*, Arctic Anthropology 19(2): 93-99, with Joan B. Townsend

1987 *Archaeology of a late prehistoric subsistence locality, the Clam Gulch Site (49KEN-045)*, Anthropological Papers of the University of Alaska 21: 89-103

1992 *Effect of crude oil contamination on some archaeological sites in the Gulf of Alaska, 1991 investigations*, Office of History and Archaeology Report No. 30, Alaska Division of Parks and Outdoor Recreation, p. 1-138, with J. David McMahan and Charles E. Holmes

RESUME

J. David McMahan
Archaeologist I
Office of History and Archaeology
Alaska Division of Parks and Outdoor Recreation
P.O. Box 107001
Anchorage, AK 99510-7001

1977 B.A. -Anthropology (with honors), University of Tennessee, Knoxville
1983 M.A. -Anthropology, University of Tennessee, Knoxville

PROFESSIONAL EXPERIENCE

1973-76	Archaeologist, Tennessee Department of Conservation, Archaeology Division
1977-78	Archaeologist, National Park Service, NPR-Alaska Work Group
1976-83	Archaeologist, University of Tennessee, Knoxville
1984-present	Archaeologist, Office of History and Archaeology, Alaska Division of Parks

PUBLICATIONS / REPORTS

1983-present	23 Cultural Resource Management reports as senior or sole author 7 Cultural Resource Management reports as secondary author 8 papers presented at professional meetings and conferences

Vitae: John L. Mattson

USDA Forest Service
Chugach national Forest
201 E. 9th Avenue
Anchorage, Alaska 99501

Name: John L. Mattson

Date and Place of Birth: March 16, 1939, Everett, Washington

Education: Everett Community College, Everett, Washington, 1957-1960: A.A. in Education. University of Washington, Seattle, Washington, 1960-1962: B.A. in Anthropology. University of North Carolina at Chapel Hill, Chapel Hill, North Carolina, 1074-1985: Ph.D. in Anthropology.

Title of M.A. Thesis: A contribution to Skagit Prehistory

Title of Ph.D. Dissertation: Puget Sound Prehistory

Military Service: Personnel Administration Specialist, Fort Huachuca, Arizona. 1963-1965.

Marital Status: Single.

Papers and Publications: Numerous papers, reports and articles.

Ph.D. Speciality and Interests: Pacific Rim Prehistory; The Pleistocene and Human Adaptations; Peopling of the New World; Man and Agriculture.

Current Position and Tenure: Forest Archeologist, Chugach National Forest, Anchorage, Alaska.

Field Experience: Pacific Northwest, Southeast, Alaska.

Employment: Agricultural worker, Plywood manufacturing, Long shoring, Logging, Archaeology laboratory assistant, Museum assistant, Teaching assistant, Research assistant, Archeological consultant, Forest Archeologist.

Vitae: Linda Finn Yarborough

USDA Forest Service
Chugach national Forest
201 E. 9th Avenue
Anchorage, Alaska 99501

Name: Linda Finn Yarborough

Date and Place of Birth: September 14, 1952, Washington, D.C.

Education: Michigan State University, Ph.D. student in Anthropology. University of Toronto, Master of Arts in Anthropology, 1974. State University of New York, Bachelor of Arts in Anthropology, 1973.

Marital Status: Married - Michael R. yarborough. Two children.

Papers and Publications: Numerous papers, reports and articles. List available.

Ph.D. Speciality and Interests: Pacific Rim Prehistory; Prehistory of Prince William sound and Southcentral Alaska; Faunal analysis.

Current Position and Tenure: Assistant Forest Archeologist and Cooperative Education Student, Chugach National Forest, Anchorage, Alaska.

Field Experience: Archeological survey, testing, and excavations throughout many regions of Alaska.

Employment: Archaeologist, Archaeological Consultant, Instructor, Research Associate.

Vitae: Fred P. Clark

USDA Forest Service
Chugach national Forest
201 E. 9th Avenue
Anchorage, Alaska 99501

Name: Fred Paul Clark

Date and Place of Birth: June 21, 1956, Wamego, Kansas.

Education: University of Alaska, Anchorage: Interdisciplinary Master of Science in Public Administration and Anthropology, 1992. University of Idaho, Moscow: Bachelor of Science in Anthropology, Psychology, Philosophy, and Sociology.

Marital Status: Married - Cindy B. Amdur. Two children.

Papers and Publications: Numerous papers, reports and articles. List available.

Speciality and Interests: Intergovernmental Relations; Pacific Rim Prehistory; Prehistory of Southcentral Alaska; Native American/Alaska Native Issues.

Current Position and Tenure: Native American Tribal Liaison and Assistant Forest Archeologist, Chugach National Forest, Anchorage, Alaska.

Field Experience: Archeological survey, testing, and excavations throughout many regions of Alaska, the Pacific Northwest, California, Great Plains, and Costa Rica, Central America.

Employment: Archaeologist, Archaeological Consultant, Research Assistant, woodworking, heavy equipment operation, property management.

Resume
Terje (Ted) G. Birkedal

Born: June 18, 1946, Stavanger, Norway

Present Occupation: Chief, Division of Cultural Resources and Acting Regional Archeologist, Alaska Region, National Park Service

Address: Division of Cultural Resources
National Park Service, Alaska Regional Office
2525 Gambell Street
Anchorage, Alaska 99503
907/257-2668

Education:

Ph.D., Anthropology (1976); M.A., Anthropology (1970); B.A. *cum laude*, Anthropology (1968), University of Colorado (Colorado Scholars Program Scholarship, NSF Undergraduate Traineeship, and NSF Graduate Fellowship)

Field Experience:

1965-1992: Survey and excavation experience includes Western Slope of Rockies, Colorado; High Grass Plains, Colorado; Colorado Plateau Area of American Southwest (Colorado, Utah, Arizona, and New Mexico; Rio Grande Valley, New Mexico; Delta Area of Louisiana; Southwestern Norway; Bella Bella Region of Canadian Northwest Coast; Guam (Micronesia); and various locations in national parks of Alaska. Includes both prehistoric and historical archeological experience.

Professional Job Experience:

1971-1975:	Instructor, Department of Anthropology, University of Guam
1976-1982:	Archeologist and later Branch Chief, Branch of Indian Archeological Assistance, Southwest Region, National Park Service, Santa Fe
1982-1985:	Chief, Branch of Archeological Resource Management, Southwest Region, National Park Service, Santa Fe
1986-1992:	Regional Archeologist, Alaska Region, National Park Service, Anchorage
1992-Present:	Chief, Division of Cultural Resources, Alaska Region, National Park Service, Anchorage

(Majority of Federal career has been spent on the conduct, management, and administration of large archeological projects.)

Professional Affiliations:

Society for American Archeology; Alaska Anthropological Association; National Trust for Historic Places; Sigma xi: Scientific Honorary Society

RESUME

Aron Crowell
Department of Anthropology
University of California, Berkeley

Education

Ph.D., Anthropology, Candidate; University of California, Berkeley
Dissertation: *Social Distinctions and Material Life at Three Saints Bay, An 18th Century Russian Fur Trade Settlement on Kodiak Island, Alaska.*
M.A., Anthropology (1984), B.A., Anthropology (1978); George Washington University

Publications and Papers

Author or co-author of one book, 11 articles in professional journals, three published reports, and three unpublished reports, as well as having presented 17 professional papers.

Archaeological Research, Museum Exhibits and Research, and Teaching Experience

·Project Archeologist, Kenai Fjords Coastal Survey, Alaska (National Archeological Survey tiative), U.S. National Park Service (1992-present).
·Guest Speaker and Archaeological Research Facility Lab Instructor, University of California, Berkeley (1991-1992).
·Project Director, Principal Investigator, and Field School Instructor, Three Saints Bay Archaeology Project (UCB), Kodiak, Alaska (1990-1992).
·Consultant and Graduate Student Lecturer, Fort Ross Archaeological Project, University of California Berkeley (1990-1991).
·Archaeological Consultant, Exxon Cultural Resource Program, Anchorage, Alaska (1989-1992).
·Consultant, Arctic Studies Program, National Museum of Natural History/National Museum of Man, Smithsonian Institution, Washington, D.C. (1988-1992).
·Co-Curator, *Crossroads of Continents: Cultures of Siberia and Alaska,* National Museum of Natural History/National Museum of Man, Smithsonian Institution, Washington, D.C. (1986-1988).
·Co-Director and Instructor, Bryn Mawr Field School, Kodiak Island, Alaska (1986).
·Principal Investigator, Uyak Bay Survey Project, Kodiak, Alaska (1985).
·Principal Investigator, Archaeological Survey, St. Lawrence Island, Alaska (1984).
·Graduate Student Instructor, Department of Anthropology, George Washington University (1982-1984).
·Research Assistant, Department of Anthropology, National Museum of Natural History/National Museum of Man, Smithsonian Institution, Washington, D.C. (1980-1986).
·Independent Research and Field Assistant, Kalahari Project (George Washington University), Dobe, Botswana (1977, 1976).
·Field Assistant, Labrador Archaeological Project and Torngat Archaeological Project (Smithsonian Institution), Labrador, Canada (1977, 1975).

RESUME

. McClenahan
ior Park Service: Katmai National Park and Preserve, Aniakchak National
nt : Preserve, Alagnak Wild River
7; King Salmon, AK 99613
-3305; (907)246-3538

ON

Three years beyond the Master's level, toward the Ph.D. in Anthropology, University of Oregon, Eugene
Master of Arts, Anthropology, University of Oregon
Master of Science, Curriculum and Instruction, Michigan State University, East Lansing
Bachelor of Arts, English, Social Sciences, University of Hawaii, Manoa, Honolulu

S AND HONORS

92 NPS Letters of Commendation for field research in connection with the Exxon-Valdez incident.
Invited member, Pi Gamma Mu, International Honor Society in Social Science
Graduate Research Fellowship, Department of Anthropology, University of Oregon
34 Graduate Teaching Fellowship, Department of Anthropology, University of Oregon
U.S. Department of Defense, Letters of Commendation

MENT HISTORY

sent USDI-National Park Service, Katmai NP&P, Aniakchak NP&P, Alagnak WR
Park Archeologist, Cultural Resources Management Specialist.
91 USDI-National Park Service, Alaska Regional Office, Anchorage, AK.
Staff Archeologist.
91 Department of Anthropology, University of Alaska, Anchorage, Chugiak-Eagle River Campus, Eagle River, AK
Adjunct Faculty, anthropology and prehistory courses.
-8 Heritage Research Associates, Eugene, OR 97403.
Research Associate.
-5 Pacific Northwest Cultural Resources Consultants, Corvallis, OR.
Principal, cultural resources consulting firm.
-6 University of Oregon Department of Anthropology and Oregon State Museum of Anthropology, Eugene, OR.
Archeological Field Assistant.
5 University of Oregon, and Oregon State University.
Adjunct Faculty.

RESUME

Steven L. Klingler, Archeologist
Alaska Regional Office, Division of Cultural Resources
National Park Service
2525 Gambell Street
Anchorage, Alaska 99503

Education

Received a B.A. *cum laude* in Anthropology (minor in Sociology) from the University of Alaska Anchorage in 1977 and continued post-baccalaureate course work.

Archaeological Experience

Seventeen years of archaeological experience, focusing on Alaska and the prehistory of its Native cultures, having worked for the U.S. National Park Service (1990-present), Alaska Department of Natural Resources (1980-1990), U.S. Fish and Wildlife Service (1979-1980), and U.S. Forest Service (1978). Served as crew leader and supervisor during a number of survey and excavation projects—managed supplies and equipment logistics, supervised the activities of up to seven archaeologists, and directed daily activities and determined specific methods and procedures to be used in both excavation and survey.

Participated in major excavations and extensive testing programs: Dry Creek (1976), Beluga Point (1977), Chugachik Island (1977), Hidden Falls (1978), Yukon-Kuskokwim Delta (1980), Little Diomede Island (1980), Middle Bay Brick Kiln (1981), Nilnunqa (1983, 1984), Sterling Highway (1984), Summit Island (1985), and Seward Peninsula (1990). Participated in major archaeological survey and testing activities along Teklanika River (1976), on Unimak Island (1979), in Bristol Bay (1982), on Shuyak Island (1983), as well as minor surveys throughout Alaska, especially while preforming archaeological clearance surveys. Excavated single and multi-component sites, prehistoric and historic occupations, middens, house pits, and burials. Experienced with transit, alidade, and Brunton compass; set grid and mapped sites. Performed all normal lab activities associated with artifactual materials recovered during field work, including stabilization and cleaning, numbering and cataloging, photography, and analysis.

Written a number of published reports relating to cultural resources clearance surveys and evaluations, which involved library and archive research to supplement field findings; presented reports at professional and public meetings; and prepared a number of manuscripts and in-office reports detailing field activities, site descriptions, and site evaluations.

General knowledge and awareness of Federal and State preservation laws and regulations; worked directly for or with the State Historic Preservation Office, reviewing proposed Federal and State projects for potential impacts to cultural resources, accomplishing 106 reviews, and performing cultural resources surveys and evaluations.

CURRICULUM VITAE
Charles Edward DITERS
1 May 1993

Born: 3 April 1949, Hartford, Connecticut

Present Occupation: Regional Archaeologist/Regional Historic Preservation Officer.

Address: Alaska Regional Office
U.S. Fish and Wildlife Service
1011 E. Tudor Rd.
Anchorage, Alaska 99503
(907) 786-3386

Other Appointments

1989-	Alaska State Museum Collections Advisory Committee, Vice-chair 1989-1991, chair 1991-
1991-1992	Board of Directors, Alaska Anthropological Association.
1991-	Iditarod National Historic Trail Advisory Committee

Education

Dartmouth College, Hanover, New Hampshire (AB, Anthropology, June 1971)

Brown University, Providence, Rhode Island (AM, Anthropology, May 1977)

Field Experience

1970	Excavation, Healy Lake Village Site, Alaska (University of Alaska)
1970	Survey, Alyeska Pipeline route, Hogan Hill to Black Rapids (University of Alaska)
1971	Excavation, Aniganigurak and Mosquito Lake Sites, Atigun Canyon, Alaska (University of Alaska)
1977	Survey, National Petroleum Reserve, Alaska (National Park Service)
1978	Survey, National Petroleum Reserve, Alaska (National Park Service)
1978	Excavation, Russian Bishop's House, Sitka National Historic Park, Alaska (National Park Service)
1980-82	Surveys and project clearances, Chugach National Forest, Alaska
1982-	Surveys and project clearances, National Wildlife Refuges throughout Alaska

Professional Affiliations:

Society for American Archaeology
Alaska Anthropological Association
Arctic Institute of North America

CURRICULUM VITAE
Debra Garland CORBETT
8 May 1993

Born: 28 May 1958

Occupation: Archaeologist

Address: U.S. Fish and Wildlife Service
1011 E. Tudor Rd.
Anchorage, Alaska 99503
(907) 786-3399

Education:

University of Arizona, Tucson, Arizona (BA in Anthropology, May 1980)

University of Alaska, Fairbanks, Alaska (MA in Anthropology, December 1992)

Field 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(h)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 Affiliation:

Alaska Anthropological Association

H. Budget

Approved budget forms attached:

EXXON VALDEZ TRUSTEE COUNCIL

Project Description: Site Specific Archeological Restoration will utilize full on-site damage examination and treament to ameliorate injury to archeological sites that were impacted by oiling, oil spill cleanup, and vandalism as a direct result of the *Exxon Valdez* oil spill event. Immediate action is required to restore injured sites and stem further injury.

Budget Category	Approved 1-Oct-92 28-Feb-93	Proposed* 1-Mar-93 30-Sep-93	Total FY 93	FY 94	FY 95	FY 96	FY 97	Sum FY 98 & Beyond
Personnel	$0.0	$83.8	$83.8	$71.0	$261.8	$261.8	$261.8	$1,048.4
Travel	$0.0	$33.8	$33.8	$33.8	$161.7	$161.7	$161.7	$782.4
Contractual	$0.0	$108.2	$108.2	$105.2	$218.7	$218.7	$218.7	$1,367.8
Commodities	$0.0	$7.1	$7.1	$7.1	$47.6	$47.6	$47.6	$201.9
Equipment	$0.0	$7.1	$7.1	$7.0	$26.6	$26.6	$26.6	$141.6
Capital Outlay	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Sub-total	$0.0	$240.0	$240.0	$224.1	$716.4	$716.4	$716.4	$3,542.1
General Administration	$0.0	$20.1	$20.1	$18.0	$54.6	$54.6	$54.6	$386.1
Project Total	$0.0	$260.1	$260.1	$242.1	$771.0	$771.0	$771.0	$3,928.2
Full-time Equivalents (FTE)	0.0	1.7	1.8	1.5	4.0	4.0	4.0	*

Amounts are shown in thousands of dollars.

Budget Year Proposed Personnel:

Position	Months Budgeted	Cost	Comment

* Cannot be computed due to lack of equivalency between Federal and State personnel structure (see individual agency forms)

* FY 93 is a transition year from the previously used oil fiscal year to the federal fiscal year. This new project also includes proposed funding for January and February, 1993.

17-Jul-92

1993

Project Number: 93006
Project Title: Site Specific Archeological Restoration
Agency: Dept. of Interior, National Park Service

11/12/92

FORM 2A
PROJECT
DETAIL

Project Description: Site Specific Archeological Restoration will utilize full on-site damage examination and treatment to ameliorate injury to archeological sites that were impacted by oiling, oil spill cleanup, and vandalism as a direct result of the *Exxon Valdez* oil spill event. Immediate action is required to restore injured sites and stem further injury.

Budget Category	Approved 1-Oct-92 28-Feb-93	Proposed* 1-Mar-93 30-Sep-93	Total FY 93	FY 94	FY 95	FY 96	FY 97	Sum FY 98 & Beyond
Personnel	$0.0	$9.1	$9.1	$7.8				
Travel	$0.0	$7.7	$7.7	$7.7				
Contractual	$0.0	$84.9	$84.9	$82.4				
Commodities	$0.0	$1.0	$1.0	$1.0				
Equipment	$0.0	$1.2	$1.2	$1.2				
Capital Outlay	$0.0	$0.0	$0.0	$0.0				
Sub-total	$0.0	$103.9	$103.9	$100.1	$0.0	$0.0	$0.0	$0.0
General Administration	$0.0	$7.3	$7.3	$6.9				
Project Total	$0.0	$111.2	$111.2	$107.0	$0.0	$0.0	$0.0	$0.0
Full-time Equivalents (FTE)	0.0	0.2	0.2	0.2				

Amounts are shown in thousands of dollars.

Budget Year Proposed Personnel:

Position	Months Budgeted	Cost	Comment
GS-12 Supervisor	0.5	$2.0	
GS-09 Field Director	1.5	$4.1	
GS-07 Crew Member	0.1	$2.0	
GS-09 Draftsman	0.2	$0.5	
GS-11 Records Mgr.	0.2	$0.5	

* FY 93 is a transition year from the previously used oil fiscal year to the federal fiscal year. This new project also includes proposed funding for January and February, 1993.

17-Jul-92

Project Number: 93006
Project Title: Site Specific Archeological Restoration
Sub-Project:
Agency: Dept. of Interior, National Park Service

11/12/92

FORM 3A SUB-PROJECT DETAIL

1993

		Proposed
Travel:	Per Diem:	$2.9
	Transportation:	$4.8
Contractual:	Film Processing:	$0.2
	Report Duplication:	$0.1
	Sample Processing:	$13.8
	* Curation	$68.3
	** Repatriation	$2.5
	(Large contracts, curation and sample processing assigned to NPS)	
Commodities:	Film, videotape, bags, tags, ammunition, sample jars, etc.:	$1.0
Equipment:	***Basic field equipment – floatation work suits, 2-way radios, E.P.I.R.B.s, safety emergency kits, weatherproof VHS camcorders, tents, shovels, sledge hammers, etc.	$1.2

* Curation: One-time cost for curation in perpetuity; estimate in accordance with standards in 36 CFR Part 79 (Curation of Federally-owned and Administered Archeological Collections).

** Repatriation of human remains, grave goods or cultural patrimony in accordance with the Native American Graves Protection and Repatriation Act (NAGPRA), includes cultural anthropolocial consulting contract, arrangements with recipient groups, etc.

***Equipment costs shown only include specific equipment needs of each participating agency, not all items on the list will be purchased by each agency; also, agencies will share use of some equipment.

11/12/92

Project Number: 93006
Project Title: Site Specific Archeological Restoration
Sub-Project:
Agency: Dept. of Interior, National Park Service

FORM 3B
SUB-
PROJECT
DETAIL

Project Description: Site Specific Archeological Restoration will utilize full on-site damage examination and treatment to ameliorate injury to archeological sites that were impacted by oiling, oil spill cleanup, and vandalism as a direct result of the *Exxon Valdez* oil spill event. Immediate action is required to restore injured sites and stem further injury.

Budget Category	Approved 1-Oct-92 28-Feb-93	Proposed* 1-Mar-93 30-Sep-93	Total FY 93	FY 94	FY 95	FY 96	FY 97	Sum FY 98 & Beyond
Personnel	$0.0	$14.9	$14.9	$12.7				
Travel	$0.0	$10.4	$10.4	$10.4				
Contractual	$0.0	$3.5	$3.5	$3.0				
Commodities	$0.0	$1.2	$1.2	$1.2				
Equipment	$0.0	$1.8	$1.8	$1.7				
Capital Outlay	$0.0	$0.0	$0.0	$0.0				
Sub-total	$0.0	$31.8	$31.8	$29.0	$0.0	$0.0	$0.0	$0.0
General Administration	$0.0	$2.6	$2.6	$2.1				
Project Total	$0.0	$34.4	$34.4	$31.1	$0.0	$0.0	$0.0	$0.0
Full-time Equivalents (FTE)	0.0	0.4	0.4	0.4				

Amounts are shown in thousands of dollars.

Budget Year Proposed Personnel:

Position	Months Budgeted	Cost	Comment
GS-12 Supervisor	0.9	$4.0	
GS-09 Field Director	2.2	$6.1	
GS-07 Crew Member	1.5	$3.4	
GS-09 Draftsman	0.2	$0.6	
GS-11 Records Mgr.	0.2	$0.8	

* FY 93 is a transition year from the previously used oil fiscal year to the federal fiscal year. This new project also includes proposed funding for January and February, 1993.

17-Jul-92

Project Number: 93006
Project Title: Site Specific Archeological Restoration
Sub-Project:
Agency: Dept. of Interior, Fish & Wildlife Service

11/12/92

FORM 3A SUB PROJECT DETAIL

1993

		Proposed
Travel:	Per Diem	$3.9
	Transportation	$6.5
Contractual:	Film Processing	$0.3
	Report Duplication	$0.2
	* Repatriation	$3.0
Commodities:	Film, videotape, bags, tags, ammunition, sample jars, etc.	$1.2
Equipment:	**Basic field equipment -- floatation work suits, 2-way radios, E.P.I.R.B.s, safety emergency kits, weatherproof VHS camcorders, tents, shovels, sledge hammers, etc.	$1.8

* Repatriation of human remains, grave goods or cultural patrimony in accordance with the Native American Graves Protection and Repatriation Act (NAGPRA), includes cultural anthropolocial consulting contract, arrangements with recipient groups, etc.

**Equipment costs shown only include specific equipment needs of each participating agency, not all items on the list will be purchased by each agency; also, agencies will share use of some equipment.

11/12/92

Project Number: 93006
Project Title: Site Specific Archeological Restoration
Sub-Project:
Agency: Dept. of Interior, Fish & Wildlife Service

FORM 3B
SUB-
PROJECT
DETAIL

EXXON VALDEZ TRUSTEE COUNCIL

Project Description: Site Specific Archeological Restoration will utilize full on-site damage examination and treatment to ameliorate injury to archeological sites that were impacted by oiling, oil spill cleanup, and vandalism as a direct result of the *Exxon Valdez* oil spill event. Immediate action is required to restore injured sites and stem further injury.

