19.08.01 (5 of 16)

19.08.01

FY 2000 DPDs and Budgets

19.8.1

Exxon Valdez Oil Spill Trustee Council

645 G Street, Suite 401, Anchorage, AK 99501-3451 907/278-8012 fax:907/276-7178

admin

MEMORANDUM

TO: Restoration Work Force

FROM: Sandra Schubert
Project Coordinator

RE: Additional Items for Binders of FY 00 DPDs and Budgets

DATE: April 24, 2000

Attached are the final two Detailed Project Descriptions and budgets for your FY 00 binders. These items were still outstanding at the time the binders and the subsequent addendum were distributed.

00396/Shark assessment	DPD and budget
00478/Testing satellite tags	DPD and budget

Revision 3/21/00
Approved TC 2/29/00

Alaska Salmon Shark Assessment Project

Project Number:	00396
Restoration Category:	Research
Proposer:	Leland B. Hulbert NMFS, Auke Bay Laboratory
Lead Trustee Agency:	NOAA
Cooperating Agencies:	Alaska Department of Fish and Game, US Geological Survey, Prince William Sound Science Center, University of Washington, University of Alaska Fairbanks, Virginia Institute of Marine Science
Alaska Sea Life Center:	no
Duration:	Year 1 of 2 year project
Cost FY 00:	$86.0K
Geographic Area:	Prince William Sound
Injured Resource/Service:	Pacific salmon, Pacific herring, rockfish, harbor seals

ABSTRACT

This project investigates salmon shark abundance indices, movements, demographics, and trophic interactions in the eastern Gulf of Alaska (GOA) and Prince William Sound (PWS). State-of-the-art satellite tags and data archival tags will be employed to describe salmon shark movements and migrations, and critical feeding areas and depths. The project will construct an index ratio of surface-to-subsurface abundance and apply the ratio to aerial survey counts and methods to estimate the abundance of sharks in PWS. Salmon shark abundance data from various agencies will be incorporated in the assessment of abundance trends. A random line transect sampling design and methodology will be used to calculate an unbiased estimate of salmon shark population in Port Gravina. Salmon shark diet composition from stomach sample analyses will be used to estimate salmon shark consumption biomass of prey species. This research is needed to assess the role of a predominant shark species as sentinels of change in the dynamic ocean climate and trophic structures in PWS and the GOA.

INTRODUCTION

Salmon sharks, *Lamna ditropis,* are one of the predominant shark species in coastal GOA, yet very little is known of its trends in abundance, demographics, ecology, or seasonal movements. Throughout the 1990's shark sightings and bycatch in PWS and the eastern GOA increased dramatically. In regions of high abundance, salmon sharks have the potential to affect the recovery of oil spill damaged species including wild salmon, herring, and rockfish. This proposed study will employ a conventional tagging and sampling effort, aerial survey counts, and the latest advances in marine biotelemetry technology to collect data on salmon shark abundance, a surface-to-subsurface ratio, movements and migrations, and seasonal residency in PWS and the eastern GOA.

Conventional tag-and-recapture programs studying sharks are dependent on fisheries for tag recoveries, and as indicators of movement and behavior have limited resolution. Due to the low exploitation rate of salmon sharks in commercial fishing gear, they are inaccessible to most conventional methods of study. Salmon sharks don't readily lend themselves to observation, they are rarely tagged, and consequently, very little is known about their movements and ecology in Alaska waters. The new technology of satellite telemetry makes it possible for researchers to study effectively for the first time the migratory habits and seasonal residency of large predatory sharks in the GOA and PWS ecosystems. Data collected from conventional tagging efforts and aerial abundance surveys, will be supplemented with data from satellite tags and archival data storage tags. These advanced data-gathering technologies provide state-of-the-art methods to acquire otherwise difficult to collect or unattainable data on the movements and ecology of these apex fish predators in the PWS and GOA ecosystems.