Budget Category	Approved 1-Oct-92 28-Feb-93	Proposed* 1-Mar-93 30-Sep-93	Total FY 93	FY 94	FY 95	FY 96	FY 97	Sum FY 98 & Beyond
Personnel	$0.0	$10.6	$10.6	$9.9				
Travel	$0.0	$7.2	$7.2	$7.2				
Contractual	$0.0	$5.3	$5.3	$5.3				
Commodities	$0.0	$1.0	$1.0	$1.0				
Equipment	$0.0	$1.2	$1.2	$1.2				
Capital Outlay	$0.0	$0.0	$0.0	$0.0				
Sub-total	$0.0	$25.3	$25.3	$24.6	$0.0	$0.0	$0.0	$0.0
General Administration	$0.0	$2.0	$2.0	$1.9				
Project Total	$0.0	$27.3	$27.3	$26.5	$0.0	$0.0	$0.0	$0.0
Full-time Equivalents (FTE)	0.0	0.3	0.3	0.3				

Amounts are shown in thousands of dollars.

Budget Year Proposed Personnel:

Position	Months Budgeted	Cost	Comment
GS-12 Supervisor	0.7	$2.9	
GS-09 Field Director	1.6	$4.4	
GS-07 Crew Member	1.1	$2.4	
GS-09 Draftsman	0.2	$0.4	
GS-11 Records Mgr.	0.2	$0.5	

* FY 93 is a transition year from the previously used oil fiscal year to the federal fiscal year. This new project also includes proposed funding for January and February, 1993.

17-Jul-92

1993

Project Number: 93006
Project Title: Site Specific Archeological Restoration
Sub-Project:
Agency: Dept. of Agriculture, Forest Service

11/12/92

FORM 3A SUB-PROJECT DETAIL

		Proposed
Travel:	Per Diem	$2.0
	Transportation	$5.2
Contractual:	Film Processing	$0.2
	Report Duplication	$0.1
	* Repatriation	$5.0
Commodities:	Film, videotape, bags, tags, ammunition, sample jars, etc.	$1.0
Equipment:	**Basic field equipment -- floatation work suits, 2-way radios, E.P.I.R.B.s, safety emergency kits, weatherproof VHS camcorders, tents, shovels, sledge hammers, etc.	$1.2
General Administration:		

* Repatriation of human remains, grave goods or cultural patrimony in accordance with the Native American Graves Protection and Repatriation Act (NAGPRA), includes cultural anthropolocial consulting contract, arrangements with recipient groups, etc.

**Equipment costs shown only include specific equipment needs of each participating agency, not all items on the list will be purchased by each agency; also, agencies will share use of some equipment.

11/12/92

17-Jul-92

1993

Project Number: 93006
Project Title: Site Specific Archeological Restoration
Sub-Project:
Agency: Dept. of Agriculture, Forest Service

FORM 3B
SUB-
PROJECT
DETAIL

Project Description: Site Specific Archeological Restoration will utilize full on-site damage examination and treatment to ameliorate injury to archeological sites that were impacted by oiling, oil spill cleanup, and vandalism as a direct result of the *Exxon Valdez* oil spill event. Immediate action is required to restore injured sites and stem further injury.

Budget Category	Approved 1-Oct-92 28-Feb-93	Proposed* 1-Mar-93 30-Sep-93	Total FY 93	FY 94	FY 95	FY 96	FY 97	Sum FY 98 & Beyond
Personnel	$0.0	$49.2	$49.2	$40.6				
Travel	$0.0	$8.5	$8.5	$8.5				
Contractual	$0.0	$14.5	$14.5	$14.5				
Commodities	$0.0	$3.9	$3.9	$3.9				
Equipment	$0.0	$2.9	$2.9	$2.9				
Capital Outlay	$0.0	$0.0	$0.0	$0.0				
Sub-total	$0.0	$79.0	$79.0	$70.4	$0.0	$0.0	$0.0	$0.0
General Administration	$0.0	$8.2	$8.2	$7.1				
Project Total	$0.0	$87.2	$87.2	$77.5	$0.0	$0.0	$0.0	$0.0
Full-time Equivalents (FTE)	0.0	0.8	0.8	0.6				

Amounts are shown in thousands of dollars.

Budget Year Proposed Personnel:

Position	Months Budgeted	Cost	Comment
Archeologist I	5.0	$20.5	
Archeologist II	4.0	$25.1	Archaeologist II divided between 2 positions.
Chief, H & A	0.5	$3.6	

* FY 93 is a transition year from the previously used oil fiscal year to the federal fiscal year. This new project also includes proposed funding for January and February, 1993.

17-Jul-92

Project Number: 93006
Project Title: Site Specific Archeological Restoration
Sub-Project:
Agency: AK Dept. of Natural Resources

FORM 3A SUB-PROJECT DETAIL

1993

		Proposed
Travel:	Per Diem:	$5.9
	Transportation:	$2.6
	Subtotal:	$8.5
Contractual:	Film Processing:	$0.3
	Report Duplication:	$0.2
	Air Charter:	$4.5
	Boat Charter:	$7.0
	* Repatriation:	$2.5
	Subtotal	$14.5
Commodities:	Film, videotape, bags, tags, ammunition, sample jars, etc.:	$3.9
Equipment:	**Basic field equipment -- floatation work suits, 2-way radios, E.P.I.R.B.s, safety emergency kits, weatherproof VHS camcorders, tents, shovels, sledge hammers, etc.	$2.9

* Repatriation of human remains, grave goods or cultural patrimony in accordance with the Native American Graves Protection and Repatriation Act (NAGPRA), includes cultural anthropological consulting contract arrangements with recipient groups, etc.

***Equipment costs shown only include specific equipment needs of each participating agency, not all items on the list will be purchased by each agency; also, agencies will share use of some equipment.

11/12/92

17-Jul-92

1993

Project Number: 93006
Project Title: Site Specific Archeological Restoration
Sub-Project:
Agency: AK Dept. of Natural Resources

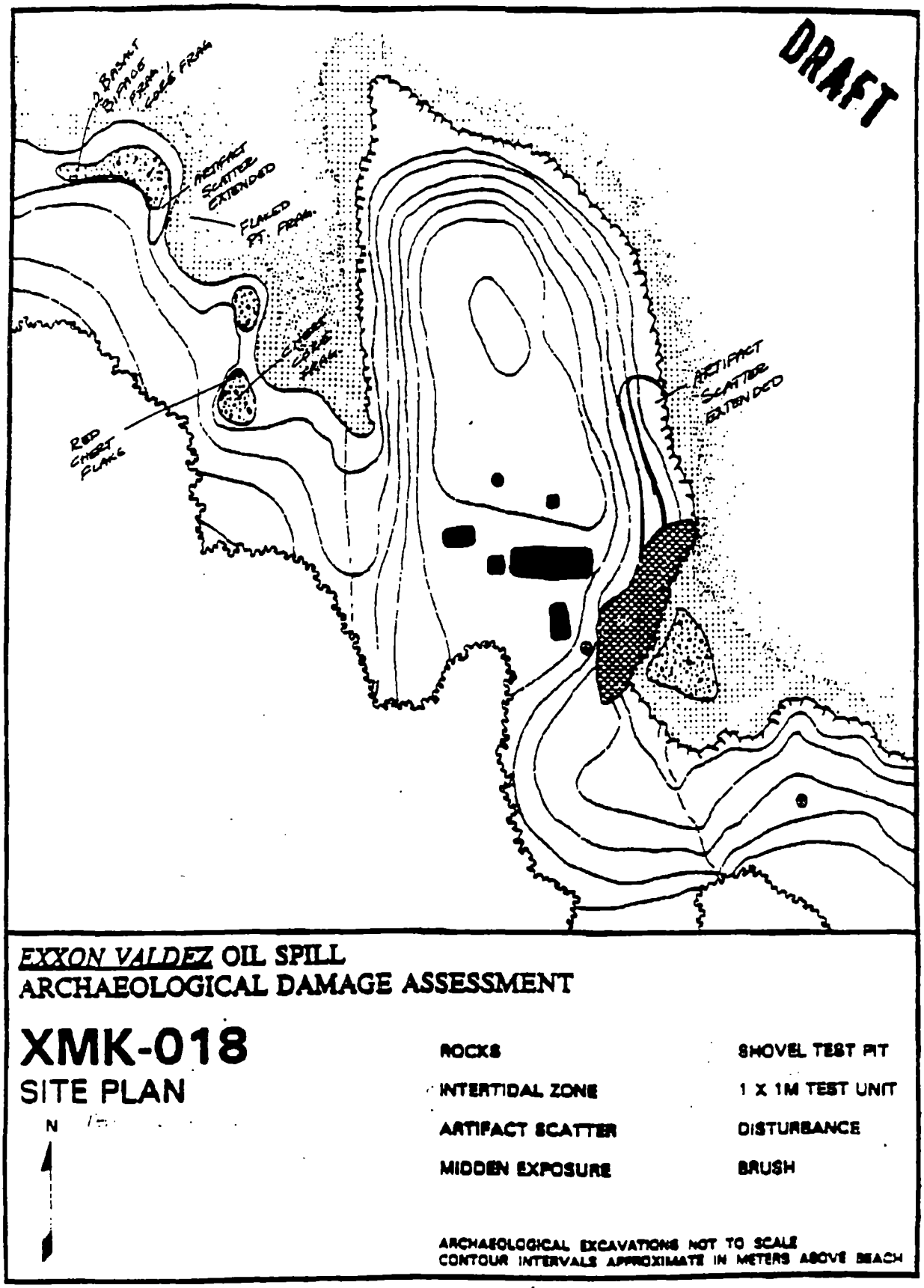
FORM 3B
SUB-
PROJECT
DETAIL

I. Appendices

Appendix 1. Known Injured Sites

Site	Land Owner	Types of Known Injury	Restoration Measures
AFG-026	AJV/USFWS*	Vandalism	Assessment, Restoration
AFG-027	AJV/USFWS*	Vandalism	Assessment, Restoration
AFG-028	AJV/USFWS*	Vandalism	Assessment, Restoration
AFG-043	NPS/DNR*	Vandalism	Assessment, Restoration
AFG-046	FAA/DNR	Oil, Oil spill response, Vandalism	Assessment, Restoration, Oil effect monitoring
AFG-081	DNR	Oil spill response, Vandalism	Assessment, Restoration
AFG-098	DNR	Vandalism	Oil effect monitoring
AFG-143	AJV/USFWS*	Vandalism	Assessment, Restoration
KOD-171	USFWS/BIA/DNR*	Vandalism	Assessment, Restoration
KOD-303	? (USFWS?)	Vandalism	Assessment, Restoration
KOD-368	KI/DNR*	Vandalism	Assessment, Restoration
KOD-427	DNR	Oil spill response	Restoration (Repatriation of human remains)
SEL-178	DNR	Oil, Oil spill response	Assessment, Restoration, Oil effect monitoring
SEL-179	PG/DNR*	Oil, Oil spill response, Vandalism	Assessment, Restoration, Oil effect monitoring
SEL-188	NPS/DNR*	Oil, Oil spill response	Oil effect monitoring
SEL-215	DNR	Oil spill response	Oil effect monitoring
SEL-220	DNR	Oil spill response	Oil effect monitoring
SEW-004	USFS/CACS/DNR*	Vandalism	Assessment, Restoration
SEW-019	CVC/DNR*	Oil, Vandalism	Restoration
SEW-068	CVC/DNR*	Oil spill response	Oil effect monitoring
SEW-077	USFS/ETC.	Oil, Oil spill response, Vandalism	Assessment, Restoration
SEW-440	USFS/DNR*	Oil, Oil spill response	Assessment, Restoration
SEW-488	USFS/CACS/DNR*	Oil, Oil spill response	Assessment, Restoration, Oil effect monitoring
XMK-058	NPS/DNR*	Oil, Oil spill response, Vandalism	Assessment, Restoration, Oil effect monitoring

*Note: Agencies are responsible for only the area below mean high tide.



Appendix 2. Example map (from Dekin, et al.)

SITE SPECIFIC RESTORATION WORK PLAN

STATE OF ALASKA
1993

The site specific work plan by the State of Alaska will deal with six sites documented as damaged to some degree: AFG-046, AFG-081, AFG-098, KOD-427, SEL-178, and SEW-440. The site AFG-046 is managed under the jurisdiction of both the State of Alaska and the Department of Transportation, Federal Aviation Agency but the State is the only agency active in site restoration and will take a lead role at working toward restoration of the site. Injury at the sites was partially documented in the report by Jesperson and Griffin (1991) which summarized available documentation and by the report submitted in draft by Dr. Albert Dekin, et. al (1992).

Personnel used on the State part of the project will be Dr. Douglas Reger and J. David McMahan, along with student assistants as needed. Resumes of Reger and McMahan are attached.

AFG-081 Restoration at AFG-081 will include mapping the site area and documenting the exact extent of the vandalism damage to the midden. The location of the damage is on the Big Bay side of the mound.

The hole left by vandals will be measured and then excavation limits will be established to encompass the damage. Excavations will be kept to a bare minimum and used to produce a gridded unit which can be accurately relocated by future researchers. Figure AK1 illustrates how the limits will be established and excavated. The excavation will be referenced to a site datum which will be surveyed in with a transit and located in the forested area to the northeast of the mound. The information collected during excavation will document what stratigraphic layers were damaged and perhaps provide an age for the deposits.

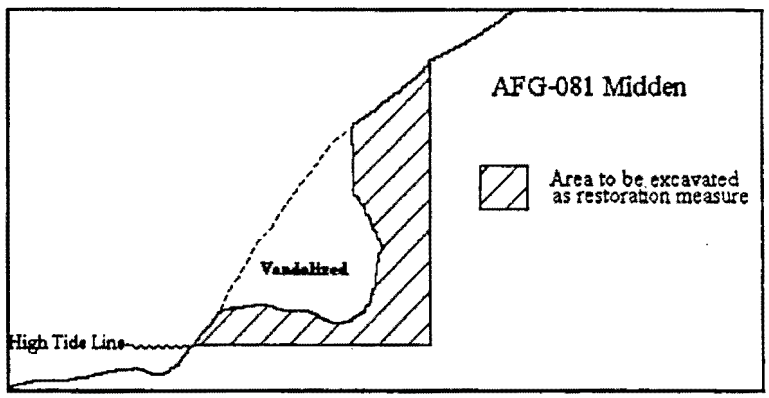


Figure AK1: Limit of excavation to restore vandalism damage at AFG-081.

The excavation hole will be lined with perforated plastic sheeting to define the exact boundaries for future excavators. The perforations will allow passage of ground water so that natural soil processes are not altered. The hole will then be re-filled with available material such as beach gravel from off site and covered with vegetation mat to allow re-vegetation of the area. That will accomplish stabilizing the excavation area and will help conceal the disturbance from future collectors.

Field work is scheduled for the middle of August 1993 with write up of a report accomplished in September 1993. The completion date is anticipated to be September 30, 1993.

AFG-046 Restoration at the Perevalnie Passage Site will consist of mapping the exact extent of damage at the site, describing the stratigraphic and cultural layers impacted by the vandalism. An additional goal will be to establish a current site status baseline against which future examinations will be compared. One apparent injury at AFG-046 was the removal of prehistoric human remains. Under federal law and regulation, agreement with the appropriate native group about disposition of the remains will be necessary. Several days will be spent reaching agreement and complying.
Field work and consultation will be accomplished in August 1993 with a report and completion anticipated by September 1993.

AFG-098 AFG-098 will be checked to document site condition during 1993 and to obtain sediment samples for chemical processing. The site datum used during damage assessment studies in 1991 will be re-used during the current project. Photo documentation will be done from similar stations to allow comparison of site condition over time. Field work will be accomplished during August, 1993 and a completion report anticipated during September, 1993.

KOD-427 Human remains collected from KOD-427 will be obtained from the State Troopers and reinterred after consultation with the appropriate native group. Initial contact will be through the Kodiak Area Native Association and then the local community as identified. The consultation and reinterment will be accomplished by September 1993.

SEL-178 The Port Dick Cabin Site, SEL-178, was injured from use as a helicopter landing and refueling base. Continued walking over the area caused erosion of the site surface. Restoration at the site will consist of making an accurate map of the site with exact location of the injured areas. Several small excavations will be placed where trails were eroded to document the exact extent of damage to the deposits. Figure AK1 illustrates how test units will be located relative to damaged areas. All locations and injuries will be referenced to a permanent site datum established at the rocky outcrop at the north end of the spit. Excavation units and holes created by erosion of trails will be filled and re-vegetated. Because some injury was feared from spills of helicopter fuel during re-fueling operations, samples of site deposits will be tested using a Hanby Field Testkit for detecting presence of petroleum hydrocarbons in the sediments.

Fieldwork will occur in late June or July and a report of activities is anticipated by September 30, 1993.

SEW-440 Restoration at SEW-440 will consist of accurately mapping the extent of injuries for reference by future researchers and placing stabilizing rocks on disturbed areas. A permanent site datum will be established to reference all activities. Sediments in the intertidal site area will be tested with the Hanby Field Testkit for presence of petroleum hydrocarbons.

Fieldwork will take place in the first week of September with a report of activities anticipated by September 30, 1993.

BUDGET

Personal Services	$49,200
Travel	8,500
Contractual	14,500
Commodities	3,900
Equipment	2,900
Sub-total	$79,000
General Administration	8,200
Agency Total	$87,200

SITE SPECIFIC RESTORATION WORK PLAN

U.S. Department of Agriculture, Forest Service
1993

Background

The site specific work plan by the Forest Service will focus on a three sites: the Crafton Island Cave Site (SEW-004), the Louis Bay Lamp Site (SEW-488), and a site on the southeastern coast of Evans Island (SEW-077). Because of the extent of damage to the Crafton Island Cave Site, the main thrust of site restoration this year will be at this site. The main thrust here is also because of the Chugach Alaska Corporation's strong commitment to site restoration at this site. This is an ANCSA 14(h)(1) selection (BLM# AA-10957) which has been determined eligible for conveyance to CAC, but which has not yet been conveyed. As such, CAC has given this site its highest priority for monitoring and protection. The other two sites will be visited and assessed, but that will be done with an eye toward determining the extent of restoration needed in the future.

Crafton Island Cave Site (SEW-004)

While de Laguna (1956) visited or recorded a number of cave or rock shelter sites in her pioneering archeological survey work in the Prince William Sound, the Crafton Island site was not one of them. The site was first recorded in 1970 after a letter from V. MacMaster brought the site to the attention of the State Office of History and Archaeology. The Cooperative Parks Study Unit collected "four ground slate points, two [or three] manos/pestles, lithic debris, wood fragments, antler and bone" (AHRS n.d.) during a 1981 survey. The piece of antler was described as a potential tool, but too badly gnawed and charred to tell for certain.

During visits to the site in 1989 as part of the Exxon Valdez Oil Spill effort, BIA Archeologist Neal Crozier (1989) and CAC archeologists Lora Johnson and Rita Miraglia (Miraglia 1989) visited the site on separate occasions, each making note of extensive vandalism. Crozier collected soil/deposit samples for chemical analysis and preservation data, noting that he saw no human bones exposed at the site. Johnson and Miraglia collected two ground stone projectile points, which they transferred to Charles Mobley, Exxon archeologist. Like Crozier, Johnson and Miraglia were unable to identify any human bone at the site. Forest Service archeologist Linda F. Yarborough (1992a) visited the site in 1992, observing a large number of porpoise bones which apparently had been deposited on the surface as a result of vandalism, but again no human bones.

Injury to the site was partially documented in the report by Jesperson and Griffin (1991) which summarized available documentation and by the report submitted in draft by Dr. Albert Dekin, et al (1992).

Forest Service personnel involved in this part of the restoration program will include John L. Mattson, Linda F. Yarborough, and Fred P. Clark. Volunteer assistants from the Native

communities of Prince William Sound will be involved as schedules allow. The project will be conducted in close consultation and involvement with Chugach Alaska Corporation.

The effort to negate the effects of the vandalism on SEW-004 will be guided by 36 CFR Part 66 and the Advisory Council's (1980:23-31) "Recommendations for Archeological Data Recovery." This restoration project is "designed to ensure that the operation addresses legitimate research questions, that it produces useful results, that it is conducted efficiently, and that it produces the maximum direct and indirect benefit to the public for the least cost" (Advisory Council on Historic Preservation 1980:24).

1. Injury Assessment

An accurate map of the site will be generated. This map will document the site's present condition and show topographic features, cultural features, the distribution of exposed artifacts, locations of test excavations, level of mean high tide, erosion exposures, and locations of looting, vandalism, and/or evidence of other injury. A permanent datum and a secondary reference point will be established.

The current status of injury will be documented, including a measure of the extent of the injury. If significant physical restorations are necessary, an estimate of the areas which will be subject to site restoration will be made. If indicated, tests, for buried cultural material and oil contamination, may be made in the intertidal area.

Profile drawings, with soil and *Munsell* color descriptions, will be obtained from stratigraphic exposures.

All tests and evidence collected, through sediment sampling, artifact collection, etc., will be provenienced in three dimensions in reference to the map datum, either by Cartesian coordinates or by azimuth, distance, and elevation. Details of methodology will be documented.

A full photographic record of the current status of the site will be obtained. This will include establishing photographic stations referenced to the site datum. Photo records (which may include video as well as still photographs) will document roll number, film type, frame number, subject, direction of view, date and time, and photographer.

A determination of archeological value and cost of any additional restoration and repair will be made and a damage assessment report prepared.

2. Emergency Restoration

Restoration conducted in 1993 will be somewhat limited; more substantive restoration, if the need is demonstrated, may be deferred until 1994.

Restoration will include controlled recovery and analysis of any disturbed archeological resources and clearing off the face of any injury exposures and excavating small tests of adjacent deposits. Test excavations may be necessary to determine the full extent of the injury and to document the age and content of deposits. The permanent curation of any collected material will be provided under contract (per 36 CFR 79). The repatriation and/or reinterment of any disturbed Native American human remains and related cultural items will also be provided for (per ARPA and NAGPRA).

As necessary, looter or vandal excavations will be backfilled, the ground contour will be reconstructed, and the surface will be stabilized. The limits of the disturbed deposits will be marked, such as by lining the hole with perforated plastic sheeting.

Fieldwork will be integrated with ongoing Forest Service activities in the area between June 14, 1993 and September 30, 1993.

SEW-077

SEW-077 consists of prehistoric midden and a scatter of artifacts at the base of the southern point of Sawmill Bay, on the southeastern coast of Evans Island. During the Exxon cleanup effort, an investigator "noted an extensive concentration of fire cracked rock and an abundance of ground and pecked stone with a 150m x 30m area on the beach. Remnants of a log skidding operation, a pier or jetty, rusted cables, iron staples, pilings, log skids, a log pile, pieces of purple glass, and may culturally modified trees. . ." (AHRS card for SEW-007). Assessment and restoration for this site have been recommended.

1. Injury Assessment

An accurate map of the site will be generated. This map will document the site's present condition and show topographic features, cultural features, the distribution of exposed artifacts, locations of test excavations, level of mean high tide, erosion exposures, and locations of looting, vandalism, and/or evidence of other injury. A permanent datum and a secondary reference point will be established.

The current status of injury will be documented, including a measure of the extent of the injury. If significant physical restorations are necessary, an estimate of the areas which will be subject to site restoration will be made. If indicated, tests, for buried cultural material and oil contamination, may be made in the intertidal area.

Profile drawings, with soil and Munsell color descriptions, will be obtained from stratigraphic exposures.

All tests and evidence collected, through sediment sampling, artifact collection, etc., will be provenienced in three dimensions in reference to the map datum, either by Cartesian coordinates or by azimuth, distance, and elevation. Details of methodology will be documented.

A full photographic record of the current status of the site will be obtained. This will include establishing photographic stations referenced to the site datum. Photo records (which may include video as well as still photographs) will document roll number, film type, frame number, subject, direction of view, date and time, and photographer.

A determination of archeological value and cost of any additional restoration and repair will be made and a damage assessment report prepared.

2. Emergency Restoration

Restoration conducted in 1993 will be somewhat limited; more substantive restoration, if the need is demonstrated, may be deferred until 1994.

Restoration will include controlled recovery and analysis of any disturbed archeological resources and clearing off the face of any injury exposures and excavating small tests of adjacent deposits. Test excavations may be necessary to determine the full extent of the injury and to document the age and content of deposits. The permanent curation of any collected material will be provided under contract (per 36 CFR 79). The repatriation and/or reinterment of any disturbed Native American human remains and related cultural items will also be provided for (per ARPA and NAGPRA).

As necessary, looter or vandal excavations will be backfilled, the ground contour will be reconstructed, and the surface will be stabilized. The limits of the disturbed deposits will be marked, such as by lining the hole with perforated plastic sheeting.

Fieldwork will be integrated with ongoing Forest Service activities in the area between June 14, 1993 and September 30, 1993.

SEW-488

The Louis Bay Lamp Site (SEW-488) "consists of an oil lamp, a polished cobble, and a cut bone fragment that had eroded out from the hillside above the beach. These artifacts were collected from the upper tidal zone of a 100m long beach bordered by rocky headlands. The limits of the site were not fully investigated." (J.D. Gallison, 1989 Exxon SCAT Fieldnotes, in AHRS file for SEW-488). The site is located on the west shore of Lower Passage, at the north end of Knight Island. This site has been recommended for assessment, Restoration, and Oil effect monitoring.

1. Injury Assessment

An accurate map of the site will be generated. This map will document the site's present condition and show topographic features, cultural features, the distribution of exposed artifacts, locations of test excavations, level of mean high tide, erosion exposures, and locations of looting, vandalism, and/or evidence of other injury. A permanent datum and a secondary reference point will be established.

The current status of injury will be documented, including a measure of the extent of the injury. If significant physical restorations are necessary, an estimate of the areas which will be subject to site restoration will be made. If indicated, tests, for buried cultural material and oil contamination, may be made in the intertidal area.

Profile drawings, with soil and Munsell color descriptions, will be obtained from stratigraphic exposures.

All tests and evidence collected, through sediment sampling, artifact collection, etc., will be provenienced in three dimensions in reference to the map datum, either by Cartesian coordinates or by azimuth, distance, and elevation. Details of methodology will be documented.

A full photographic record of the current status of the site will be obtained. This will include establishing photographic stations referenced tot he site datum. Photo records (which may include video as well as still photographs) will document roll number, film type, frame number, subject, direction of view, date and time, and photographer.

A determination of archeological value and cost of any additional restoration and repair will be made and a damage assessment report prepared.

2. Emergency Restoration

Restoration conducted in 1993 will be somewhat limited; more substantive restoration, if the need is demonstrated, may be deferred until 1994.

Restoration will include controlled recovery and analysis of any disturbed archeological resources and clearing off the face of any injury exposures and excavating small tests of adjacent deposits. Test excavations may be necessary to determine the full extent of the injury and to document the age and content of deposits. The permanent curation of any collected material will be provided under contract (per 36 CFR 79). The repatriation and/or reinterment of any disturbed Native American human remains and related cultural items will also be provided for (per ARPA and NAGPRA).

As necessary, looter or vandal excavations will be backfilled, the ground contour will be reconstructed, and the surface will be stabilized. The limits of the disturbed deposits will be marked, such as by lining the hole with perforated plastic sheeting.

3. Oil Monitoring and Sample Collection

A full photographic record of the current status of the sample collection areas will be obtained. This will include establishing photographic stations referenced to the site datum. Photo records (which may include video as well as still photographs) will document roll number, film type, frame number, subject, direction of view, date and time, and photographer.

Monitoring the direct effect of oiling will be accomplished through controlled collection of sediment samples. Samples will be recovered from three locations within or immediately adjacent to the site boundary; one in the low intertidal, one in the mid intertidal, and one in the upper intertidal. The sampling locations will be permanently marked on the ground and plotted on the site map. If indicated, samples may be collected from above the high tide line.

Small sample units, each about 20cm square, will be excavated at each sample location. Two primary samples will be collected from each unit, one from approximately 10cm below the surface and one from approximately 10cm above the "sterile base." Similar duplicate samples will be collected. Any artifacts or other archeological material encountered in the sample units will be collected, analyzed, and curated.

Chemically cleaned 250ml sampling jars will be used to collect the sediment samples. The primary and duplicate samples will be collected using sterile tools. A label noting the sample number, date, time, location (including the three-point provenience), and collector will be affixed to each sample. Duplicate samples will be designated by the same sample but with letter modifiers. The sample jars will be adequately sealed.

Analysis, for total recoverable petroleum hydrocarbons and for calcium, phosphate, and total organic carbon will be performed under contract.

Fieldwork will be integrated with ongoing Forest Service activities in the area between June 14, 1993 and September 30, 1993.

Personnel

The key personnel involved in various phases of this project will include Ted Birkedal, Chief, Division of Cultural Resources, Alaska Region; John L. Mattson, Forest Archeologist, Chugach National Forest; Linda Finn Yarborough, Assistant Forest Archeologist, Chugach National Forest; and Fred P. Clark, Assistant Forest Archeologist, Chugach National Forest (see attached resumes).

Budget

Personnel	$13,200
Travel	5,200
Contractual	5,000
Commodities	700
Equipment	1,200
General Administration	2,000
Project Total	$27,300

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Work Plan—Site Specific Archeological Restoration (Project 93-006)
U.S. National Park Service (Phase I, 1993)

Background

Under the aegis of, and in conformance with, the general work plan for Site Specific Archeological Restoration, the U.S. National Park Service (NPS) will undertake to perform appropriate site specific archeological restoration at three archeological sites, the Kaguyak Village site (AFG-043), the McArthur Pass site (SEL-188), and the Cape Gull Cove site (XMK-058).

Two of the sites, AFG-043 and XMK-058, are located within Katmai National Park and Preserve. The third site, SEL-188, is located within Kenai Fjords National Park. To date, these three sites represent the only NPS sites that have been documented as injured and still require restoration action (Jesperson and Griffin 1992; McAllister n.d.). Specific restorative actions to be conducted at each site in 1993 are detailed below:

Kaguyak Village site (AFG-043)

AFG-043 is an historic (and possibly prehistoric) village site located on the Alaska Peninsula north of Cape Chiniak. The site consists of about 25 house depressions, 13 historic structures, a kashim, remains of a burned Russian Orthodox church, and a cemetery area. During 1989 and 1990, Exxon investigators documented recent vandalism on the site. The restoration measures which have been recommended include full injury assessment and physical restoration. NPS will undertake the following restoration activities at this site:

1. Injury Assessment

An accurate map of the site will be generated. This map will document the site's present condition and show topographic features, cultural features, the distribution of exposed artifacts, locations of test excavations, level of mean high tide, erosion exposures, and locations of looting, vandalism, and/or evidence of other injury. A permanent datum and a secondary reference point will be established.

The current status of injury will be documented, including a measure of the extent of the injury. If significant physical restorations are necessary, an estimate of the area which will be subject to site restoration will be made. If indicated, tests, for buried cultural material and oil contamination, may be made in the intertidal area.

Profile drawings, with soil and *Munsell* color descriptions, will be obtained from stratigraphic exposures.

All tests and evidence collected, through sediment sampling, artifact collection, etc., will be provenienced in three dimensions in reference to the map datum, either by Cartesian coordinates or by azimuth, distance, and elevation. Details of methodology will be documented.

A full photographic record of the current status of the site will be obtained. This will include establishing photographic stations referenced to the site datum. Photo records (which may include video as well as still photographs) will document roll number, film type, frame number, subject, direction of view, date and time, and photographer.

A determination of archeological value and cost of any additional restoration and repair will be made and a damage assessment report prepared.

2. Emergency Restoration

Restoration conducted in 1993 will be somewhat limited; more substantive restoration, if the need is demonstrated, may be deferred until 1994.

Restoration will include controlled recovery and analysis of any disturbed archeological resources and clearing off the face of any injury exposures and excavating small tests of adjacent deposits. Test excavations may be necessary to determine the full extent of the injury and to document the age and content of deposits. The permanent curation of any collected material will be provided under contract (per 36 CFR 79). The repatriation and/or reinterment of any disturbed Native American human remains and related cultural items (per ARPA and NAGPRA) will also be provided for.

As necessary, looter or vandal excavations will be backfilled, the ground contour will be reconstructed, and the surface will be stabilized. The limits of the disturbed deposits will be marked, such as by lining the hole with perforated plastic sheeting.

Field work, which will be integrated with ongoing NPS activities in the area, shall be conducted between June 14, 1993 and September 30, 1993.

McArthur Pass site (SEL-188)

SEL-188 consists of prehistoric midden and a scatter of intertidal artifacts located on the southern coast of Kenai Peninsula, on the eastern shore of Nuka Bay. The site was heavily oiled during the *Exxon Valdez* spill incident and suffered further injury during the oil spill response activity. As extensive work previously done at the site is considered to have accomplished other restoration measures (Betts, et al. 1991), the only measure which has been recommended is oil effect monitoring. However, any additional signs of injury not noted during previous investigations will be documented and a more complete and detailed map of the site will be made to maintain conformance with the level of documentation specified in the general work plan.

Oil Monitoring and Sample Collection

A full photographic record of the current status of the site will be obtained. This will include establishing photographic stations referenced to the site datum. Photo records

(which may include video as well as still photographs) will document roll number, film type, frame number, subject, direction of view, date and time, and photographer.

Monitoring the direct effect of oiling will be accomplish through controlled collection of sediment samples. Samples will be recovered from three locations within or immediately adjacent to the site boundary: one in the low intertidal, one in the mid intertidal, and one in the upper intertidal. The sampling locations will be permanently marked on the ground and plotted on the site map. If indicated, samples may be collected from the above tide-line.

Small sample units, each about 20cm square, will be excavated at each sample location. Two primary samples will be collected from each unit, one from approximately 10cm below the surface and one from approximately 10cm above the "sterile base." Similar duplicate samples will be collected. Any artifacts or other archeological material encountered in the sample units will be collected, analyzed, and curated.

Chemically cleaned 250ml sampling jars will be used to collect the sediment samples. The primary and duplicate samples will be collected using sterile tools. A label noting the sample number, date, time, location (including three-point provenience), and collector will be affixed to each sample. Duplicate samples will be designated by the same sample number but with letter modifiers. The sample jars will be adequately sealed.

Analysis, for total recoverable petroleum hydrocarbons and for calcium, phosphate, and total organic carbon will be performed under contract.

Field work, which will be integrated with ongoing NPS activities in the area, shall be conducted between June 14, 1993 and September 30, 1993.

Cape Gull Cove site (XMK-058)

XMK-058, which is located on the western shore of Shelikof Strait, consists of prehistoric midden, three house depressions, four small depression features, and a scatter of intertidal artifacts. The site was heavily oiled during the *Exxon Valdez* spill incident, was subject to minor vandalism, and suffered further injury during the oil spill response activity. The restoration measures recommended include full field site damage assessment, physical restoration, and oil effect monitoring.

1. Injury Assessment

An accurate map of the site will be generated. This map will document the site's present condition and show topographic features, cultural features, the distribution of exposed artifacts, locations of test excavations, level of mean high tide, erosion exposures, and locations of looting, vandalism, and/or evidence of other injury. A permanent datum and a secondary reference point will be established.

The current status of injury will be documented, including a measure of the extent of the injury. If significant physical restorations are necessary, an estimate of the

area which will be subject to site restoration will be made. If indicated, tests, for buried cultural material and oil contamination, may be made in the intertidal area.

Profile drawings, with soil and *Munsell* color descriptions, will be obtained from stratigraphic exposures.

All tests and evidence collected, through sediment sampling, artifact collection, etc., will be provenienced in three dimensions in reference to the map datum, either by Cartesian coordinates or by azimuth, distance, and elevation. Details of methodology will be documented.

A full photographic record of the current status of the site will be obtained. This will include establishing photographic stations referenced to the site datum. Photo records (which may include video as well as still photographs) will document roll number, film type, frame number, subject, direction of view, date and time, and photographer.

A determination of archeological value and cost of any additional restoration and repair will be conducted and a damage assessment report prepared.

2. Emergency Restoration

Restoration conducted in 1993 will be somewhat limited; more substantive restoration, if the need is demonstrated, may be deferred until 1994.

Restoration will include controlled documentation and analysis of any disturbed archeological resources and clearing off the face of any injury exposures and excavating small tests of adjacent deposits. Test excavations may be necessary to determine the full extent of the injury and to document the age and content of deposits. The permanent curation of any collected material will be provided under contract (per 36 CFR 79). The repatriation and/or reinterment of Native American human remains and related cultural items (per ARPA and NAGPRA) will also be provided for.

As necessary, looter or vandal excavations will be backfilled, the ground contour will be reconstructed, and the surface will be stabilized. The limits of the disturbed deposits will be marked, such as by lining the hole with perforated plastic sheeting.

3. Oil Monitoring and Sample Collection

A full photographic record of the current status of the sample collection areas will be obtained. This will include establishing photographic stations referenced to the site datum. Photo records (which may include video as well as still photographs) will document roll number, film type, frame number, subject, direction of view, date and time, and photographer.

Monitoring the direct effect of oiling will be accomplished through controlled collection of sediment samples. Samples will be recovered from three locations within or immediately adjacent to the site boundary: one in the low intertidal, one in the mid intertidal, and one in the upper intertidal. The sampling locations will be permanently marked on the ground and plotted on the site map. If indicated, samples may be collected from above the high tide line.

Small sample units, each about 20cm square, will be excavated at each sample location. Two primary samples will be collected from each unit, one from approximately 10cm below the surface and one from approximately 10cm above the "sterile base." Similar duplicate samples will be collected. Any artifacts or other archeological material encountered in the sample units will be collected, analyzed, and curated.

Chemically cleaned 250ml sampling jars will be used to collect the sediment samples. The primary and duplicate samples will be collected using sterile tools. A label noting the sample number, date, time, location (including three-point provenience), and collector will be affixed to each sample. Duplicate samples will be designated by the same sample number but with letter modifiers. The sample jars will be adequately sealed.

Analysis, for total recoverable petroleum hydrocarbons and for calcium, phosphate, and total organic carbon will be performed under contract.

Field work, which will be integrated with ongoing NPS activities in the area, shall be conducted between June 14, 1993 and September 30, 1993.

Personnel

The key personnel involved in various phases of this project will include Ted Birkedal, Chief, Division of Cultural Resources, Alaska Region; NPS Archeologists Aron Crowell and Steve Klingler; and Pat McClenahan, Archeologist, Katmai National Park and Preserve (see attached resumes).

Budget

Personnel	$9,100.00
Travel	7,700.00
Contractual	* 84,900.00
Commodities	1,000.00
Equipment	1,200.00
General administration	7,300.00
Project Total	* $111,200.00

*Includes $82,100 for administration of contracts for special analyses and curation on behalf of all participating agencies. Actual amount devoted to site work and project administration is $29,100.

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SITE SPECIFIC RESTORATION WORK PLAN

U.S. FISH AND WILDLIFE SERVICE
1993

This site specific work plan outlines restoration work proposed for five sites damaged by vandalism and pothunting during oil spill cleanup activities. Sites AFG-026, AFG-027, AFG-028, and AFG-143 are on Afognak Island, and KOD-171 is on Kodiak Island. Injury at the sites is partially documented in the report by Jesperson and Griffin (1991). All sites sustained similar injury, including potholes excavated into site features and collections and excavations in eroding midden areas. Initial assessment and restoration approaches will therefore be similar for all sites.

Work will be directed by Charles Diters and assisted by Debra Corbett. Volunteers will help as needed. Vitae for Diters and Corbett are attached.

AFG-026

AFG-026, Izhut Bay, is a prehistoric midden on the south side of the entrance to Kitoi Bay, on the southeast coast of Afognak Island. The site has two sections separated by a bedrock outcrop. Artifacts found at the site suggest Koniag phase occupation. Both sections of the site have been impacted by illegal excavation.

Restoration will include establishing a permanent datum, mapping the site and documenting with notes and photography, the exact locations and extent of vandalism damage to the midden. Any new damage will also be documented. Potholes on the surface of the site will be measured. Limited excavations of selected pits will be conducted to determine the nature of the disturbed deposits, and perhaps provide materials for dating the site. Two pits in the eroding midden face will also be examined. Profiles of the pothole walls and eroding midden faces will be drawn.

Emergency restoration measures in 1993 will include backfilling the potholes and test excavations. Pit boundaries will be defined for future investigators and suitable material, probably from the beach, used to fill them. Stabilization of the eroding midden faces will await assessment results and be addressed in a separate restoration plan.

Work is planned for the month of July 1993. Analysis of artifacts and dating samples will follow and a final report should be completed by September 30, 1993.

AFG-027

AFG-027 is a 31 m long midden on the west side of the entrance to Izhut Bay. The low end of the site is now in the intertidal zone, and the house reported there has been lost, but other features have been exposed. The upper midden, 40 cm thick shows no obvious features. Recent damage is essentially confined to this upper portion. A modern trapping camp occupies part of the site.

A permanent datum will be established and the site mapped and thoroughly documented. All existing damage from vandalism and erosion will be accurately plotted and described. Direct impacts, if any, from the modern camp will be examined as well. The trail to the beach may be a cause of erosion of the midden face. Again the pits are located in two different areas necessitating different approaches. Those on the surface of the site will be examined and a sample tested to provide information on the nature of the deposits and possibly to collect material for dating the site. Those pits excavated into the eroding midden faces will be cleaned and profiled.

All potholes will be backfilled. Recommendations for stabilization of the eroding midden face will follow assessment work in 1993.

Fieldwork and report preparation will follow the same timetable as outlined for AFG-026.

AFG-028

This site is located on the south shore of locally named Ruth Bay, off the west shore of Izhut Bay, on southeast Afognak Island. The 63 m long midden is eroding along most of the beach front. A single house pit is reported. Both Koniag and Kachemak artifacts have been recovered from the site.

The site will be mapped and documented as described above, following the same timetable. The reported potholes at this site are larger than those reported for the previous two sites. Two along the eroding midden front are particularly large. All potholes will be described and one or two within the feature will be tested to determine the nature of the deposits. The eroding midden face will be cleaned and profiled. All potholes will be filled with sterile material from the beach. Additional stabilization will follow the assessment in 1993.

Fieldwork and report preparation will follow the same timetable as outlined for AFG-026.

AFG-143

AFG-143 is 250 m southeast of AFG-027. The midden has at least four house pits. Three of the house pits and the eroding midden face have been vandalized.

A detailed site map will be prepared and all damage described. One pothole in each of the three damaged features will be expanded, and the disturbed deposits described and drawn. The vandalized area along one erosional face will be cleared and profiled. Two other erosional faces will be also be profiled.

Fieldwork and report preparation will follow the same timetable as outlined for AFG-026.

KOD-171

Chief Cove 1 is located on the north side of Chief Cove on the north shore of Spiridon Bay, Kodiak Island. The site was briefly excavated by Hrdlicka (1944:98-99). Nowak

(1977:40-43) reports at least 22 house pits in the over 200 m long site. Lower relic berms north of the main site area have evidence of shallower depressions. Erosion is concentrated at the southern end of the site.

Damage at KOD-171 is reported to consist only of excavations into an eroding midden face. No disturbance was noted in the surface of this large site. Restoration will begin with mapping the site and describing all known disturbance. The eroding midden face will be profiled. Stabilization of the erosion face will follow the assessment in 1993.

Fieldwork and report preparation will follow the same timetable as outlined for AFG-026.

BUDGET

Personnel	$14,900.00
Travel	10,400.00
Contractual	3,500.00
Commodities	1,200.00
Equipment	1,800.00
General Administration	2,600.00
Project Total	$34,400

FINDING OF NO SIGNIFICANT IMPACT

The National Park Service (NPS), as lead agency, has prepared an environmental assessment which evaluates the site specific archeological restoration proposal, project number 93006, proposed by the Exxon Valdez Oil Spill Trustees in the **Exxon Valdez Oil Spill Restoration 1993 Draft Work Plan.**

The following alternatives were considered: no action and site specific archeological restoration (preferred alternative).

The NPS has determined that the proposed action will benefit natural and cultural resources with a minimum potential for adverse effect as documented by the environmental assessment. The restoration activities seek to repair archeological sites injured by the Exxon Valdez Oil Spill. The project provides for the salvage of archeological artifacts and information from these sites and will aid the restoration of soils and vegetation on disturbed archeological sites. Other agency (United States Fish and Wildlife Service, United States Forest Service and Alaska Department of Natural Resources) land and resources specialists will be consulted on an as-needed basis. The NPS will consult with the State Historic Preservation Officer for compliance with section 106 of the National Historic Preservation Act. The Army Corps of Engineers will be consulted, as appropriate, regarding the projects's potential to affect water resources. The project will also be coordinated with the State of Alaska Division of Governmental Coordination and the appropriate district coastal management programs to ensure consistency with Alaska coastal zone management program. The proposed action complies with the Endangered Species Act, the Marine Mammals Protection Act and Executive Orders 11988 and 11990.

There will be no restriction of subsistence activities as documented by the Alaska National Interest Lands Conservation Act, Title VIII, Section 810(a) Summary Evaluation and Findings.

I find that the proposed action does not constitute a major federal action affecting the quality of the human environment. Therefore, in accordance with the National Environmental Council on Environmental Quality (40 CFR 1508.9), an environmental impact statement will not be prepared for the project.

Regional Director, Alaska Region

12/2/92
Date

93012

DETAILED RESTORATION PROJECT DESCRIPTION

Project Title: Genetic Stock Identification of Kenai River Sockeye Salmon

Project ID#: 93012

Project Type: Restoration

Project Leaders: Lisa Seeb
James Seeb

Lead Agency: Alaska Department of Fish and Game

Cooperating Agencies: None

Project Cost: $300.1K

Start Date: Continuing (Oct.1, 1992) **Finish Date:** Continuing (September 30, 1993)

Geographic Area of Project: Upper Cook Inlet, Alaska

Project Leader Signature: Lisa W. Seeb James E. Seeb

Project Manager:

Name:

Signature:

B. Introduction

The cohorts of sockeye salmon originating from and after the 1989 spawning in the Kenai River drainage are so depleted that a severe reduction or complete elimination of their harvest may be necessary starting in 1993 to insure even minimally adequate escapements. Genetic stock identification (GSI) techniques will be implemented to manage the harvest of these EVOS-damaged stocks in Cook Inlet mixed harvest areas. GSI has only recently been applied as an in-season management tool, and it has proven to be extremely effective for allocating and adjusting the harvest of stocks intercepted in stock mixtures such as those that occur in Cook Inlet (e.g., White and Shaklee 1991).

Beginning in 1992, baseline genetic data were collected from 25 subpopulations from the Kenai, Kasilof, and Susitna Rivers (Table 1). Samples from the Cook Inlet commercial harvest will be analyzed and reduced to stock components using these data and GSI techniques. Area managers will use this information to modify fishing areas and openings in order to facilitate harvest of the surplus Kasilof River and Susitna River stocks while protecting the EVOS-damaged Kenai River stocks.

Results from the 1992 field season are currently under continued analysis, but appear very promising. Simulation studies to date indicate Kenai River stocks can be identified with a high level of precision and accuracy in a variety of mixtures (e.g., Table 2). These simulation studies are ongoing and will be fully reported in the final report for FY 93 (December 15, 1993).

C. Project Description

1. Resources and/or Services:

This study will investigate sockeye salmon in the Kenai River system on the Kenai Peninsula (Figure 1). In their recent study, Schmidt and Tarbox (1992) documented sockeye salmon overescapement to the Kenai River as a result of the 1989 oil spill. They suggest that major economic damage to commercial, subsistence, and sport fisheries will likely occur. Smolt emigration from the Kenai River in the spring of 1992 was less than one-fiftieth the number estimated in 1989, clearly indicating a high probability of future returns below existing escapement goals.

2. Objectives:

The objectives of this study are to:

1. Obtain baseline allozyme genetic data (during 1992-1995) from all significant spawning stocks contributing to mixed-stock harvests of sockeye salmon in Cook Inlet.

2. Obtain genetic data each week from samplings of the various mixed-stock harvests beginning in 1993.

3. Use GSI algorithms (e.g., Pella and Milner 1987) to provide weekly estimates of the presence of Kenai River stocks in the different mixed-stock areas so that managers may modify area and time of harvest in order to protect these damaged stocks while targeting surplus Kasilof River and Susitna River stocks.

4. Investigate the added utility of DNA-level markers to discriminate among Cook Inlet populations

3. Methods

a. Sampling Methods

Baseline and mixed stock samples will be collected by personnel conducting Restoration Science Study 93015 - Kenai River Sockeye Salmon Restoration. During the 1993 field season, up to 38 baseline populations will be collected (Table 3). Considerable emphasis will be placed on sampling populations not sampled in 1992, particularly from the Susitna River drainage, although the majority of the Kenai and Kasilof populations will be resampled in 1992 to obtain accurate estimate of allele frequency and to verify temporal stability. Sample sizes for allozyme baseline collections will be 100 to maximize the precision around the allele frequency estimates (Allendorf and Phelps 1980, Waples 1990).

Fishery samples will be collected from the central drift gillnet fishery and from the eastside set gillnet fishery. The drift net fishery will be sampled one time; the eastside set gillnet fishery will be sampled twice (Table 4). Mixed stock sample sizes will be set at 400 (Pella and Milner 1987).

Muscle, liver, eye, and heart will be dissected from freshly killed individuals. Tissues will be placed in labeled cryovials and transferred into liquid nitrogen (Appendix A,B). Tissues from baseline collections will be stored on liquid nitrogen until transferred to -80°C storage in Soldotna or Anchorage. Soldotna samples will be transferredto the Anchorage laboratory on dry ice or liquid nitrogen and again placed in -80°C storage where they will remain until laboratory analysis.

b. Laboratory techniques

Allozyme electrophoretic data (Utter et al. 1987, Seeb et al. 1987) will be collected for the loci identified in during year 1 of the study (Table 5). An extensive allozyme screening was undertaken to maximize the potential number of available gene markers. A total of 77 allozyme loci were resolved

(Table 5). Of the resolvable loci, 31 were polymorphic in at least one individual (*sAAT-1,2; mAAT-1; mAH-1,2; ALAT; CK-B; GAPDH-2; GDA-1; G3PDH-1,2; GPI-B1,2; mIDHP-1; sIDHP-1; LDH-B2; sMDH-A1,2; sMDH-B1,2; mMEP; MPI; PEPA; PEPB-1; PEPD-1; PEPLT; PGDH; PGM-1; PGM-2; TPI-1,2)*.

All gel scoring will be conducted on-line to ensure rapid turnaround, complete documentation, and immediate availability of summary statistics. Allozyme techniques will follow those of Harris and Hopkinson (1976), May et al. (1979), and Aebersold et al. (1987); nomenclature rules will follow the American Fisheries Society standard (Shaklee et al. 1990). A photographic record of each polymorphic gel will be made.

DNA will be extracted from liver and heart tissue (Chapman and Brown 1990, Bermingham et al. 1991) using phenol/chloroform extractions and ethanol precipitation (Sambrook et al. 1989) from a subsample of the baseline individuals. After extraction, the DNA will be amplified using the polymerase chain reaction (PCR) (Kocher et al. 1989, Chapman and Brown 1990, Carr and Marshall 1991). Primer selection for PCR will include both universal (Kocher et al. 1989) and other unpublished primers (Kessing et al. 1989) and include those from the ND5/6 and ND2 regions of mtDNA. These regions have proven useful in other stock identification studies within the genus *Oncorhynchus*. Amplified DNA will be cut with up to 20 restriction enzymes and separated on agarose gels. Fragments will be visualized under UV light, and a photographic record will be made of each gel.

c. Analytical methods

The allozyme data will be analyzed using the genetic analysis program, BIOSYS-1 (Swofford and Selander 1981) and NTSYS-pc (Rohlf 1993). Genotypic and allelic frequency estimates will be calculated for each baseline and mixed-stock sample at every locus. Genetic distance measures (Nei 1978), which summarize multi-locus data into a single number, will also be calculated between all pairs of spawning locations. These values will be used to construct branching diagrams using numerical taxonomic techniques (UPGMA) which provide a representation of overall phenetic similarity. The stability of the resulting dendrogram will be evaluated using the jackknifing procedures of Lanyon (1985). A neighbor-joining tree (Saitou and Nei 1987) will be constructed to provide a phylogenetic tree relating the populations. Chi-square goodness-of-fit to Hardy-Weinberg equilibrium will be performed to test for random mating within each population.

Homogeneity of allelic frequencies among the various collections will be tested using a log-likelihood ratio analysis (G-statistic) (Smouse and Ward 1978) ($\alpha = 0.01$) (Cooper 1968). Rejection of the null hypothesis of homogeneity is indicative of discrete spawning populations. The total gene frequency dispersion at each locus will be subdivided into within-and among-

river system components in a hierarchical fashion. Hierarchical levels will be organized to test for homogeneity of 1) within drainages of the systems, 2) among drainages within river systems, and 3) among river systems. The likelihood analysis will use the computational formula of Sokal and Rohlf (1981). This statistic is distributed approximately as the chi-square statistic with (no. of alleles - 1) X (no. of region - 1) = (degrees of freedom). The likelihood values (G) can be summed over all loci to obtain a total value at each level of analysis.

Stock contribution to mixed fishery samples will be estimated using a conditional maximum likelihood program (GIRLSEM) developed by National Marine Fisheries Service (NMFS) (Pella and Milner 1987, Masuda et al. 1991) (see Appendix C). The precision of the stock composition estimates will be determined by bootstrap resampling (Efron and Tibshirani 1986). In bootstrapping, individuals of the stock and mixture samples are randomly resampled with replacement to obtain new samples equal in size to the original samples. Standard errors of stock composition estimates due to sampling errors in the stock and mixture samples can be estimated from the standard errors of composition estimates over resamplings of the bootstrap. Approximately 100 bootstrap resamplings should provide sufficiently accurate estimates of standard error (Masuda et al. 1991). Accuracy graphs will be obtained by constructing simulated samples of mixtures with specific stock proportions and then by bootstrap resampling the baseline to obtain estimates of stock proportions. This same type of simulation will be used to evaluate the effect of mixture sample size on the accuracy and precision of the stock composition estimates and will be used to adjust mixture sample size in succeeding years.

Considerable progress has been made in developing the analytical and computational techniques to rapidly provide fishery estimates for in-season management. Development of a comprehensive package of genetic analysis programs Windows applications (Microsoft Windows 3.1) has begun and includes the following components: 1) an on-line gel scoring program providing extensive documentation of results and error checking capability, 2) a set of genetic analysis programs providing allele frequency estimates, heterogeneity analyses, and fit to expected genetic models, and 3) revised input into the GIRLS algorithm (Masuda et al. 1991) to allow rapid fishery estimates and a flexible method to conduct multiple simulation studies. The object oriented genetics applications will work synchronously within the Windows environment to provide a user friendly interface for data input and complicated analyses so that the geneticists can make a fast turn-around from field samples to fishery estimates. Functional versions (beta) of these programs will be completed prior to the July, 1993, in-season fishery.

4. Alternatives:

The alternative of doing nothing and continuing harvest would risk overharvest of Kenai River sockeye salmon stocks and would further retard any recovery efforts. The alternative of total fishing closures would risk overescapement and underutilization of other Cook Inlet stocks. Underutilization translates into a significant EVOS-caused loss of human, social, and economic use.

5. Location:

The project will be conducted in Upper Cook Inlet, Alaska.

6. Benefits:

The resources affected have had an economic value in excess of $100 million dollars in direct commercial value. In addition, the resources have a major economic benefit to the sport fishing industry and are important to subsistence and personal use fishers on the Kenai Peninsula.

7. Technical Support:

Administrative support is provided by the Administrative, Habitat, and Commercial Fisheries Management and Development Divisions staff of the Alaska Department of Fish and Game. The project leaders are not funded by this project and are supported with general funds from the State of Alaska. These studies are integrated into ongoing studies by the Commercial Fisheries Management and Development Division.

8. Contracts:

A contract is proposed (value less than $ 10,000) to be awarded to the most qualified bidder for developmental work on DNA markers for stock identification.

9. Mitigation Measures:

No mitigation measures are required for this project.

10. Literature Cited:

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D. Schedules and Planning

The study is a continuation of work in progress. Laboratory and data analysis of genetic samples continues 12 months a year and will be in progress throughout the study period.

Data and Report Submission Schedule

Date	Activity
Mar.-July, 1993	Laboratory analysis of 1992 baseline populations
Mar.-July, 1993	Numerical analysis of 1992 stock structure and Cook Inlet fisheries
July, 1993	In-season fishery analysis
Aug,1993-May 1994*	Laboratory analyses of 1993 baseline populations
Aug,1993-June, 1994*	Numerical analysis of 1993 stock structure and Cook Inlet fisheries
Dec. 15, 1993*	Draft Status Report for FY93
Feb. 28, 1994*	Final Status Report for FY93

* Part or all of these studies will be completed in the following fiscal year (FY94)

Project Personnel:

Personnel	Responsibilities
Lisa W. Seeb, co-PI	Supervise lab staff and biometrician; GSI analyses, report writing
James E. Seeb, co-PI	Coordinator with Soldotna, report writing
Richard Gates, Proj. Biomet.	Data-base management, data handling and transfer, GSI analyses, simulation and modeling

Project Personnel Continue:

Personnel	Responsibilities
Laboratory Staff	
Fish Bio II	Lab logistics, allozyme team leader
Fish Bio IV	DNA team leader
Fish Tech III	Allozyme analysis
Fish Tech III	DNA analysis
Fish Tech III	Allozyme analysis
Fish Tech II	Allozyme analysis

E. Environmental Compliance/Permit/Coordination Status

No environmental effect of these programs occurs beyond that of traditional fisheries management data collection activities. These activities are within existing collecting permits or Federal special use permits issued to the Department of Fish and Game for scientific data collection.

Laboratory safety procedures and training will follow guidelines outlined in the Alaska Department of Fish and Game, Genetics Laboratory Hazard Communications Program. This program has been developed with the assistance of the Alaska Department of Occupational Safety and Health.

F. Performance Monitoring:

The performance monitoring of this project is through the checks and balances of the State of Alaska Accounting System with the Commercial Fisheries Management and Development, Habitat and Restoration, and Administration Divisions of the Department of Fish and Game and the Department of Administration. Contractual compliance, personnel hiring, EEO compliance, and other administrative provisions are within the State of Alaska hiring and administrative chains of command and covered in standard operating procedures and administrative regulations. Filling of new position follows state hiring guidelines when vacancies occur. Project time frames for reports and analysis are maintained through proper planning and integration of these activities within the existing administrative structure of the Commercial Fisheries Management and Development Division.

The scientific and technical aspects of the study are subject to internal review within the Division of Commercial Fisheries Management and Development. Publications are submitted through an internal peer review process with the major findings submitted to

peer-reviewed journals. Reports, work plans, and study design are subject to the peer review process established by the EVOS Board of Trustees and Chief Fisheries Scientist Office. Technical aspects of the genetic stock identification of Cook Inlet sockeye salmon will be presented at the annual meeting of the American Fisheries Society, Portland, OR. Interim annual status reports will be generated.

F. Personnel Qualifications:

Lisa. W. Seeb (L. Wishard)
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EDUCATION:

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

PROFESSIONAL EXPERIENCE:

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

SELECTED PUBLICATIONS:

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

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

PROFESSIONAL EXPERIENCE:

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

SELECTED PUBLICATIONS:

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

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Table 1. Sockeye salmon genetic samples originating from Upper Cook Inlet, 1992.

Collection Date(s)	Location	N
Kenai Peninsula Escapement		
Kasilof River Drainage		
7/29	Nikolai Creek	100
8/10	Moose Creek	100
8/11	Glacier Flats Creek	100
8/12	Bear Creek	100
Kenai River Drainage		
8/03	Hidden Creek	100
8/13	Quartz Creek	100
8/18	Between Kenai & Skilak Lakes	100
8/19	Outlet of Skilak Lake	100
7/01	Russian River (early run)	100
8/07	Russian River (late run)	100
8/31	Ptarmigan Creek	100
9/01	Tern Lake	50
Bishop Creek Drainage		
9/02	Outlet of Daniels Lake	100
Knik Arm Escapement		
Fish Creek Drainage		
7/22	Fish Creek (Big Lake)	100
Susitna River Drainage		
Talkeetna River		
8/20	Larson Creek	100

Table 1. Continued.

Collection Date(s)	Location	N
Yentna River		
8/20	Chelatna Lake	100
8/24	Hewitt Lake	50
9/09	Unnamed Slough (West Fork Yentna)	100
Skwentna River		
8/25	Shell Lake	100
Talachulitna River		
8/24	Judd Lake	100
8/25	Trinity Lake	100
West Side Escapement		
Beluga River Drainage		
9/01	Coal Creek	100
Chakachatna River Drainage		
9/08	Chilligan River	100
Crescent River Drainage		
7/01-7/27	Crescent River Composite	200
Packers Creek Drainage		
7/16	Packers Lake, Kalgin Island	100

Table 1. Continued.

Collection Date(s)	Location	N
Central District Drift Fishery		
7/13	Commercial Catch	200
7/20	Commercial Catch	160
Composite Sampling		
7/02-7/03	Kasilof River Composite	200
7/22-7/23	Kasilof River Composite	200
7/13-7/14	Kenai River Composite	200
7/26-7/27	Susitna River Composite (sunshine)	200
8/4	Susitna River Composite (sunshine)	114
7/15	Yentna River Composite	200
7/24	Yentna River Composite	200

Total Fish = 4,174

Baseline Fish = 2,500
Composite & Drift Fishery = 1,674

Table 2. Simulation results for varying contribution of Kenai River sockeye salmon in Cook Inlet mixtures.

True Fraction of Kenai R. Sockeye	GSI Estimated Fraction	Standard Deviation of Estimate
0.60	0.563	0.061
0.50	0.477	0.061
0.40	0.379	0.057
0.30	0.282	0.059
0.20	0.197	0.048

Table 3. Sampling locations proposed for genetic samples during the 1993 field season.

Location/Drainage	Population	Sample Size
Kenai River	Hidden Creek	100
	Quartz Creek	100
	Russian River (late)	100
	Skilak Lake outlet	100
	Between Lakes (early)	100
	Between Lakes (late)	100
	Russian River below	100
Kasilof	Nikolai Creek	100
	Moose Creek	100
	Bear Creek	100
Susitna River	Larson Creek	100
	Stephan Lake	100
	Hewitt/Whiskey Creek	100
	Judd Lake	100
	Chulatna Lake	100
	Trinity Lake	100
	Shell Lake	100
	W. Fork Yentna River	100
	Chunilna Creek	100
	Fish Creek	100
	Puntila Lake	100
	Red Salmon Lake	100
	Red Shirt Lake	100
	Swan Lake	100
	Trapper Lake	100
	Fish Lake Creek	100

Location/Drainage	Population	Sample Size
	Hungryman Creek	100
	Quartz Creek	100
	Eightmile Creek	100
Knik Arm	Fish Creek	100
	Cottonwood Creek	100
	Nancy Lake	100
	Wasilla Lake	100
Western Cook Inlet		
Beluga River	W. Fork Coal Creek	100
Chakachatna River	Chilligan River	100
Big River	Wolverine Creek	100
	McArthur River	100
	Crescent River	100
Total Baseline Samples		3,800

Table 4. Commercial fishery samples proposed for the 1993 field season

Location	Sample Size/Period	Total
Eastside Set Gillnet	400	800
Central Drift Gillnet	400	400
Total Fishery Samples		1200

Table 5. Enzymes or proteins screened in Cook Inlet sockeye salmon. Enzyme nomenclature follows Shaklee et al. (1990), and locus abbreviations are given. Buffer abbreviations are as described in text.

Enzyme or Protein	Enzyme Number	Locus	Tissue	Buffer
Aspartate aminotransferase	2.6.1.1	*sAAT-1,2*	Heart	ACE7
		sAAT-3	Eye	TBCL
		mAAT-1	Heart	ACE 7.2
		mAAT-2	Liver	ACE 7.0
		mAAT-3	Liver	ACE 7.0
Acid phosphatase	3.1.3.2	*ACP-1*	Liver	TBE
Adenosine deaminase	3.5.4.4	*ADA-1*	Heart	TBE
		ADA-2	Heart	TBE
Aconitate hydratase	4.2.1.3	*mAH-1,2*	Heart	ACE 7.0
		mAH-3	Heart	ACE 7.0
		mAH-4	Heart	ACE7.0
		sAH	Liver	ACE 7.0
Adenylate kinase	2.7.4.3	*AK*	Eye	ACE 7.0
Alanine aminotransferase	2.6.1.2	*ALAT*	Muscle	KG
Creatine kinase	2.7.3.2	*CK-A1*	Muscle	TBCL
		CK-A2	Muscle	TBCL
		CK-B	Eye	TBCLE
		CK-C1	Eye	TBCLE
		CK-C2	Eye	TBCLE
Esterase-D	3.1.1.-	*ESTD*	Muscle	TBCLE
Fructose-biphosphate aldolase	4.1.2.13	*FBALD-3*	Eye	ACE7.0
		FBALD-4	Eye	ACE 7.0

Table 5. Continued.

Enzyme or Protein	Enzyme Number	Locus	Tissue	Buffer
Fumarate hydratase	4.2.1.2	*FH*	Muscle	ACN 7.0
β-N-Acetylgalactosaminidase	3.2.53	*βGALA*	Liver	ACE 7.0
Glyceraldehyde-3-phosphate dehydrogenase	1.2.1.12	*GAPDH-1*	Muscle	ACN 7.0
		GAPDH-2	Heart	ACN 7.0
		GAPDH-3	Heart	ACN 7.0
		GAPDH-4	Eye	ACE 7.0
		GAPDH-5	Eye	ACE 7.0
Guanine deaminase	3.5.4.3	*GDA-1*	Liver	TC4
		GDA-2	Liver	TC4
N-Acetyl-β-glucosaminidase	3.2.1.53	*βGLUA*	Liver	TC4
Glycerol-3-phosphate dehydrogenase	1.1.1.8	*G3PDH-1,2*	Muscle	ACN 7.0
		G3PDH-3	Heart	ACN 7.0
		G3PDH-4	Heart	ACN 7.0
Glucose-6-phosphate isomerase	5.3.19	*GPI-B1,2*	Muscle	TBCLE
		GPI-A	Muscle	TBCLE
Glutathione reductase	1.6.4.2	*GR*	Eye	TBCLE
Hydroxyacylglutathione hydrolase	3.1.2.6	*HAGH*	Liver	TBE
L-Iditol dehydrogenase	1.1.1.14	*IDDH-1*	Liver	TBE
		IDDH-2	Liver	TBE

Table 5. Continued.

Enzyme or Protein	Enzyme Number	Locus	Tissue	Buffer
Isocitrate dehydrogenase (NADP+)	1.1.1.42	*mIDHP-1*	Heart	ACN 7.0
		mIDHP-2	Heart	ACN 7.0
		sIDHP-1	Liver	ACE 7.0
		sIDHP-2	Liver	ACE 7.0
L-Lactate dehydrogenase	1.1.1.27	*LDH-A1*	Muscle	ACN 7.0
		LDH-A2	Muscle	ACN 7.0
		LDH-B1	Eye	TBE
		LDH-B2	Liver	TBE
		LDH-C	Eye	TBE
αMannosidase	3.2.1.24	*αMAN*	Liver	TC4, ACE 7.0
Malate dehydrogenase	1.1.1.37	*sMDH-A1,2*	Heart	ACN 7.0
		sMDH-B1,2	Heart	ACN 7.0
		mMDH-1	Muscle	ACN 7.0
		mMDH-2	Muscle	ACN 7.0
		mMDH-3	Muscle	ACN 7.0
Malic enzyme (NADP+)	1.1.1.40	*sMEP-1*	Muscle	ACN 7.0
		sMEP-2	Liver	TC4

Table 5. Continued.

Enzyme or Protein	Enzyme Number	Locus	Tissue	Buffer
		mMEP	Muscle	ACN 7.0
Mannose-6-phosphate isomerase	5.3.1.8	*MPI*	Liver	TBE
Dipeptidase	3.4.-.-	*PEPA*	Eye	TBE
Tripeptide aminopeptidase	3.4.-.-	*PEPB-1*	Heart	TBE
Peptidase-C	3.4.-.-	*PEPC*	Eye	TBE
Proline dipeptiase	3.4.13.9	*PEPD-1*	Heart	TBE
Peptidase-LT	3.4.-.-	*PEPLT*	Muscle	KG
Phosphogluconate dehydrogenase	1.1.1.44	*PGDH*	Liver	ACE 7.0
Phosphoglucomutase	5.4.2.2	*PGM-1*	Heart	ACE 7.2
		PGM-2	Muscle	TBCLE
Phosphoglycerate kinase	2.7.2.3	*PGK-1*	Eye	ACE 7.0
		PGK-2	Eye	ACE 7.0
Pyruvate kinase	2.7.1.40	*PK-1*	Heart	ACN 7.0
		PK-2	Heart	ACN 7.0
Purine-nucleoside phosphorylase	2.4.2.1	*PNP-1*	Eye	TBCL
Superoxide dismutase	1.15.1.1	*sSOD-1*	Liver	TBE
		mSOD	Heart	ACN 7.0
Triose-phosphate isomerase	5.3.1.1	*TPI-1,2*	Eye	TBCL
		TPI-3	Eye	TBCL

Figure 1. Map of Cook Inlet, Alaska.

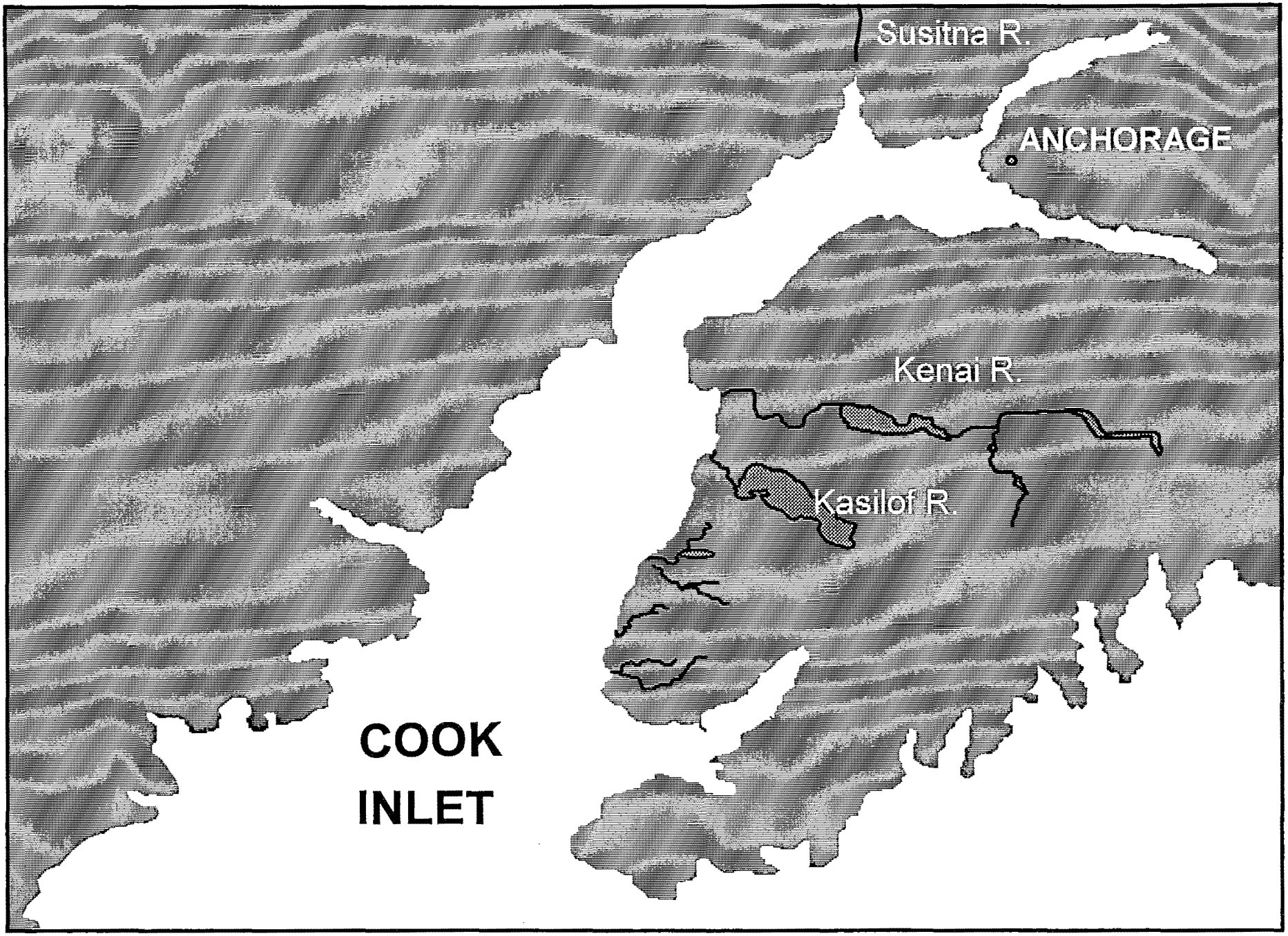

Figure 1. Map of Cook Inlet, Alaska.

APPENDIX A

25 May 1993

Collection of Finfish Genetic Samples
ADF&G Genetics Laboratory, Anchorage

I. General info

We use tissue samples from muscle, liver, heart, and eye from individual fish to determine the genetic characteristics and profile of a particular run or stock of fish. The most important thing to remember in collecting samples is that tissues need to be as fresh and as cold as possible at all times.

II. Sample size

A sample size of 50-100 adult fish is preferred for the baseline electrophoretic study. Samples of juveniles are statistically less desirable and sample sizes will need to be larger than for adults; generally a sample size of 150-200 juveniles is necessary.

III. Tissue sampling

A. General set up

We use four tissues (muscle, liver, eye, and heart) for protein electrophoresis. Working fast is necessary, so it is best to try to get set up in as comfortable a place as possible. You might use a portable table, piece of plywood, or anything to give you a surface at a good height. Before sampling (night before?), label tubes using lab markers or adhesive labels (provided in sampling kit). Place the prepared tubes in the racks provided. Four separate tubes, corresponding to the four tissues, should be labeled for each individual. The following code should be used:

Species code	* see instructions for each project
Location code	* see instructions for each project
Individual #	# i.e. 01, 02, 03....100
Tissue	M,L,E,H (muscle, liver, eye, heart)

B. Use of liquid nitrogen

We will be using a liquid nitrogen container to immediately freeze the tissues. Inside the liquid nitrogen container are 6 cylindrical canisters. We

have shipped special test tubes called "cryotubes" in which to place the samples. These cryotubes have plastic seals and screw on caps to withstand liquid nitrogen storage. Five to six tubes are stored in a cane.

The working time of the liquid nitrogen container under normal conditions is 81 days (35VHC) or 50 days (18HC). To prolong the liquid nitrogen, samples can be pre-frozen (if a freezer or dry ice is available) and added in a group to minimize the number of times the container is opened. The liquid nitrogen level can be checked periodically with a flashlight or actually measured with a stick (2.3 liters/inch in 35VHC; 1.25 liters/inch in 18HC).

"Large" 35 VHC container:
30 canes will fit in each of the six canisters. 5 cryovials will fit on a cane comfortably or 6 in a pinch. Total capacity is 900 - 1080 tubes.

"Small" 18HC container:
17 canes will fit in each of the six canisters. 5 to 6 cryovials will fit on a cane. The total capacity is 510 - 612 Nalgene tubes.

Safety with liquid nitrogen:

1. Wear gloves, protective eyewear, and protective footwear when placing samples in container. Liquid nitrogen boils at -196°, and it will spit and boil when samples are added.

2. Do not tip the tank over as it does not seal.

3. Keep lid on liquid nitrogen container at all times when you are not placing samples in it.

4. Use a small cooler with ice, snow, or blue ice to hold canes until an adequate number are collected to be put in liquid nitrogen container. Depending on the conditions and the speed of sampling, place samples in liquid nitrogen within about one hour of sampling.

5. Use liquid nitrogen only in well ventilated areas (usually not a problem in the field). Avoid directly breathing the vapor.

6. Hazardous Materials Forms need to be filled out when shipping a filled liquid nitrogen container by air cargo.

B. Actual sampling

Please take samples from freshly killed fish. We find it easiest to set up four canes simultaneously and organize the samples in canes by tissue. Thus, muscle tissue from fish 1-5 would all be in one cane.

Fill the tubes approximately 3/4 full or to the 1.8 ml mark, leaving air space at the top. Overfilling the tubes can cause them to burst when frozen. Please minimize the amount of blood, dirt, skin, and fat in the sample.

1. Muscle

Muscle samples should be "white" muscle, not muscle from along the lateral line. Use a piece of muscle dorsal to the lateral line. If you have trouble getting the tissue into the tubes, cut it into smaller pieces.

2. Liver

The liver is (generally) located on the fish's left side, just behind the pectoral fin. An L-shaped incision slicing down ventrally behind the pectoral fin then caudally along the belly works well. Please do not include the gall bladder (the small green/yellow sac of fluid attached to the liver).

3. Heart

Once you have taken the liver, it is easy to get the heart by just opening the belly incision towards the head.

4. Eye

There are two ways to take the eyes. If the eyes are small enough (juveniles), they can be placed intact into a cryotube. This is the easiest method. If they are too large, you must pipette out the liquid and black retinal fluid. Using a sharp scalpel, cut a small slit in the surface of the eye, then insert a pipette into the slit and suck out the fluid and black retinal material. Squirt this into the cryotube.

We appreciate your help with the sampling. If you have any questions, please give us a call.

Lisa Seeb	267-2249
Chris Habicht	267-2169
Laboratory (Kristin Denning)	267-2454

APPENDIX B

Guidelines for GSI Fishery Sampling

I. General info

We use tissue samples from muscle, liver, heart, and eye from individual fish to determine the genetic characteristics and profile of the fishery. Fish sampled from the fishery will be of varying quality. However, once you begin sampling, the tissues need to be handled carefully and kept as cold as possible at all times.

II. Sample size and design

A sample size of 400 fish per sampling period per area is needed. Our goal is to obtain as dispersed and randomized sampling of the fishery as possible. If feasible, sample in 100 fish groups to spread sampling across the sampling period. If this is not possible, 400 fish can be set aside and sampled as a group.

III. Tissue sampling

A. General set up

We use four tissues (muscle, liver, eye, and heart) for protein electrophoresis. **It is critical in fishery sampling to insure that all tissues from one individual are correctly marked.** We must be able to merge data across tissues for each individual

Working fast is necessary, so it is best to try to get set up in as comfortable a place as possible. You might use a portable table, piece of plywood, or anything to give you a surface at a good height. Before sampling (night before?), label tubes using adhesive labels (provided in sampling kit). Place the prepared tubes in the racks provided. Four separate tubes, corresponding to the four tissues, should be labeled for each individual. The following code should be used:

Species code	* see instructions for each project
Location code	* see instructions for each project
Individual #	# i.e. 01, 02, 03....100
Tissue	M,L,E,H (muscle, liver, eye, heart)

B. Use of liquid nitrogen

We will be using a liquid nitrogen container to immediately freeze the tissues. Inside the liquid nitrogen container are 6 cylindrical canisters. We have shipped special test tubes called "cryotubes" in which to place the samples. These cryotubes have plastic seals and screw on caps to withstand liquid nitrogen storage. Five to six tubes are stored in a cane.

The working time of the liquid nitrogen container under normal conditions is 81 days (35VHC) or 50 days (18HC). To prolong the liquid nitrogen, samples can be pre-frozen (if a freezer or dry ice is available) and added in a group to minimize the number of times the container is opened. The liquid nitrogen level can be checked periodically with a flashlight or actually measured with a stick (2.3 liters/inch in 35VHC; 1.25 liters/inch in 18HC).

"Large" 35 VHC container:
30 canes will fit in each of the six canisters. 5 cryovials will fit on a cane comfortably or 6 in a pinch. Total capacity is 900 - 1080 tubes.

"Small" 18HC container:
17 canes will fit in each of the six canisters. 5 to 6 cryovials will fit on a cane. The total capacity is 510 - 612 Nalgene tubes.

Safety with liquid nitrogen:

1. Wear gloves, protective eyewear, and protective footwear when placing samples in container. Liquid nitrogen boils at -196°, and it will spit and boil when samples are added.

2. Do not tip the tank over as it does not seal.

3. Keep lid on liquid nitrogen container at all times when you are not placing samples in it.

4. Use a small cooler with ice, snow, or blue ice to hold canes until an adequate number are collected to be put in liquid nitrogen container. Depending on the conditions and the speed of sampling, place samples in liquid nitrogen within about one hour of sampling.

5. Use liquid nitrogen only in well ventilated areas (usually not a problem in the field). Avoid directly breathing the vapor.

6. Hazardous Materials Forms need to be filled out when shipping a filled liquid nitrogen container by air cargo.

B. Actual sampling

We find it easiest to set up four canes simultaneously and organize the

samples in canes by tissue. Thus, muscle tissue from fish 1-5 would all be in one cane.

Fill the tubes approximately 3/4 full or to the 1.8 ml mark, leaving air space at the top. Overfilling the tubes can cause them to burst when frozen. Please minimize the amount of blood, dirt, skin, and fat in the sample.

1. Muscle

From fishery samples, muscle tissue can originate from anywhere on the body or head including the cheek. If you have trouble getting the tissue into the tubes, cut it into smaller pieces.

2. Liver

The liver is (generally) located on the fish's left side, just behind the pectoral fin. An L-shaped incision slicing down ventrally behind the pectoral fin then caudally along the belly works well. Please do not include the gall bladder (the small green/yellow sac of fluid attached to the liver).

3. Heart

Once you have taken the liver, it is easy to get the heart by just opening the belly incision towards the head.

4. Eye

Pipette out the liquid and black retinal fluid. Using a sharp scalpel, cut a small slit in the surface of the eye, then insert a pipette into the slit and suck out the fluid and black retinal material. Squirt this into the cryotube.

We appreciate your help with the sampling. If you have any questions, please give us a call.

Lisa Seeb 267-2249
Chris Habicht 267-21169
Laboratory (Kristin Denning) 267-2454

APPENDIX C

Maximum likelihood estimation procedure

Consider a mixed-stock sample of N fish that contains G multilocus genotypes. The likelihood function for the observed multilocus genotype frequencies is multinomial

$$L = \prod_{i=1}^{G} \lambda_i^{Y_i} , \qquad (1)$$

Millar (1987), where λ_i is the probability of occurrence of the ith genotype and Y_i is the number of fish in the mixture with the ith genotype. Moreover, the genotype probabilities in the fishery are a linear function of the conditional probabilities of genotype given stock and the S proportionate stock contributions

$$\lambda_i = \sum_{j=1}^{S} x_{ij}\theta_j , \qquad (2)$$

Millar (1987), where θ_j is the proportionate contribution of the jth stock and x_{ij} is the conditional probability of the ith genotype given an individual is from the jth stock. These conditional probabilities are computed using a multinomial probability function for each locus in the analysis, where the multinomial parameters are the allele relative frequencies in the baseline, and the observed allele counts in the mixture sample taken from the fishery. The individual locus genotypes are assumed to be independent so that the multilocus genotype conditional probability is the product of each single locus genotype conditional probability.

Maximum likelihood estimation is carried out by finding the best stock proportions, θ, that produces the genotype probabilities, λ, in Equation 2 that best explains the data, Y, in Equation 1.

Several nonlinear optimization algorithms can be used to solve for the optimal stock proportions (Pella and Milner 1987). With the EM algorithm (Dempster et al. 1977), new θ estimates at iteration $t + 1$ are calculated as:

$$\theta_j^{(t+1)} = \frac{\theta_j^{(t)}}{N} \sum_{i=1}^{G} \left(\frac{Y_i x_{ij}}{\lambda_i^{(t)}} \right) , \qquad (3)$$

where $\lambda_i^{(t)}$ is computed by Equation 2 on each iteration. Initially all θ values are set to $1/S$. Iterations are continued until the maximum difference between θ values on successive iterations falls below a specified value.

The program GIRLSEM uses the EM algorithm in the inital search for a

solution, then switches to the Gauss-Newton algorithm. Because the likelihood is from the exponential family and due to the linear relation in Equation 2, the Gauss-Newton algorithm reduces to an interatively reweighted least squares algorithm (IRLS) (Masuda et al. 1991). Moreover,

the solution is constrained so that $0 \leq \sum_{i=0}^{s-1} \theta_i \leq 1$ and $\theta_s = 1 - \sum_{i=1}^{s-1} \theta_i$.

The algorithm of GIRLSEM is far too complicated to be discussed here, and the reader is referred to the GIRLSEM User Guide (Masuda et al., 1991) for a detailed explanation of its mathematical numerics. Further detailed discussion of the MLE applications can also be found in Pella and Milner (1987), Millar (1987), and Fournier et al. (1984).

Project Description: This project targets restoration of the EVOS-damaged Kenai River sockeye stocks by using stock identification techniques to protect damaged stocks from interception in commercial fisheries. Starting in 1992 we will collect baseline genetic data from 28 subpopulations from the Kenai, Kasilof, and Susitna Rivers. Samples from the Cook Inlet commercial harvest will be analyzed and reduced to stock components using these data and GSI techniques starting in 1993. Area managers will use this information to modify fishing areas and openings in order to facilitate harvest of the surplus Kasilof River and Susitna stocks while protecting the depleted Kenai River stocks.

Budget Category	Approved** 1-Oct-92 28-Feb-93	Proposed* 1-Mar-93 30-Sep-93	Total FY 93	FY 94	FY 95	FY 96	FY 97	Sum FY 98 & Beyond
Personnel	$73.5	$179.5	$253.0	$240.0	$252.0	$0.0	$0.0	$0.0
Travel	$2.5	$12.0	$14.5	$14.0	$15.0	$0.0	$0.0	$0.0
Contractual	$3.5	$18.0	$21.5	$40.0	$42.0	$0.0	$0.0	$0.0
Commodities	$14.8	$34.7	$49.5	$55.0	$58.0	$0.0	$0.0	$0.0
Equipment	$0.0	$31.9	$31.9	$20.0	$10.0	$0.0	$0.0	$0.0
Capital Outlay	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Sub-total	$94.3	$276.1	$370.4	$38.8	$377.0	$0.0	$0.0	$0.0
General Administration	$11.3	$24.5	$35.8	$67.0	$40.7	$0.0	$0.0	$0.0
Project Total	$105.6	$300.6	$406.2	$105.8	$417.7	$0.0	$0.0	$0.0
Full-time Equivalents (FTE)	2.1	3.9	6	4.8	5.1			

Amounts are shown in thousands of dollars.

Budget Year Proposed Personnel: Position	Months Budgeted	Cost
1 Biometrician	7.0	$35.0
1 Fisheries Biologist II	7.0	$32.0
3 FW Technician III	21.0	$65.4
1 FW Technician II	7.0	$19.0
1 Analyst/Programmer IV	1.3	$6.7
1 Analyst/Programmer II	0.8	$3.1
1 Publication Specialist II	0.8	$3.3
1 Program manager	2.0	$15.0

Comment

* FY93 is a transition year from the previously used oil fiscal year to the federal fiscal year.

** If not funded in FY94, $169.0K will be needed for removal of field equipment, data analysis and final report preparation.

FY 93 is a transition year from the previously used oil fiscal year to the federal fiscal year. This new project also includes proposed funding for January and February, 1993.

June 17, 1993

Project Number: 93012
Project Title: Genetic Stock Identification of Kenai River Sockeye Salmon
Agency:AK Dept. of Fish & Game

FORM 2A PROJECT DETAIL

1993

93015

DETAILED RESTORATION PROJECT DESCRIPTION

Project Title: Kenai River Sockeye Salmon Restoration

Project ID#: 93015

Project Type: Restoration

Project Leader: Kenneth E. Tarbox

Lead Agency: Alaska Department of Fish and Game

Cooperating Agencies: None

Project Cost: $457 K

Start Date: Continuing (Oct. 1, 1992) **Finish Date:** Continuing (September 30, 1993)

Geographic Area of Project: Upper Cook Inlet, Alaska

Project Leader Signature: Stephen M Fried for Kenneth E. Tarbox

Project Manager:

Name:

Signature:

A. Introduction

Sockeye salmon *Oncorhynchus nerka* which spawn in the Kenai River system (Figure 1) were injured by the Exxon Valdez oil spill (EVOS). Greatly reduced fishing time in the Upper Cook Inlet (UCI) area due to EVOS caused sockeye salmon spawning escapement levels in the Kenai River system to exceed the desired amount by three times. The biological impact of EVOS on Kenai River sockeye salmon stocks may be one of the most serious documented. Data collected by NRDA Fish/Shellfish Study 27, Sockeye Salmon Overescapement, indicated greatly reduced survival of juvenile sockeye salmon during the winter-spring rearing period. The extremely high escapement may have initially produced more rearing juvenile sockeye salmon than could be supported by nursery lake productivity. In general, when rearing salmon abundance greatly exceeds lake carrying capacity, the species and size composition of prey resources are altered which affects all trophic levels. Because of such changes, juvenile sockeye growth is reduced, freshwater mortality is increased, greater proportions of fry remain in the lake for another year of rearing, and smolt condition is reduced and marine mortality is increased. Limiting sockeye salmon fry production by closely regulating the number of spawning adults may be the only way to restore the productivity of these rearing areas.

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

Results from the 1992 investigations (Tarbox 1993) indicated that modification to the 1993 proposed studies submitted in the fall of 1992 was necessary. Results indicated that new "off the shelf" salmon counting hydroacoustic equipment for use starting in 1994 is not available. Sockeye salmon behavior (nearshore orientation) and densities (> 1500 hour) in the Kenai River prohibited the direct purchase of replacement equipment for the existing Bendix sonar counters. Therefore, this phase of the project has been dropped and the budget adjusted accordingly. In addition, a reduction in scope and cost has been incorporated into the test fish portion of the project.

B. Project Description

1. Resources and/or Services:

This study will investigate sockeye salmon in the Kenai River system on the Kenai Peninsula (Figure 1). Recent findings (Schmidt and Tarbox 1992) have suggested major economic damage to commercial, subsistence, and sport fisheries may result because of the sockeye salmon over-escapement event associated with fisheries closures caused by the 1989 oil spill. Smolt emigrating from the Kenai River in the spring of 1992 were less than one-fiftieth the number estimated in 1989. This suggests a likely possibility of future returns below existing escapement goals.

2. Objectives:

The following revised objectives are based on data presented in the 1992 progress report:

1. improve stock identification capabilities by combining parasite and genetic stock identification information in algorithms to provide estimates of Kenai River stocks in the mixed stock fishery of UCI.

2. provide more accurate estimates of abundance of Kenai River sockeye salmon within UCI by increasing the sampling power of the offshore test fishing program.

3. Methods:

Stock identification

Stock identification studies used to regulate human use of UCI sockeye salmon have in past years relied on scale growth patterns. The accuracy and precision of this technique has varied considerably from year to year (D. Waltemyer, personal communication, ADF&G). Kenai stocks typically dominate the total return, and their scale patterns are generally distinct enough to provide some separation from other stocks. However, when runs to other systems are more abundant (as may occur in 1993, 1994) separation of Kenai stocks will be much more difficult. To be able to identify the contribution of Kenai River sockeye salmon to the total run accurately in this situation will require improvements in stock identification procedures. Recent work by the principal investigators, in cooperation with National Marine Fisheries Service staff, has shown that parasite occurrence can be used to improve estimates of stock contribution during the fishing season (Tarbox et. al 1991). The combination of parasites and genetic stock identification techniques (Restoration Science Study Number 59) should greatly increase the accuracy of UCI stock assessment estimates.

Sockeye salmon escapements into major drainages of Upper Cook Inlet (Table 1) will be sampled for genetic and parasite characteristics. During this second year of this continuing project, 15 populations of the original 25 sampled in 1992 will be resampled to evaluate stability of the genetic markers. In addition, mixed stock samples will be collected from a single drift net and set net fishing period to test the feasibility of "in season" techniques relative to management use. Sample sizes for allozyme baseline collections have been set at 100 to maximize the precision around allele frequency estimates (Allendorf and Phelps 1981, Waples 1990). Mixed stock sample sizes have been set at a minimum of 400 based on the results of simulation studies conducted with 1992 baseline data (L. Seeb, personal communication, ADF&G).

Muscle, liver, eye, and heart will be dissected from recently killed sockeye salmon. Tissues will be placed in labeled cryovials stored in liquid nitrogen until transferred to -80^{0}C storage freezers in Soldotna or Anchorage. Soldotna samples will be shipped to the ADF&G Anchorage laboratory on dry ice or liquid nitrogen and again placed in -80^{0}C storage until processed. Laboratory analysis will be done under project 93012. The body cavity of each sockeye salmon will be examined for the presence of the nematode *Philonema oncorhynchi* (Tarbox et al. 1991).

Offshore Test Fish Program

The sockeye salmon total run to UCI has been estimated early during the season by test fishing between Anchor River and Red River delta (Tarbox 1992). Sockeye salmon returning to UCI are captured with a drift gill net at a series of stations. Salmon are identified to species and sex, and length measurements are made. Estimates of total sockeye salmon return are made several times during the season by estimating expected total test fishery catch per unit of effort (CPUE) for the season and catchability of sockeye salmon in the test fishery. Analysis of historical data has indicated that existing sampling effort and catch has not been proportional to abundance. To assess run size more accurately, additional sampling effort will be added to the existing program.

In 1992 hydroacoustic equipment and techniques were tested in UCI offshore waters. Results of this work indicated that hydroacoustic techniques could detect salmon and provide a population estimate for "in season" management use (Thorne and Salomone 1993). However, the primary limitation identified in the study was vessel speed relative to limitations (signal/noise ratio) of the hydroacoustic gear. Examination of the data set indicated that a minimum of 12 random orthogonal transects within UCI would be needed to provide a useable estimate of adult salmon abundance. In 1992 vessel speed was 5.5 km/hr, and at this speed an "in season" estimate could not be generated within 48 hours (window of opportunity between management decisions). Therefore, in 1993 an increase of vessel speed to 10 km/hr will be attempted while completing the 12 randomly selected transects. In addition to this effort the vessel and hydroacoustic gear will be deployed for six days in conjunction with the existing ADF&G test fish vessel at Anchor Point. The estimates of salmon abundance will be compared with the test fish catch for a preliminary development of a program to estimate sockeye salmon hydroacoustic targets.

4. Alternatives:

An alternative is to do nothing with the risk that either the Kenai River sockeye stock will be over-harvested and further retard any recovery efforts or that the other stocks in Cook Inlet will be under utilized with the risk of overescapement consequences or at a minimum a loss of human social and economic use.

5. Location:

This project will be conducted in Upper Cook Inlet, Alaska.

6. Benefits:

The resources affected have had an annual economic value in excess of $100 million dollars in direct commercial value. In addition, the resources have a major economic benefit to the sport fishing industry and are important to subsistence and personal use fishers on the Kenai Peninsula.

7. Technical Support:

Administrative support is provided by the Administrative, Habitat, and Commercial Fisheries

Divisions staff of the Alaska Department of Fish and Game. The project leaders and their assistants are not fully funded by this project and are supported with general funds from the State of Alaska. These studies are integrated with ongoing studies by the Commercial Fisheries Division. Consequently, the EVOS investigations have been integrated into the normal operations of these Divisions for efficiency in completing the objectives of these studies.

8. Contracts:

A sole source contract is proposed (value not to exceed $70,000) to be awarded to *BioSonics Inc.* for continuing work in UCI with hydroacoustic equipment. *BioSonics Inc.* was awarded the original contract in 1992 through competitive bid procedures. The experience gained in 1992 and the recent purchase of *BioSonics Inc* equipment for this project make them the logical contractor for the continuation of these studies.

9. Mitigation Measures:

No mitigation measures are required for this project.

10. Literature Cited:

Allendorf, F.W. and S. R. Phelps. 1981. Use of allelic frequencies to describe population structure. Can. J. Fish. Aquat. Sci. 38:1507 - 1514.

Tarbox, K.E. 1992. An estimate of the migratory timing of sockeye salmon into Upper Cook Inlet, Alaska, in 1991 using a test fishery. Regional Information Report 2S92-1. Alaska Department of Fish and Game, Anchorage.

Tarbox, K.E. 1993. State/Federal Natural Resources Damage Assessment status report for Restoration Science Study R53. Alaska Department of Fish and Game, Soldotna.

Tarbox, K.E., A. Moles, and D.L. Waltemyer. 1991. Presence of parasites in sockeye salmon of Upper Cook Inlet, Alaska. Regional Information Report 2S91-5. Alaska Department of Fish and Game, Commercial Fisheries Division, Anchorage.

Thorne, R.E. and P. Salomone. 1993. Feasibility study of acoustic techniques for adult salmon assessment in Upper Cook Inlet. Prepared for ADF&G by BioSonics, Inc., Seattle.

Schmidt, D. and K.E. Tarbox. 1992. State/Federal Natural Resources Damage Assessment status draft preliminary status report for Fish/Shellfish Study No. 27. Alaska Department of Fish and Game, Soldotna.

Waples, R.S. 1990. Temporal changes of allele frequency in Pacific salmon: implications for mixed stock fishery analysis. Can. J. Fish. Aquat. Sci.47:968-976

C. Schedules and Planning

The studies described are generally continuations of work in progress. Laboratory and data analysis of field samples continues 12 months a year and will be in progress throughout the study period. Field data collection efforts begin in mid June.

Task	Dates
Stock Identification	May - September
Hydroacoustic Surveys	July
Progress Report for FY93	February 1994
Draft Final Report for FY 93	March 1994 *
Final Report for FY 93	June 1994 *

* Part or all of these studies will be completed in the following fiscal year (FY94).

D. Environmental Compliance/Permit/Coordination Status

The studies proposed provide for data collection and field sampling programs. No environmental effect of these programs occurs beyond that of traditional fisheries management data collection activities. These activities are within existing collecting permits or Federal special use permits issued to the Department of Fish and Game for scientific data collection. No other permits or other coordination activities are involved. This project received a categorical exclusion under the National Environmental Policies Act (NEPA).

E. Performance Monitoring

The performance monitoring of this project is monitored through the checks and balances of the State of Alaska Accounting System within the Commercial Fisheries, Habitat and Restoration, and Administration Divisions of the Department of Fish and Game and the Department of Administration. Contractual compliance, personnel hiring, EEO compliance, and other administrative provisions are within the State of Alaska hiring and administrative chains of command and covered in standard operating procedures and administrative regulations. Replacement personnel are readily available by reassignment from permanent and seasonal staff within the commercial Fisheries Division of the ADF&G in Soldotna and Anchorage, when temporary problems are encountered. Filling new position follows state hiring guidelines when permanent vacancies occur. Project time frames for reports and analysis are maintained through proper planning and integration of these activities within the existing administrative structure of the Commercial Fisheries Division.

The scientific and technical aspects of the study are subject to internal review within FRED and the Commercial Fisheries divisions. Publications are submitted through an internal peer review process

with the major findings submitted to peer review journals. Reports, work plans, and study design are subject to the peer review process established by the EVOS Board of Trustees and Chief Scientist office. This year technical aspects of the overescapement studies' findings to date and future plans were reviewed by a panel of international sockeye salmon researchers in a special half day session of the Kokanee and Sockeye Salmon workshop sponsored by the Northern Pacific International Chapter of the American Fisheries Society at Vancouver, B.C. in March, 1992. These studies provide the basis for the management programs being developed under this restoration project. Interim annual status reports will be generated with publications being provided in peer review journals and scientific symposia, as significant findings are obtained. The final report will be issued upon completion of the final year of field data collection.

F. Personnel Qualifications

Principal Investigator:

Mr. Ken Tarbox, UCI Commercial Fisheries Division Research Project Leader, Soldotna, AK. Mr. Tarbox has served as the Research Project Leader for UCI for 13 years. During this period he has been responsible for the conduct of hydroacoustic monitoring of adult salmon escapements, stock identification programs, offshore test fish programs, and rearing studies of juvenile sockeye salmon in the Kenai River drainage. Mr Tarbox has numerous publications related to these tasks.

Other staff:

Numerous other staff of ADF&G provide assistance in completing these studies.
Primary staff include:
Project Biometrician: Linda Brannian, ADF&G, Anchorage.
Project Assistant: Dave Waltemyer, ADF&G, Soldotna.

G. Budget

Detailed budget submittals are provided in the attached table.

Budget Category	Approved 1-Oct-92 28-Feb-93	Proposed* 1-Mar-93 30-Sep-93	Total FY 93
Personnel	73.3	203.1	273.9
Travel	4.2	10.6	14.8
Contractual	116.4	136.5	252.9
Commodities	3.2	41.2	44.4
Equipment	86.9	25.4	112.3
Capital Outlay	0	0	0
Sub-total	284.0	416.8	700.8
General Administration	19.1	40.0	59.1
Project Total	303.1	456.8	759.9
Full-time Equivalents (FTE)	0	4.0	4.0

Table 1. Sampling schedule for the 1993 field season - genetic program.

Type	Location/Drainage	Spawning Stock	Sample Size
Commercial Fishery	Eastside Set Gillnet		800
	Central Drift Gillnet		400
Spawning Populations			
	Kenai River	Hidden Creek	100
		Quartz Creak	100
		Russian River (late)	100
		Skilak Lake outlet	100
		Between Lakes (Early	100
		Between Lakes (Late)	100
		Russian River below	100
	Kasilof River	Nikolai Creek	100
		Moose Creek	100
		Bear Creek	100
	Susitna River	Larson Creek	100
		Stephan Lake	100
		Hewitt/Whiskey Creek	100
		Judd Lake	100
		Chulatna Lake	100
		Trinity Lake	100
		Shell Lake	100
		W. Fork Yentna Rive	100
		Chunilna Creek	100
		Fish Creek	100
		Puntila Lake	100
		Red Salmon Lake	100
		Red Shirt Lake	100
		Swan Lake	100
		Trapper Lake	100
		Fish Lake Creek	100
		Hungryman Creek	100
		Quartz Creek	100
		Eightmile Creek	100
	Knik Arm	Fish Creek	100
		Cottonwood Creek	100
		Nancy Lake	100
		Wasilla Lake	100
	Western Cook Inlet		
	Beluga River	W. Fork Coal Cr	100
	Chakachatna River	Chilligan River	100
	Big River	Wolverine Creek	100
		McArthur River	100
		Crescent River	100
Total Samples			5,000

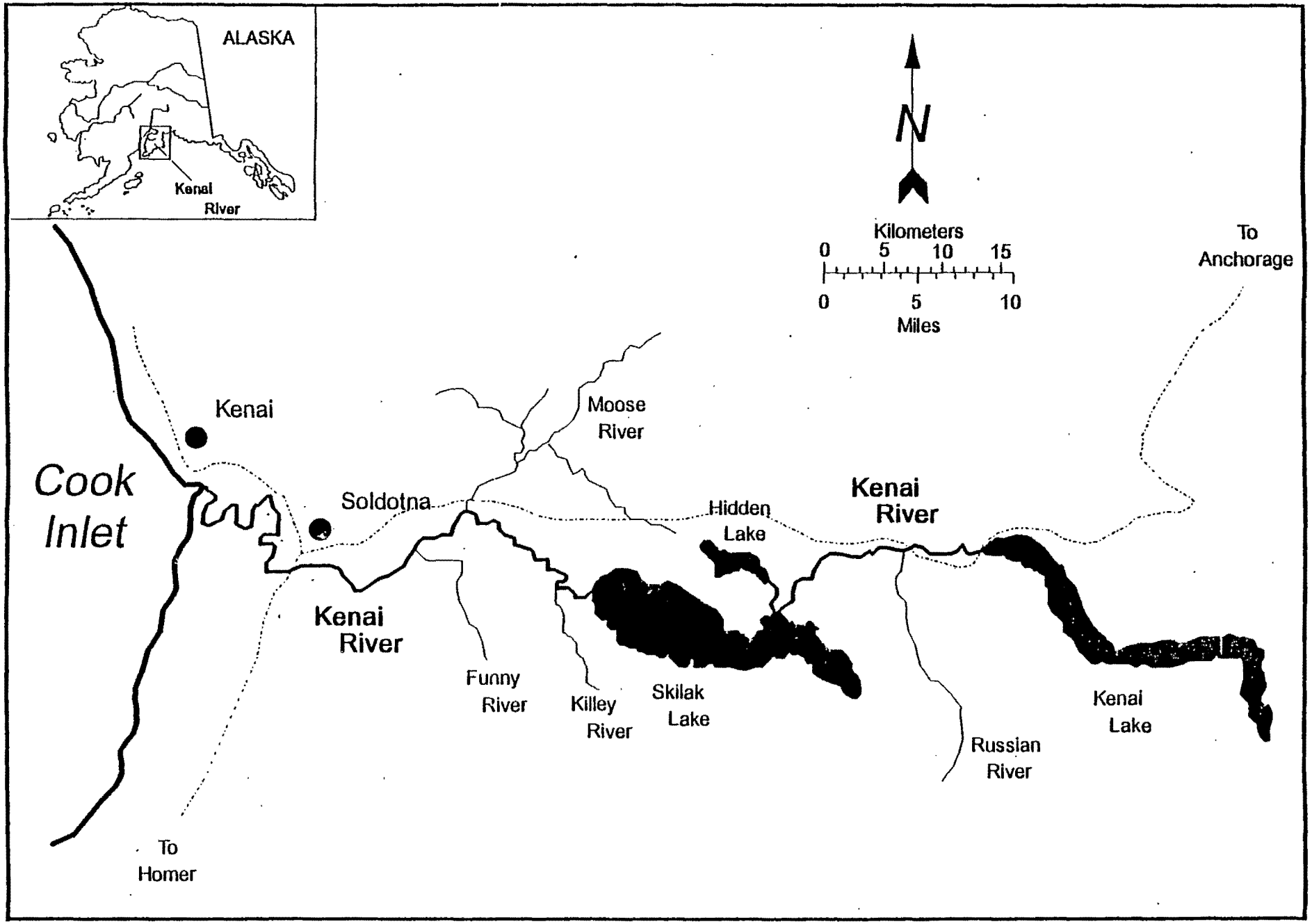

Figure 1. Map of the Kenai River drainage

93017

DETAILED RESTORATION PROJECT DESCRIPTION

Project Title: SUBSISTENCE RESTORATION PROJECT

Project ID #: 93017

Project Type: Subsistence

Project Leader: Rita A. Miraglia

Lead Agency: Alaska Department of Fish and Game

Cooperating Agencies: USDOI, Bureau of Indian Affairs,
National Oceanographic and Atmospheric Administration

Project Cost: $307,100

Start Date: 3/1/93 **Finish Date:** 9/30/93

Geographic Area of Project: Prince William Sound, Kenai Peninsula, Kodiak Island, and the Alaska Peninsula

Project Leader Signature:

Project Manager:

Name: Dr. Joseph R. Sullivan

Signature:

A. INTRODUCTION

Subsistence uses of fish and other wildlife make up a vital natural resource service that was injured by the *Exxon Valdez* oil spill. Data collected by the Alaska Department of Fish and Game's Division of Subsistence demonstrated this injury. Annual per capita subsistence harvests declined dramatically in ten of the communities the year after the spill. The decline ranged between 12 and 77 percent of prespill averages. Harvests in some communities showed limited recoveries in the second year after the spill, while harvest levels in other communities showed no signs of recovery. Concerns arose over the long term health effects of using resources from the spill area. These concerns resulted in a loss of confidence by subsistence hunters and fishermen in their own abilities to decide if their traditional foods are safe to eat. These concerns, as well as a perceived reduction in available resources, contributed to the reduced harvest levels. We propose to undertake a subsistence restoration project involving the following communities; Chenega Bay, Tatitlek, Cordova, Valdez, Nanwalek, Port Graham, Seldovia, Kenai, Seward, Larsen Bay, Karluk, Old Harbor, Akhiok, Port Lions, Ouzinkie, Kodiak City, Chignik Lake, Chignik, and Chignik Lagoon.

The goal of the project is to restore the subsistence uses of fish and wildlife damaged by the Exxon Valdez Oil Spill. Community meetings are planned to help identify and map the specific areas and resources of continued concern to subsistence users. This will provide a comprehensive, final opportunity to identify these concerns. This project will be coordinated with the Alaska Department of Environmental Conservation's spring shoreline survey (Restoration Project #38) to corroborate the reports of persistent oiling. Samples of subsistence species of continued concern will be collected from harvest areas identified during the mapping. Community representatives will help in site selection as well as the collection of samples. The samples will be analyzed for the presence of hydrocarbon contamination. The analyses are to be done at the National Oceanic and Atmospheric Administration/National Marine Fisheries laboratory in Seattle. Community representatives will be transported to the lab and given a tour of the facilities. The results of the tests, along with findings from other damage assessment and restoration studies, will be interpreted by the Oil Spill Health Task Force and reported to the communities in an informational newsletter and community visits. This information will help the Trustee Council to make decisions concerning restoration, enhancement or replacement of lost subsistence resources and uses.

B. PROJECT DESCRIPTION

Resources and/or Services:

This project will provide information to restore not only the subsistence resources but the confidence of the communities that use those resources.

Objectives:

The goal of the project is to restore the subsistence uses of fish and wildlife damaged by the *Exxon Valdez* Oil Spill. Subsistence harvests in 10 communities the first year after the spill, as measured in pounds of usable weight per person, declined from 12 percent to 77 percent compared to prespill averages. Similar declines occurred in the breadth of resources used and participation in subsistence

activities. In some communities, only limited recovery to prespill levels has occurred. For example, subsistence harvests in seven communities were measured for the second postspill year. Harvests increased in five of these communities compared to the year after the spill, but most of these harvests remained below prespill levels. In the other two communities, Chenega Bay and Tatitlek, harvest levels showed no signs of recovery. They remained 60 percent or more below those before the spill.

A primary reason for the continued low level of subsistence harvests is the communities' concerns about the long-term health effects of using resources from the spill area. To address this concern, studies which tested subsistence foods for hydrocarbon contamination were conducted under guidance of the Oil Spill Health Task Force in 1989, 1990, and 1991. The health advice communicated by the Task Force was that most resources tested, including finfish, marine mammals (except for blubber from heavily oiled seals, which showed elevated levels of hydrocarbons), deer, and ducks had very low to background levels of hydrocarbons and are safe to eat. However, elevated levels of hydrocarbons occurred in some marine invertebrates collected from oiled beaches. The Task Force advised that using shellfish from such beaches represents an increased health risk. Consequently, the Task Force recommended that subsistence users not harvest marine invertebrates from obviously contaminated beaches. Without long-term monitoring of such beaches it is not possible to advise local communities when this increased risk has declined or ended.

Directly related to the concern about subsistence food safety is the loss of confidence by subsistence hunters and fishermen in their own abilities to decide if their traditional foods are safe to eat. The Task Force studies were designed to provide vital information to subsistence harvesters to augment their own abilities to judge whether subsistence resources are usable. As noted above, evidence suggests that the Task Force efforts to respond to this loss of confidence are incomplete. Further evidence is available from preliminary findings of research in oil spill communities jointly funded by the Division of Subsistence, ADF&G, and the U.S. Department of the Interior, Minerals Management Service. For example, most of the households interviewed in April 1992 in Chenega Bay, Nanwalek (English Bay), and Ouzinkie reported they felt they had still not been adequately informed about the safety of using subsistence foods from the oil spill area. In each community, concerns were expressed about the long-term health effects of using some of these resources, especially shellfish. In public meetings conducted in five communities in June 1992, questions continued about long-term health risks.

Adding to the challenge of communicating information is the lack of information from damage assessment studies. As this information becomes available it must be evaluated along with the Task Force health assessments and with observations of subsistence harvesters. The findings from these studies will enable subsistence harvesters to more fully understand current conditions in their traditional harvest areas. However, injuries to subsistence uses are likely to remain as long as harvesters believe they have not been fully informed about the condition of natural resources and habitats in the spill area. Consequently, this information must be communicated clearly and by methods appropriate to these communities.

In summary, the lack of confidence in the safety of using subsistence foods remains. The need remains to monitor selected resources and harvest areas for evidence that health risks associated with using resources from oiled areas have diminished. Finally, the communication of information about study findings and injured resources to subsistence users needs to be continued and enhanced.

Methods:

Community meetings are planned for the following nineteen communities: Chenega Bay, Tatitlek, Cordova, Valdez, Nanwalek, Port Graham, Seldovia, Kenai, Seward, Larsen Bay, Karluk, Old Harbor, Akhiok, Port Lions, Ouzinkie, Kodiak City, Chignik Lake, Chignik, and Chignik Lagoon, to identify and map the specific harvest areas and resources of continued concern to subsistence users. This will provide a comprehensive, final opportunity to identify these concerns. This study will be coordinated with the Alaska Department of Environmental Conservation's spring shoreline survey (Restoration Project #38) to corroborate the reports of persistent oiling. Also, the Division of Subsistence will use the results of a joint study currently being conducted with the U.S. Minerals Management Service in 15 communities to learn where concerns continue to exist and the nature of those concerns. Those communities where no concern is indicated will be dropped from the study.

Samples of subsistence foods will be collected from representative harvest areas. Such areas are to be identified during the mapping as either being persistently oiled, or of especial importance to subsistence users. Two shellfish sites will be sampled at each community. One previously tested site will be retested for trend assessments, while still giving each community the option to add one site not previously tested. Mussels are the ideal species to sample. They take up contamination readily and take a longer time to get rid of it than other shellfish species. Other species are to be sampled where mussels are not available. Rockfish samples near each community are also to be collected. Four samples are to be taken from each fish and shellfish site during each sampling trip. Fish and shellfish are to be collected at different times of the year because uptake and accumulation of hydrocarbons are influenced by temperature as is the reproductive cycle. There should be four sampling trips over the course of the year, winter, spring, summer and fall. Species selected for sampling will consider concerns expressed in the community meetings. Community representatives will help in site selection and the collection of samples.

Bile and blubber samples are to be taken from five harbor seals. Samples of the skin and internal organs of twenty ducks from Prince William Sound are to be taken. These samples will come from animals harvested by subsistence hunters for food, in the company of a biologist. Each will write an evaluation of the general health of each animal, including condition of the liver and other internal organs.

All samples will be analyzed for the presence of hydrocarbon contamination or metabolites. The results of the tests, along with findings from other damage assessment and restoration studies, will be interpreted by the Oil Spill Health Task Force, and reported to the communities in a series of informational newsletters and community visits. Samples will be analyzed for the presence of hydrocarbon contamination. Test results, along with findings from other damage assessment and restoration studies, will be interpreted by the Oil Spill Health Task Force, and reported to the communities in an informational newsletter and community visits.

The Subsistence Division will select sites in consultation with the communities. Sample collection will be contracted out since the Division of Subsistence does not have personnel available for this task. The contractor will be required to (1) perform two collection trips to each study community during the first year of the project, in coordination with the Division of Subsistence and the study communities, (2) collect samples of shellfish and rockfish at predetermined sites near the study communities. Samples are to be handled according to a protocol established by the Division of

Subsistence and the National Marine Fisheries Laboratory (Appendix A), and (3) send the samples to the National Marine Fisheries Laboratory, again following the protocol, (4) provide the Division of Subsistence with a report after each sampling trip detailing sample collection, handling and delivery, including copies of all relevant field notes, and an inventory of samples. The collection of seal and duck samples, will be carried out by local subsistence hunters in cooperation with Alaska Department of Fish & Game personnel. Samples are to be tested by the National Marine Fisheries Laboratory. This will provide consistency with earlier studies undertaken by the Division of Subsistence and Exxon. Community representatives will tour of the facilities to view the testing procedures. Interpretation of the test results should be undertaken by the Oil Spill Health Task Force.

Test results and evaluation of the effectiveness of the program is to be done by the Subsistence Division. These results will be communicated to community residents by a quarterly Subsistence Division newsletter. It is important that the findings of damage assessment and restoration studies be integrated into this communication effort. Such information, when released, may cause renewed concern among subsistence harvesters. It is often difficult to anticipate the effect of such a report, or the media accounts derived from it, will have in these communities. The newsletter will put this information in context for subsistence users. It will also be important to follow distribution of the newsletter with community visits. These can involve informal visits to households and/or formal meetings. The purpose is to enable discussion to develop between the researchers and the communities regarding the study findings.

Alternatives:

Reduce the scale of the collection and testing components of the project by narrowing the geographical area. Since Prince William Sound was generally the most heavily impacted area, those resources would show the most contamination over time. Therefore, if the levels of hydrocarbon contamination there have returned to background levels or otherwise diminished, similar or even more reduced levels would be expected on Kodiak, the Kenai Peninsula, and the Alaska Peninsula. However, this would probably be a less effective way of reassuring residents of those communities for two reasons. First, they would not have the direct involvement in sample collection they would have otherwise, and secondly, they might not agree that the findings in Prince William Sound apply to their area.

Location:

Communities in Prince William Sound, the Kenai Peninsula, Kodiak Island, and the Alaska Peninsula.

Benefits:

The Division of Subsistence, in cooperation with other members of the Oil Spill Health Task Force, successfully carried out a similar program for three years. A Task Force Toxicological Expert Committee formulated health advice for subsistence harvesters in the oil spill impact area. Through the Oil Spill Health Task Force newsletter, this information was communicated to the affected communities. However, the work is not complete. Limited access to results of the damage assessment studies created the impression in most communities that the task force did not base its

conclusions on a complete assessment of all data. We need an opportunity to put the information from the damage assessment into context.

Involvement of subsistence users in decisions affecting mitigation, monitoring, enhancement and replacement of the natural resources will help accelerate the recovery of the resources subsistence users rely upon. There is a need in these communities to actively participate in restoration of the environment. Community involvement, combined with effective communication of information concerning the safety of the resources will result in subsistence harvests approaching prespill levels and reduce anxieties about their use. If this occurred, it would lead to a reduced reliance on commercially purchased foods. It would also restore the communities' abilities to pass on skills and knowledge associated with using subsistence foods.

A potentially adverse effect is the risk of encouraging people to rely on expensive tests to decide the safety of their food supply, rather than their own powers of observations gained over a lifetime of use of these resources bolstered by traditional knowledge. This may be avoided by reminding people that the harvesters can discern the difference between a sick animal and a healthy one, and can assess beach conditions as well.

If the project results in a return to greater use of subsistence foods, this could be beneficial for the physical and emotional health of community residents who have suffered from the increased reliance on store-bought food. This is especially true for the elders. They have relied all their lives on wild resources harvested locally. Younger people will also be major beneficiaries in learning the skills necessary to live in these rural communities.

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

Technical Support:

Hydrocarbon assay and bile metabolite fluorescence tests will be conducted by the National Oceanic and Atmospheric Administration/National Marine Fisheries Laboratory in Seattle under the direction of Dr. Usha Varanasi.

The Oil Spill Health Task Force will interpret the results in cooperation with appropriate state and federal agencies and the impacted communities.

Contracts:

The collection of fish and shellfish test samples will be contracted out either by competitive bid or by sole source contract with a consortium of local village corporations.

Mitigation Measures:

No mitigation measures are anticipated for this project.

Literature Cited:

Fall, James A.

1990 Subsistence After the Spill: Uses of Fish and Wildlife in Alaska Native Villages and the *Exxon Valdez* Oil Spill. Paper presented at the 89th annual Meeting of the American Anthropological Association New Orleans, Louisiana, November 28, 1990. Files, Division of Subsistence, Anchorage.

1991 Subsistence uses of Fish and Wildlife in 15 Alutiq Villages after the *Exxon Valdez* Oil Spill. Paper presented at the 18th annual meeting of the Alaska Anthropological Association, Anchorage, Alaska, March 23, 1991. Files, Division of Subsistence, Anchorage.

Fall, James A., et al

1992 Subsistence Harvests and Uses in Seven Gulf of Alaska Communities in the Second year following the *Exxon Valdez* Oil Spill. Prepared for the United States Department of the Interior Fish and Wildlife Service. Files, Division of Subsistence, Anchorage.

Oil Spill Health Task Force

1990-1991 The Oil Spill Health Task Force Newsletter, nine issues produced, February 1990; March 1990; April 1990; May 1990; June 1990; July/August 1990; September/October 1990; June 1991; and September 1991. Files, Division of Subsistence, Anchorage.

C. SCHEDULES AND PLANNING

Note: there will be ongoing communication with communities throughout the project, with visits to communities as needed.

Activities scheduled and funded during this budget period:

March-May 1993	Community meetings to map areas and species of concern
June-July 1993	Coordinate with DEC shoreline assessment to verify oiling information
June 1993	Collect subsistence food samples for testing (anticipate 2-month turnaround for test results)
August 1993	Informational newsletter issued, tour of NOAA/NMFS laboratory
September 1993	Collect subsistence food samples for testing

Activities not funded during this budget period:

October 1993	Data summary, draft report (estimate 8 weeks for peer review)

November 1993	Informational newsletter issued
December 1993	Collect subsistence food samples for testing, final report on fiscal year '93 activities
February 1994	Informational newsletter issued
March 1994	Collect subsistence food samples for testing
May 1994	Informational newsletter issued
June-July 1994	Coordinate with DEC shoreline assessment to verify oiling information
June 1994	Develop plan for additional cleanup/mitigation of oil, if needed
September 1994	Develop plan for enhancement/replacement of subsistence resources
October 1994	Data summary, draft report (estimate 8 weeks for peer review)
December 1993	Final report on fiscal year '94 activities

D. ENVIRONMENTAL COMPLIANCE/PERMIT/COORDINATION STATUS

This project is categorically excluded under NEPA guidelines.

A scientific collection permit will be obtained from the Alaska Department of Fish and Game for the collection of fish and shellfish samples. A permit for the seal samples may not be needed if they are from seals killed by subsistence hunters for food.

E. PERFORMANCE MONITORING

Progress of the project will be monitored by the Oil Spill Health Task Force in consultation with the National Marine Fisheries Laboratory. In the past the member groups in the Oil Spill Health Task Force included the Indian Health Service, the North Pacific Rim (Chugachmuit), Kodiak Area Native Association, Alaska Department of Fish and Game, the United States Coast Guard, and the National Oceanic and Atmospheric Administration.

In addition, the Division of Subsistence conducted annual household harvest surveys in all these communities since 1989. Information collected included degrees of confidence in the safety of subsistence resources and fear of contamination. This is the result of specific questions on this topic, and of answers to open ended questions regarding changes in the subsistence harvest. The surveys will be continued in some communities for the next two years. In those communities where surveys will not be conducted, a brief questionnaire and informal visits by researchers can be used to evaluate the degree of concern.

F. PERSONNEL QUALIFICATIONS

James Fall

Dr. Fall is the Regional Program Manager for the Division of Subsistence, Alaska Department of Fish and Game, for southcentral and southwest Alaska. He has held this position since 1981. Since 1989, he has supervised the division's oil spill response and research program. Also, he has served as the department's representative on the Oil Spill Health Task Force. Dr. Fall has written several articles and reports on the effects of the *Exxon Valdez* oil spill on subsistence activities and harvests.

Rita Miraglia

Ms Miraglia has served as the Oil Spill Coordinator for the Division of Subsistence since 1990. As such, she has organized and participated in the subsistence resource collection and testing programs of 1990 and 1991. She has also been the lead communicator of study findings to communities through organizing community meetings and writing newsletters. She has also helped the Oil Spill Health Task Force's activities.

Craig Mishler

Dr. Mishler has been a Subsistence Resource Specialist with the Division of Subsistence since 1989, with primary responsibility for Kodiak Island. He organized and conducted the division's subsistence resource collection and testing program in the Kodiak Island area in 1990. He has participated in Oil Spill Health Task Force informational meetings there in 1989 and 1992.

Rachel Mason

Dr. Mason has also conducted research as a Subsistence Resource Specialist on Kodiak Island. She helped Craig Mishler with community meetings, sampling site selections, and sampling.

Jody Seitz

Ms Seitz has worked as a Subsistence Resource Specialist with the Division of Subsistence since 1989, with responsibility for Prince William Sound communities since 1991. She participated extensively in Division of Subsistence research projects in these communities, including the collection of information about subsistence harvests after the oil spill.

G. Budget

Personnel	$143.7
Travel	30.0
Contractual	85.5
Commodities	18.1
Equipment	0.0
Capital Outlay	0.0
Subtotal	$277.3
General Administration	29.8
Project Total	$307.1

Project Description: This project is aimed at restoring the use of subsistence resources by residents of the oil spill affected region. In cooperation with community representatives, samples of food will be taken from harvest areas. These samples will be analysed for the presence of hydrocarbon contamination. If appropriate, and in cooperation with appropriate agencies and communities, a clean-up and mitigation plan will be developed; where direct action is not feasible, a plan will be developed to identify alternative resources.

Budget Category	Approved 1-Oct-92 28-Feb-93	Approved 1-Mar-93 30-Sep-93	Total FY 93	** FY 94	FY 95	FY 96	FY 97	Sum FY 98 & Beyond
Personnel	0	$143.7	$143.7	$81.8	$81.8			
Travel	0	$30.0	$30.0	$41.0	$41.5			
Contractual	0	$85.5	$85.5	$164.0	$4.5			
Commodities	0	$18.1	$18.1	$1.0	$1.0			
Equipment	0	$0.0	$0.0	$0.0	$0.0			
Capital Outlay	0	$0.0	$0.0	$0.0	$0.0			
Sub-total	0	$277.3	$277.3	$287.8	$128.8	$0.0	$0.0	$0.0
General Administration	0	$29.8	$29.8	$21.7	$11.8			
Project Total	0	$307.1	$307.1	$309.5	$140.6	$0.0	$0.0	$0.0
Full-time Equivalents (FTE)	0					0.0	0.0	0.0

Budget Year Proposed Personnel:

Position	Months Budgeted	Cost	Comment
93			** If not funded in FY 94, $46 K will be needed for lab analysis, report preparation and delivery of report to the communities.
For details refer to the 3A and 3B forms.			

Project Number: 93-017
Project Title: Subsistence Food Safety Survey and Testing
Subproject:
Agency: ADF&G

FORM 2A
PROJECT
DETAIL

Project Description: This project is aimed at restoring the use of subsistence resources by residents of the oil spill affected region. In cooperation with community representatives, samples of food will be taken from harvest areas. These samples will be analysed for the presence of hydrocarbon contamination. If appropriate, and in cooperation with appropriate agencies and communities, a clean-up and mitigation plan will be developed; where direct action is not feasible, a plan will be developed to identify alternative resources.

Budget Category	Approved 1-Oct-92 28-Feb-93	Approved 1-Mar-93 30-Sep-93	Total FY 93	** FY 94	FY 95	FY 96	FY 97	Sum FY 98 & Beyond
Personnel	0	$78.5	$78.5	$81.8	$81.8			
Travel	0	$30.0	$30.0	$41.0	$41.5			
Contractual	0	$85.5	$85.5	$164.0	$4.5			
Commodities	0	$0.8	$0.8	$1.0	$1.0			
Equipment	0	$0.0	$0.0	$0.0	$0.0			
Capital Outlay	0	$0.0	$0.0	$0.0	$0.0			
Sub-total	0	$194.8	$194.8	$287.8	$128.8	$0.0	$0.0	$0.0
General Administration	0	$17.8	$17.8	$21.7	$11.8			
Project Total	0	$212.6	$212.6	$309.5	$140.6	$0.0	$0.0	$0.0
Full-time Equivalents (FTE)	0	1.3	1.3	1.5	1.5	0.0	0.0	0.0

Budget Year Proposed Personnel:

Position	Months Budgeted	Cost	Comment
93 Subsistence Res Spec II	9	$38.5	** If not funded in FY 94, $46 K will be needed for lab analysis, report
Subsistence Res Spec II	2	$8.5	preparation and delivery of report to the communities.
Program Manager	1	$7.5	
Analyst/Programmer IV	0.5	$2.7	
Analyst/Programmer II	0.5	$2.1	
Publication Specialist	0.5	$2.2	
Biologist III	2	$12.0	
BIA Personnel if needed		$5.0	

10-Feb-93

1993

Project Number: 93-017
Project Title: Subsistence Food Safety Survey and Testing
Subproject:
Agency: ADF&G

FORM 3A PROJECT DETAIL

Travel:	
community mapping meetings	$15.0
other community travel	$15.0
Contractual:	
sample collection	$80.5
copying and phone costs	$1.5
newsletters(printing, mailing)	$3.0
data management	$0.5
Commodities:	
supplies, notebooks, etc	$0.8
Equipment:	

10-Feb-93

Project Number: 93-017
Project Title: Subsistence Food Safety Survey and Testing
Subproject:
Agency: ADF&G

FORM 3B
PROJECT
DETAIL

APPENDIX A

SUBSISTENCE FOODS SAMPLING PROGRAM
Protocols for the Collection and Handling of Samples
Alaska Department of Fish and Game
Division of Subsistence
January 8, 1993

Chain of Custody

Chain of custody and collection forms (attached) will be used. The beach and water conditions (degree of oiling) will be clearly noted on the collection forms as well as the results of sight and smell tests conducted in the field. These waterproof forms will be placed in the zip lock bag with each individual tissue sample with the species and location as visible as possible.

Field note books will be rite-in the-rain. Any deviation from protocol and the study plan can be documented in the field notes. The location of the sampling site will be determined with the aid of USGS grid maps or NOAA charts. The site locations should be plotted on the map.

Whenever samples are split, a separate chain of custody record will be prepared for each portion and marked to indicate with whom the samples are being split.

Evidence tape must be affixed to the shipping container before the samples leave the custody of the sampling personnel. The seal must be signed and dated before the container is shipped. The original chain of custody record accompanies the shipment; a copy is retained by the sample shipper. If samples are sent by common carrier, copies of all bills of lading or air bills must be retained as part of the permanent documentation.

Entries into the field logbooks or field data sheets are signed or initialed and dated by the person making the entry at the time of entry. Each days entries are closed out with a horizontal line, date and initial. Errors in field logbooks or other records are corrected by drawing a single line through the error, entering the correct information, and signing and dating the correction. Never erase an entry or any part of an entry. Do not remove the pages from the logbook.

Preparation

Aluminum foil will be cooked at 350 degrees Fahrenheit for one hour before it can be used to wrap tissue samples. All other sampling equipment will be washed using detergent and rinsed before and after each sample collection. This includes clam shovels, knives, containers, and gloves. Instruments used for exterior dissection must be cleansed before they can be used for internal dissection.

Collection Blank

At least one field blank and replicate sample should be taken for each collection site. A field blank is a sample container (foil and zip lock bag or bile container) opened in the field, closed and stored as if it contained a sample. Chain of custody forms will accompany blanks, and blanks will be sent to the laboratory.

Collection

The method of collection must not contaminate the samples. Do not collect any subsurface samples through surface slicks. Organisms to be analyzed for petroleum hydrocarbons should be freshly killed or recently dead. Decomposed organisms should not be collected.

Fish will always be handled with latex gloves. Each fish will be brought on board the boat in a manner so as not to contaminate it with any petroleum products such as fuel, plastics, or fuel-soaked material. The fish will then be dissected in an appropriately clean container or on aluminum foil.

For fish, approximately 0.6 to 1.0 kilograms of edible tissue will be excised. This will provide sufficient tissue to perform chemical analysis. The dissected tissue will then be double-wrapped in aluminum foil and placed in a zip lock bag.

The bile of all fin fish will be collected by puncturing the gall bladder with a sterile disposable scalpel and catching it in a collection vial. The vial will then be placed in a zip lock bag. The gall bladder may puncture and the bile get lost while the fish is being eviscerated. This should be clearly noted on the chain of custody form belonging to the fish from which the bile was lost.

Invertebrates will be collected with clean shovels, double wrapped in aluminum foil, in groups of five to ten individuals, and placed in a ziplock bag.

Identify the species of finfish and shellfish as clearly as possible. It is necessary to be very accurate so the species dependent differences in bile metabolites can be ascertained by the laboratory. If you are unsure of the species, write detailed descriptions of the animal in the field note book, including the color, size, shape, etc.

After they are wrapped and labelled, the samples will be placed in insulated coolers containing ice packs. Keep all samples from the same station together by placing them in a separate large plastic bag.

Sample Preservation

Samples must be kept cool. They should be frozen as soon after collection as possible, and the freezing process should be rapid. Once frozen, the samples must be kept frozen until extracted or prepared for analysis. Therefore, care must be taken that the samples remain frozen throughout the shipping process.

93024

DETAILED RESTORATION PROJECT DESCRIPTION

Project Title:	RESTORATION OF THE COGHILL LAKE SOCKEYE SALMON STOCK
Study ID Number:	93024
Project Type:	Restoration Manipulation and Enhancement
Project Leaders:	Mark Willette, ADFG Kate Wedemeyer, USFS
Lead Agencies:	Alaska Department of Fish and Game, Fisheries Rehabilitation Enhancement and Development Division U.S. Department of Agriculture, Forest Service
Cost:	$191,900
Project Dates:	March 1, 1993 - September 30, 1993
Geographic Area of Project:	Coghill Lake, Prince William Sound

_____

Project Leader Date

_____

Project Manager Date

resources and services injured by the EVOS.

Objectives

This project will achieve the following objectives. More than one year of study will be required to achieve objectives 3 through 5.

1. Apply fertilizer to Coghill Lake and elevate the productivity of the lake ecosystem.

2. Monitor the residence time of nutrient-enriched water in Coghill Lake.

3. Determine the effect of fertilization on primary and secondary production.

4. Determine the effect of fertilization on the food consumption, growth, and condition of sockeye salmon fry.

5. Determine the effect of fertilization on the overwinter survival, age, size, and condition of smolts emigrating from the lake.

Methods

Objective 1:

Lake fertilization is recommended for one sockeye life cycle (5 years) to elevate the productivity of the lake and the resident sockeye salmon population. The recent five-year average loading of phosphorus into Coghill Lake is 312 mg m^2 yr^2 (Edmundson et al. 1992). The critical loading rate (Vollenweider 1976) needed for full phytoplankton productivity is 650 mg m^2 yr^2 (Edmundson et al. 1992). Therefore, an additional 273 mg m^2 yr^2 of phosphorus is needed to achieve full phytoplankton productivity. In addition, 2,273 mg m^2 yr^2 of nitrogen is needed to maintain an 18:1 atomic ratio of nitrogen to phosphorus. A pharmaceutical-grade liquid fertilizer will be applied to the lake by releasing it from a low-flying aircraft. Application will consist of six to nine passes of five-minute duration one day each week. Approximately 3,000 kg of fertilizer will be applied each day. Fertilizer will be applied over the middle third of the lake comprising an area of 3.9 km^2. Twenty-three thousand kilograms of liquid fertilizer (20-5-0) containing 20% nitrogen and 5% phosphorus will be applied from mid-June to August 1. Thirty-one thousand kilograms of nitrogen fertilizer (32-0-0) comprising equal portions of ammonium, nitrate-nitrite, and organic nitrogen will be applied from August 1 to early September. People reserving the cabin at Coghill will be notified of the fertilization schedule. Notices will also be posted in the cabin. Fertilizer will be applied no closer than a mile and a half from the cabin and lagoon where most recreational activity takes place. The pilot will not drop fertilizer in a portion of the application area if anyone is within that area.

Objective 2:

The residence time of nutrient-enriched water in Coghill Lake will be monitored to

Introduction

The goal of this project is to restore the natural productivity of Coghill Lake and the resident sockeye salmon (*Oncorhynchus nerka*) population through use of established lake fertilization techniques (LeBrassseur et al. 1978; Stockner and Hyatt 1984; Koenings and Burkett 1987; Kyle et al. 1991). Coghill Lake is located 130 km northwest of Cordova at an elevation of 18 m. The outlet of the lake empties into the eastern side of Port Wells, Prince William Sound. Coghill Lake has a surface area of 12.7 km^2, a mean depth of 46.3 m, and a total volume of 587 x 10^6 m^3 (Pellisier and Somerville 1984). This project will be conducted cooperatively by the Alaska Department of Fish and Game (ADFG) and the U.S. Forest Service (USFS).

The Coghill Lake sockeye salmon stock has historically supported an important commercial fishery in western Prince William Sound (PWS), but in recent years returns have declined considerably. In 1982, 1.2 million sockeye salmon returned to Coghill Lake, but by 1991 only 9,800 fish escaped into the lake. Results from damage assessment studies on juvenile salmon suggest that the Exxon Valdez oil spill (EVOS) may have contributed to the stock decline, because the juveniles migrated through oil-contaminated habitats in western PWS in 1989.

This project should be initiated in 1993, because the Coghill Lake stock is presently at dangerously low levels. Action must be taken to restore the stock before any further decline occurs. Sockeye salmon rear in lakes for one to three years before emigrating to sea. The production of sockeye salmon populations is closely linked to the productivity of rearing lakes (Koenings and Burkett 1987). Limnological studies indicate that fry food resources in Coghill Lake cannot support large numbers of fish. Fertilization is needed to increase lake productivity and boost zooplankton abundance until natural nutrient input from salmon carcasses is restored (Edmundson et al. 1991).

Project Description

This project will restore the natural productivity of Coghill Lake through use of established lake fertilization techniques. Nutrient loading from adult salmon carcasses is expected to maintain lake productivity after the fertilization program is completed and the run is restored. Restoration of the Coghill sockeye stock will provide natural resource services to replace those once provided by other injured stocks in the EVOS area. The USFS will apply fertilizer to the lake each summer for five years. ADFG will conduct limnological and fisheries studies needed to monitor and refine the fertilization program. These studies will focus on the effects of fertilization on primary and secondary production and the growth and survival of juvenile sockeye salmon in the lake. The results of the monitoring program will be used to estimate changes in lake carrying capacity and smolt-to-adult survival rates.

Resources and/or Services

This project will restore the natural productivity of Coghill Lake and the resident sockeye salmon population. Restoration of the Coghill Lake sockeye salmon stock will replace

determine the most effective spatial and temporal distribution of fertilization effort. Discharge will be measured in the Coghill River twice during low, medium, and high flow periods. Water depth and current speed will be measured at 10 m intervals along a transect drawn perpendicular to the stream length. The cross-sectional area of each segment and the current speed will be used to estimate the discharge within each segment. The discharge estimates for all the segments along the transect will be summed to estimate the total stream discharge. Water level in the lake will be measured at the same time that discharge is estimated. Regression analysis will be used to develop an empirical model relating lake level to stream discharge. An electronic pressure recorder will be installed in the lake to continuously monitor changes in lake level. The empirical model will be used to construct a time series of lake flushing rate throughout the fertilization period.

Objective 3:

The effect of lake fertilization on primary and secondary production will be assessed by comparing limnological data collected pre- and post-fertilization. Five years of limnological data collected monthly at Coghill Lake is available for the comparison. Analysis of variance and multiple comparisons will be used to test for pre- and post-fertilization differences ($P = .05$) in several limnological variables (filterable reactive phosphorus, ammonia, nitrate-nitrite, chlorophyll a, copepod biomass, and cladoceran biomass). The independent variables in the model will include sampling period (July-August; Sept.-October), year, and treatment (pre- and post-fertilization).

Limnological sampling will be conducted as in past years to insure valid pre- and post-fertilization comparisons. Sampling will be conducted twice each month from June through October at two stations that have been sampled in past years. The samples collected within each month will be used as replicates in the pre- and post-fertilization comparison. Temperature and dissolved oxygen concentrations will be measured from the surface to a depth of 40 m using a YSI model-57 meter. Measurements of light penetration (footcandles) will be measured at 1 m increments from the surface to a depth equivalent to 1% of the subsurface light using a Protomatic submarine photometer. The euphotic zone depth (Schindler 1978) will be calculated as the y-intercept derived by regressing depth against the logarithm of the percent subsurface light. Secchi disk transparency will be determined as the averaged reading (depth) taken by lowering a standard 20 cm disk until it disappears, and then raising the disk until it reappears. Water samples will be collected from the 1 m stratum, chemocline, and monimolimnion using a non-metallic, opaque Van Dorn sampler. Eight liters of water will be collected from each depth, stored (< 24 hr) in pre-cleaned polyethylene carboys, transported to Cordova for processing, and then shipped to the Limnology Laboratory in Soldotna for analysis.

Water samples will be analyzed for the following parameters as detailed by Koenings et al. (1987). Conductivity (μmhos/cm) will be measured with a YSI model-32 conductance meter. Alkalinity levels (mg/L) will be determined by acid titration (0.02 N H_2SO_4) to pH 4.5, using a Corning model-399A specific ion meter. Calcium and magnesium (mg/L) will be determined from separate EDTA (0.01 N) titrations after Golterman (1969), turbidity

(NTU) will be measured with a HF model-DRT100 turbidimeter, and color (Pt units) will be determined with a spectrophotometer. Total iron (μg/L) will be analyzed by reduction of ferric iron with hydroxylamine during hydrochloric acid digestion after Strickland and Parsons (1972).

All nutrient samples will be analyzed by methods detailed by Koenings et al. (1987). In general, filterable reactive phosphorus (FRP) will be analyzed by the molybdate-blue/ascorbic-acid method of Murphy and Riley (1962), as modified by Eisenreich et al. (1975). Total phosphorus will be determined using the FRP procedure, after persulfate digestion. Nitrate and nitrite (NO_3 + NO_2) will be determined as nitrite, following Stainton et al. (1977) after cadmium reduction of nitrate. Total Kjeldahl nitrogen (TKN) will be determined as total ammonia following sulfuric acid block digestion (Crowther et al. 1980). Total nitrogen will be calculated as the sum of TKN and NO_3 + NO_2. Reactive silicon will be determined using the method of ascorbic acid reduction to molybdenum-blue (Stainton et al. 1977). Estimation of the yearly phosphorus loading in Coghill Lake will be calculated after Vollenweider (1976).

Algal standing crop will be estimated by chlorophyll a analysis, after the fluorometric procedure of Strickland and Parsons (1972). The low-strength acid addition recommended by Riemann (1978) will be used to estimate phaeophytin. Water samples (1-2 L) will be filtered through 4.25-cm GF/F filters to which 1-2 mls of a saturated $MgCO_3$ solution is added just prior to the completion of filtration. The filters will be stored frozen in individual plexislides for later analysis. Samples of unfiltered lake water will be preserved with Lugol's acetate solution for later identification of phytoplankton species.

Replicate vertical zooplankton tows will be taken from 40 m depth at four stations using a 0.2 m diameter, 153-μ mesh, conical net. The net will be pulled at a constant 1 m s^{1}, and all organisms will be preserved in a 10% neutralized formalin solution. Cladocerans and copepods will be identified using keys developed by Brooks (1957), Pennak (1978), Wilson (1959), and Yeatman (1959). Copepodite stages will be identified and enumerated. Enumeration will consist of counting animals in triplicate 1 ml subsamples taken with a Hansen-Stempel pipette in a 1 ml Sedgewick-Rafter cell. Cladoceran body length will be measured to the nearest 0.01 mm for at least 10 individuals along a transect in each 1 ml subsample (Koenings et al. 1987). Cladoceran weight will be estimated from an empirical regression between body length and dry weight. Body weights of copepodites will be estimated using the average dry weight for each stage. Zooplankton biomass will be estimated for each species by the product of average body weight and abundance (Koenings et al. 1987).

Objective 4:

The effect of the fertilization program on food consumption and growth will be assessed by testing for changes in these variables over time as the fertilization proceeds. This analysis will be preceded by a survey of the lake to determine the habitats occupied by the fish in July, August, September, and October. Visual surveys, beach seine and tow net catches, and hydroacoustic surveys will be used to assess habitat utilization. A 120-

Khz dual-beam echo sounder will be used to determine the vertical distribution of fry in the lake during the day and at night. Data will be collected along 10 randomly selected transects oriented perpendicular to the longitudinal axis of the lake. The data will be analyzed using echo integration or echo counting techniques depending on fish density (Kyle 1990). Electronic water temperature recorders will be moored in habitats commonly occupied by sockeye salmon fry.

Food consumption rate will be estimated from studies of diel feeding periodicity and stomach contents analysis. The diel feeding periodicity study will estimate the food consumption rate of fish throughout the day at a single site. The stomach contents analysis will estimate the variability of stomach contents weight and prey composition among 10 sites and test for differences in these variables between months.

The diel feeding periodicity study will estimate food consumption utilizing gastric evacuation rates obtained from laboratory studies and stomach contents weight data obtained in the field. Brett and Higgs (1970) estimated the gastric evacuation rate of juvenile sockeye salmon (30-40 g) between 3 and 23° C. Gastric evacuation rate is described by a negative exponential function, i.e.

$$V_t = V_o e^{-bt} \quad (1)$$

where V_t is the stomach weight (g) at time t, V_o is the stomach weight (g) at time 0, and b is the instantaneous gastric evacuation rate (Fange and Grove 1979). Samples of ten sockeye salmon fry will be collected at three hour intervals throughout a 24 hour period using a tow net. The lengths and weights of the fish will be measured fresh. Fry stomachs will be removed and preserved in 10% buffered formaldehyde. Prey items in the stomach will be identified later in the laboratory to the lowest possible taxonomic level. Prey length will be measured to the nearest .01 mm. Prey body weight will be estimated from an empirical regression between zooplankter body-length and dry weight (Koenings et al. 1987). Stomach contents weight will be estimated by the product of abundance and mean body weight for each taxonomic group. Food consumption rate (I) during each three hour period will be estimated by:

$$I = V_o - V_o e^{-bt} \quad (2)$$

where V_o is the mean stomach contents weight at the beginning of the three hour interval, and b is the temperature-specific gastric evacuation rate (Brett and Higgs 1970). The vertical distribution of the fish and water temperature profiles will be used to estimate the temperature of the habitat occupied during each time period. The food consumption estimates during each of the three hour periods will be summed to estimate the daily ration. This study will be conducted in July, August, September, and October. If the pattern of diel migration and feeding does not change significantly over time, the study will be discontinued. Food consumption rate will then be estimated from stomach samples collected in the morning.

Stomach contents analysis will be used to test for differences in total stomach contents weight and prey composition between months. Stomach samples (n = 10) will be collected from at least ten sites throughout the lake in July, August, September, and October. The samples will be collected between 6 and 9 a.m. on the same day that the food consumption study is conducted. The lengths and weights of the fish will be measured fresh. Fry stomachs will be removed and preserved in 10% buffered formaldehyde. The remainder of the fish will be preserved in 100% ethanol for later analysis of otolith microstructure. Laboratory analysis of the samples will be performed as described above. Analysis of variance will be performed to test for differences (P = .05) in stomach contents weight and prey composition between months. Separate analyses will be conducted on total stomach contents weight as a proportion of fish body weight and on prey biomass in each taxonomic group as a proportion of total stomach contents weight. The distribution of each dependent variable will be examined to determine an appropriate transformation. As more data is obtained over the five year study, the analysis will be restructured to also test for differences between years.

Growth rate will be estimated for monthly time periods using measured fish body weights and estimated age from time of outmigration into the lake. Otolith microstructure analysis will be used to estimate fish age from otolith increment counts. Otolith increments are formed daily in juvenile sockeye salmon (Marshall and Parker 1982, Wilson and Larkin 1980). Thin sections of the otoliths will be prepared using methods developed by Volk et. al. (1984). A computer image analysis system will be used to examine the otoliths. The number of otolith increments produced since outmigration will be visually counted, and the outmigration check will be visually identified. Otolith increment counts will be used to track the growth of the dominant cohort of fish in the lake. The mean growth rate of the cohort during the previous month will be estimated from the following equation:

$$G = \frac{\overline{\ln(W_2)} - \overline{\ln(W_1)}}{t_2 - t_1} \qquad (3)$$

where $\overline{\ln(W_2)}$ is the mean of natural logarithmn (ln) of body weight in the current sample, and $\ln(W_1)$ is the mean of ln body weight in the previous sample. Samples of Coghill stock sockeye fry outmigrating from incubators at the Main Bay hatchery will be used to estimate W_1 for the first time period. The variance (s^2_p) about the mean growth rate will be estimated by:

$$s^2_p = \frac{s^2_2 + s^2_1}{(t_2 - t_1)^2} \qquad (4)$$

where s^2_2 is the variance of $\overline{\ln(W_2)}$, and s^2_1 is the variance of $\overline{\ln(W_1)}$ (Zar 1984). Analysis of variance and pairwise comparisons will be used to test for differences (P = .05) in mean growth between months. As more data is obtained over the five year study, the analysis will be restructured to also test for differences between years.

The effect of the fertilization program on fry growth will be evaluated by testing for

changes in temperature-specific growth between years. The vertical distribution of the fish, water temperature profiles, and continuous temperature measurements (obtained from electronic recorders) will be used to estimate the mean temperature of the habitat occupied by the fish during each month. Monthly mean growth will be regressed against monthly mean water temperature. Analysis of covariance will be used to test for differences ($P = .05$) in the intercept and slope of the regression between years.

The effect of the fertilization program on the condition of sockeye salmon fry will be evaluated by testing for changes in condition between months and years. The relationship between body weight (W) and length (L) is described by

$$W = a L^b \qquad (5)$$

where a is the condition factor and b is the slope of the linear-transformed model (Ricker 1975). Regression analysis will be used to estimate the relationship between ln body weight and ln length. Analysis of covariance will test for differences ($P = .05$) in the intercept and slope of the regression between years. The condition factor (a) of individual fish will be estimated by

$$a = \frac{W}{L^b} . \qquad (6)$$

Analysis of variance and multiple comparisons will be used to test for differences in condition factor between months within years.

Objective 5:

The effect of the fertilization program on the overwinter survival of sockeye fry will be evaluated by estimating fall population size and testing for pre- and post-fertilization differences in fall fry condition and size-at-age. Fall fry and spring smolt population size will be used to estimate overwinter survival. The poor overwinter survival of sockeye salmon fry in Coghill Lake appears to be due to insufficient energy reserves needed for metabolism during winter (Edmundson et al. 1992). Fulton's condition factor will be used to estimate the chemical composition and caloric content of sockeye fry immediately before winter (Harris et al. 1986). A hydroacoustic survey will be conducted in October to estimate the population size of sockeye salmon fry in the lake. A stratified-random design will be used each year to select 10 transects oriented perpendicular to the longitudinal axis of the lake. A 120-Khz dual-beam echo sounder will be used to collect data along the transects. The data will be analyzed using echo integration or echo counting techniques depending on fish density (Kyle 1990). The acoustic survey will be conducted during the darkest period of night when juvenile sockeye salmon are distributed in the upper to middle part of the water column (Narver 1970; McDonald 1973; Eggers 1978; Simpson et al. 1981; Nunnallee 1983; Burczynski and Johnson 1986; Levy 1987). A 7.5-m long mid-water trawl with a 2 x 2 m opening will be used in conjunction with the hydroacoustic surveys to determine species composition, size, and age of fish targets. Fish will be preserved in 10% buffered formaldehyde for at least six

weeks, measured to the nearest millimeter, and weighed to the nearest 0.1 g. A scale smear will be taken from each fish, affixed to a glass slide, and aged using a microfiche projector. Changes in the species composition of tow-net catches will also be evaluated to determine if the fertilization program is affecting the composition of the fish community in the lake. Analysis of variance will be used to test for pre- and post-fertilization differences in the proportion of total catch for each species in tow-net samples. Analysis of variance and multiple comparisons will be used to test for pre- and post-fertilization differences in fall fry condition factor, and length and weight at age, respectively. The distributions of these dependent variables will be examined to determine an appropriate transformation. The independent variable in these analyses will be treatment (pre- and post-fertilization).

The effect of the fertilization program on outmigrant smolts will be evaluated by testing for pre- and post-fertilization differences in smolt age composition, condition, and size at age. Sockeye salmon smolts emigrating from Coghill Lake will be enumerated using incline-plane traps (Kyle 1983). The traps will be operated continuously from early May to early June. The catch efficiencies of the traps will be determined by mark and recapture analysis. At least 300 individuals will be marked and released at the lake outlet for each mark-recapture experiment. Overwinter survival will be estimated by dividing the number of outmigrating smolts by the fry population size estimated the previous fall. A sample of 40 smolts will be collected each day to estimate age composition. The fish will be anaesthetized with MS-222. Several scales will be taken from each fish, affixed to a glass slide, and aged in the laboratory using a microfiche projector. Each fish will be measured to the nearest millimeter and weighed to the nearest .01 g. Analysis of variance will be used to test for pre- and post-fertilization differences ($P = .05$) in the proportion of total smolt abundance in each age group. Sampling period, year, and treatment will be independent variables in the model. The distributions of the dependent variables will be examined to determine an appropriate transformation. Analysis of covariance will be used to test for pre- and post-fertilization differences ($P = .05$) in smolt condition. The independent variables in the model will be sampling period, year, and treatment with ln length as a covariate. Overwinter survival will be estimated by the ratio of fall fry and spring smolt population estimates. Techniques described by Seber (1982) will be used to estimate the variance of the survival estimate.

Alternatives

Seven alternatives have been evaluated in the environmental assessment for this project (U.S. Forest Service 1993). The first alternative involves no action. This alternative would not achieve the project objective, but provides the baseline to which other alternatives can be compared. The following six additional alternatives were also considered: (1) construction of a spawning channel, (2) development of a different sockeye salmon stock for replacement, (3) pumping nutrients from the deep layer of Coghill Lake, (4) placement of vegetative debris in the lake, (5) application of the fertilizer by boat, and (6) addition of pink salmon carcasses from hatcheries. These six alternatives were rejected in the environmental assessment for the Coghill Lake fertilization project. A description of these alternatives and the reasons for their rejection is provided in the environmental assessment.

Location

This project will be conducted at Coghill Lake which is located in northwestern Prince William Sound.

Benefits

It is expected that the proposed project will increase annual sockeye salmon returns to sustained yield levels significantly faster than allowing the Coghill Lake ecosystem and sockeye population to recover on its own.

Technical Support

No technical support will be required to complete this restoration project.

Contracts

A contract will be needed with the company performing the aerial application of the fertilizer. Other contractual services will be for air charter, water quality analysis, and hydroacoustic analysis.

Mitigation Measures

Mitigation measures involve the recreational use of the cabin at Coghill Lake. Cabin users would be notified of the fertilization schedule when they reserve the cabin. Fertilizer will be applied no closer than a mile and a half from the cabin and lagoon where most recreational activity takes place. The pilot will not drop fertilizer in a portion of the application area if anyone is within that area.

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Schedules and Planning

The schedule of events for this project will extend beyond September 30, 1993. No additional funds will be required to complete the activities described in this study plan. However, action will be required to permit expenditure of funds beyond September 30, 1993 to complete the first year of the project.

DATE	ACTIVITY
May - June	Enumerate outmigrant smolts and collect samples to estimate smolt age and size composition
June - Oct.	Apply fertilizer each week, conduct limnological sampling twice each month, and collect fish samples for growth and stomach contents analysis.
July - Oct.	Conduct laboratory analyses of limnological, otolith, and stomach samples
October	Estimate fall fry population size using hydroacoustic techniques
Sept.- Nov.	Analyze data and prepare annual report
December 1, 1993	Submit draft status report for peer review

Environmental Compliance

An environmental assessment has been conducted to evaluate the various alternatives for rehabilitating Coghill lake and the resident sockeye salmon population. The assessment has concluded that the lake fertilization program is the most appropriate method for rehabilitation in this case.

Performance Monitoring

An annual draft status report detailing project results will be prepared and submitted for peer review on December 1, 1993. At the end of the five year study, all results and conclusions will be published in a referred scientific journal.

Personnel Qualifications

Mark Willette

Experience:

March 1991 - present: Area Biologist with the Alaska Department of Fish and Game, Fisheries Rehabilitation Enhancement and Development (FRED) Division in Cordova, Alaska. Supervised by Dr. William Hauser. Conduct various fisheries enhancement and evaluation projects in Prince William Sound (PWS) including limnological investigations of sockeye salmon producing lakes, and quality control of coded-wire tagging at private hatcheries. Conduct fisheries oceanographic studies in PWS in cooperation with private hatcheries and University of Alaska investigators. Principal Investigator on Natural Resource Damage Assessment studies on juvenile salmon in PWS. Chairman of PWS Regional Planning Team.

March 1986 - February 1991: Fisheries Instructor/ Assistant Research Professor, University of Alaska Fairbanks, School of Fisheries & Ocean Sciences, Supervised by Dr. Don Kramer. Conduct research on the effects of oceanographic conditions on the growth and survival of juvenile salmon in PWS, fish bioenergetics in an arctic lagoon ecosystem, age and growth of juvenile fish in the Chukchi and Bering Seas, ocean temperature variability in the North Pacific Ocean and effects on pink salmon production, salmon feeding on the high seas. Design and implement a program of education, research, and public service to promote fisheries development in northwest Alaska. Teach college level course in oceanography. Teach a marine safety and vocational training courses in fisheries.

Education:

1985 Master of Science, Fisheries Oceanography, University of Alaska Fairbanks.

1983 Bachelor of Science, Fisheries Science, University of Alaska Fairbanks.

Kate Wedemeyer

Experience:

1988 - present: District Fisheries Biologist, U.S. Forest Service, Glacier Ranger District, Girdwood, Alaska. Development of fishery enhancement projects through planning,environmental documentation, permitting, and construction. Fishery enhancement projects have been conducted in western Prince William Sound.

1987-1988: Fishery Biologist, U.S. Fish and Wildlife Service, Fisheries Resources, Fairbanks, Alaska. Performed field work and report writing for U.S. Canada Yukon River Salmon Treaty projects on the Chandalar River in interior Alaska.

1976, 1979-80, 1983: Fisheries Technician, Alaska Department of Fish and Game, F.R.E.D. Division, Sport Fish Division, and Commercial Fisheries Divisions.

Education:

1988, Master of Science, Natural Resource Management, University of Alaska, Fairbanks, Alaska.

1987, Master of Science, Fisheries Science, University of Alaska, Fairbanks, Alaska.

1985, Bachelor of Science, Biology, University of Alaska, Fairbanks, Alaska.

1972, Bachelor of Science, Psychology, minor zoology, Iowa State University.

Budget ($K):

Personnel	114.9
Travel	6.7
Contractual	15.8
Commodities	14.7
Equipment	21.5
Capital Outlay	0.0
Subtotal	173.6
General Administration	18.3
Project Total	191.9

Project Description: This project will restore the natural productivity of Coghill Lake and the resident sockeye salmon population through use of established lake fertilization techniques. The ADF&G component of the project will focus on limnological and fisheries studies needed to monitor and refine the fertilization program. The response of lake nutrient levels, primary and secondary production, and plankton species composition will be monitored. The response of sockeye salmon fry growth, prey composition, and overwinter survival will be determined. The results of the monitoring program will be used to estimate changes in lake carrying capacity and smolt-to-adult survival rates.

Budget Category	Approved 1-Oct-92 28-Feb-93	Proposed* 1-Mar-93 30-Sep-93	Total FY 93	** FY 94	FY 95	FY 96	FY 97	Sum FY 98 & Beyond
Personnel	$0.0	$114.9	$114.9	$114.9	$114.9	$114.9	$114.9	
Travel	$0.0	$6.7	$6.7	$6.7	$6.7	$6.7	$6.7	
Contractual	$0.0	$15.8	$15.8	$64.5	$64.5	$64.5	$64.5	
Commodities	$0.0	$14.7	$14.7	$10.7	$10.7	$10.7	$10.7	
Equipment	$0.0	$21.5	$21.5	$0.0	$0.0	$0.0	$0.0	
Capital Outlay	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	
Sub-total	$0.0	$173.6	$173.6	$196.8	$196.8	$196.8	$196.8	$0.0
General Administration	$0.0	$18.3	$18.3	$20.8	$20.8	$20.8	$20.8	
Project Total	$0.0	$191.9	$191.9	$217.6	$217.6	$217.6	$217.6	$0.0
Full-time Equivalents (FTE)	0.0	2.3	2.3	2.3	2.3	2.3	2.3	

Amounts are shown in thousands of dollars

Budget Year Proposed Personnel:

Position	Months Budgeted	Cost	Comment
For details, see 3A & 3B forms			

* FY 93 is a transition year from the previously used oil fiscal year to the federal fiscal year. This new project also includes proposed funding for January and February, 1993.

** If not funded in FY 94, $23.8K will be needed to retrieve field equipment and prepare a final report.

Project Number: 93024
Project Title: Restoration of Coghill Lake Sockeye Salmon Stock
Agency: AK Dept. of Fish & Game

FORM 2A PROJECT DETAIL

Project Description: This project will restore the natural productivity of Coghill Lake and the resident sockeye salmon population through use of established lake fertilization techniques. The ADF&G component of the project will focus on limnological and fisheries studies needed to monitor and refine the fertilization program. The response of lake nutrient levels, primary and secondary production, and plankton species composition will be monitored. The response of sockeye salmon fry growth, prey composition, and overwinter survival will be determined. The results of the monitoring program will be used to estimate changes in lake carrying capacity and smolt-to-adult survival rates.

Budget Category	Approved 1-Oct-92 28-Feb-93	Proposed* 1-Mar-93 30-Sep-93	Total FY 93	** FY 94	FY 95	FY 96	FY 97	Sum FY 98 & Beyond
Personnel	$0.0	$104.7	$104.7	$104.7	$104.7	$104.7	$104.7	
Travel	$0.0	$1.3	$1.3	$1.3	$1.3	$1.3	$1.3	
Contractual	$0.0	$8.8	$8.8	$14.5	$14.5	$14.5	$14.5	
Commodities	$0.0	$14.0	$14.0	$10.0	$10.0	$10.0	$10.0	
Equipment	$0.0	$21.5	$21.5	$0.0	$0.0	$0.0	$0.0	
Capital Outlay	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	
Sub-total	$0.0	$150.3	$150.3	$130.5	$130.5	$130.5	$130.5	$0.0
General Administration	$0.0	$16.3	$16.3	$15.8	$15.8	$15.8	$15.8	
Project Total	$0.0	$166.6	$166.6	$146.3	$146.3	$146.3	$146.3	$0.0
Full-time Equivalents (FTE)	0.0	2.1	2.1	2.1	2.1	2.1	2.1	

Amounts are shown in thousands of dollars

Budget Year Proposed Personnel:

Position	Months Budgeted	Cost
1 Limnologist I	1.0	$4.5
4 Fisheries Biologist I	15.5	$62.5
1 Fish & Wildlife Technician II	5.0	$15.3
1 Biometrician II	2.0	$10.4
1 Analyst/Programmer IV	0.5	$2.7
1 Analyst/Programmer II	0.5	$2.1
1 Publication Specialist II	0.5	$2.2
1 Program Manager	0.7	$5.0

Comment

* FY 93 is a transition year from the previously used oil fiscal year to the federal fiscal year. This new project also includes proposed funding for January and February 1993.

** If not funded in FY 94, $23.8K will be needed to remove field camps and prepare final report.

17-Jul-92

1993

Project Number: 93024
Project Title: Restoration of Coghill Lake Sockeye Salmon Stock
Agency: AK Dept. of Fish & Game

FORM 3A SUB-PROJECT DETAIL

		Proposed
Travel:	2 RTs-Anchorage and Cordova.	$1.3
Contractual:	Aircraft charter. Additional funds will be needed for analysis of hydroacoustic data and software.	$8.8
Commodities:	Supplies, food, fuel, etc. for field crew at the spring smolt camp. Supplies for coded-wire tag application, collection of limnology and fish samples, sample preservation and shipping, and laboratory analysis of otolith and stomach samples. Beach seine and tow net.	$14.0
Equipment:	3 electronic water temperature recorders, one electronic water level recorder, and one 120 KHz echosounder.	$21.5

Project Description: The USFS component of the project will involve application of fertilizer to Coghill Lake each year. Fertilizer will be applied from an airplane every two weeks throughout the summer.

Budget Category	Approved 1-Oct-92 28-Feb-93	Proposed* 1-Jan-93 30-Sep-93	Total FY 93	** FY 94	FY 95	FY 96	FY 97	Sum FY 98 & Beyond
Personnel	$0.0	$10.2	$10.2	$10.2	$10.2	$10.2	$10.2	$0.0
Travel	$0.0	$5.4	$5.4	$5.4	$5.4	$5.4	$5.4	$0.0
Contractual	$0.0	$7.0	$7.0	$50.0	$50.0	$50.0	$50.0	$0.0
Commodities	$0.0	$0.7	$0.7	$0.7	$0.7	$0.7	$0.7	$0.0
Equipment	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Capital Outlay	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Sub-total	$0.0	$23.3	$23.3	$66.3	$66.3	$66.3	$66.3	$0.0
General Administration	$0.0	$2.0	$2.0	$5.0	$5.0	$5.0	$5.0	$0.0
Project Total	$0.0	$25.3	$25.3	$71.3	$71.3	$71.3	$71.3	$0.0
Full-Time Equivalents (FTE)	0.0	0.2	0.2	0.2	0.2	0.2	0.2	

Amounts are shown in thousands of dollars

Budget Year Proposed Personnel:

Position	Months Budgeted	Cost	Comment
1 Fishery Biologist	1.0	$5.6	* FY 93 is a transition year from the previously used oil
1 Fishery Technician	1.0	$3.2	fiscal year to the federal fiscal year. This new project also
1 Fishery Technician	0.5	$1.4	includes proposed funding for January and February, 1993.

** If not funded in FY 94, no closeout costs are anticipated.

7-Jul-92

1993

Project Number: 93024
Project Title: Restoration of Coghill Lake Sockeye Salmon Stock
Sub-Project:
Agency: Dept. of Agriculture, Forest Service

FORM 3A SUB-PROJECT DETAIL

Travel:	Funds are requested to transport staff and vehicles by train from Whittier to Portage ($5.4K).
Contractual:	Funds are requested to store fertilizer in Wasilla until it can be applied in the summer in 1993 (.5K). Additional funds are needed for boat and air charter to transport staff from Whittier to Coghill Lake (4.9K).
Commodities:	Funds are requested for camp supplies, fuel, oil, etc. needed by staff when they travel to Coghill Lake.
Equipment:	No equipment is needed for this project.