Successful satellite platform transmitter terminal (PTT) applications have been demonstrated recently for monitoring the movements, thermal physiology, feeding habits, and diving behavior of large pelagic vertebrates including pinnipeds (Lowry et al. 1997, Boyd et al. 1998), cetaceans (Mate et al. 1998), tunas (Block et al. 1998), penguins (Culik and Jorquera 1997), and sea turtles (Morreale 1999). The most advanced versions of PTT tags, the pop-up archival transmitting (PAT) tag, and the smart position-only transmitting (SPOT) tag will be commercially available from Wildlife Computers for the first time in 2000.

PAT tags measure and record temperature, depth, and light intensity for up to one year. Data are collected each minute and summarized into 1 to 24 hour blocks of time. Depth and temperature are measured to within 0.5m and 0.05°C resolution. Time blocks, depth and temperature bin ranges are user-defined. The tag releases (pops-up) from the animal on a predetermined date and time, and transmits archived data and position. Location of the tag after pop-up is calculated from Doppler shift in the transmitted signal as the satellite approaches and then moves away from the PTT. Long-term depth and temperature data from PAT-tagged salmon sharks will be supplemented with shorter duration high resolution archival tags.

Utilization of the latest advances in remote sensing technology will yield previously inaccessible data that are necessary to study salmon shark movements and ecology. Combined with aerial surveys counts, conventional tagging efforts, and demographic and diet data the study will yield high quality information on abundance, movements, and predatory interactions of salmon sharks

in PWS and the GOA.

Information on abundance indices, seasonal residency patterns, and food habits are needed to describe shark predator-prey interactions. This information will be of great value in evaluating the ecological role of sharks in the PWS and GOA ecosystems. One of the more cost-effective methods of assessing complex interactions of a food web is diet analysis from stomach contents. Cooperation has been established with commercial and sport fishermen and various agencies to acquire shark stomachs and other lethal samples from salmon sharks in PWS and the GOA.

NEED FOR THE PROJECT

A. Statement of the Problem

We are seeing surface aggregations of salmon sharks in numbers never described before. Evidence collected in 1999 indicates that salmon sharks prefer the depth range between 10 and 50m and the majority of sharks in a given area are well below the surface and therefore not visible from above (Hulbert 1999 unpublished data). This project will construct a standardized index ratio of surface-to-subsurface distribution patterns from data collected in directed studies utilizing satellite and data archival tags, side-scanning sonar, down-sounder, and remote operated vehicle video. The index ratio will be applied to aerial survey counts collected by ADF&G (Dan Sharp), USGS (Jim Bodkin), and UAF (Evelyn Brown) in PWS. Estimates of salmon shark abundance from aerial counts in PWS will be made based on the ratio of surface-to-subsurface abundance from this project and methods in Bodkin and Udevitz 1999.

Salmon sharks have been poorly documented in most fisheries survey and commercial bycatch data. Information on salmon shark abundance, residency patterns, and seasonal movements in PWS and the GOA does not exist. The project PI has already established cooperative salmon shark sampling, data collection, and data sharing among State and Federal agencies, University researchers, and sport fishing charter operators. A short-term objective of the project is to continue to improve cooperative salmon shark data collection and data sharing opportunities.

Salmon shark body temperature averages 26.5^{0}C (80^{0}F) (Goldman 1999 unpublished data) and may be the highest of any shark. Because of this and the cold waters they inhabit in the GOA, salmon sharks likely possess a high metabolism and high daily ration. Eighteen salmon shark stomachs collected in late July during peak pink salmon returns contained as many sablefish as salmon and also contained herring and rockfish (Hulbert 1999 unpublished data). In regions of high abundance salmon sharks have the potential to affect the recovery of oil spill injured species, including Pacific herring, Pacific salmon, rockfish, and harbor seals. The ecological role of sharks in PWS and their affects on the recovery of spill injured resources in the region will vary with temporal and spatial patterns of movement. Salmon shark movement patterns are currently unknown.

Sharks inhabiting Alaskan waters have low fecundity, long life, and slow maturation. Because of this, evidence of changes in their abundance may be important indicators of long-term changes in trophic community structure. Once sharks reach a dominance level in the community they are likely to continue that dominance for a long time.

B. Rationale

This research is needed to address the role of a predominant shark species, salmon shark, in the dynamic ocean climate and trophic structures in PWS and the GOA. The ecological role of sharks in PWS and their affects on the recovery of spill injured resources in the region will vary with temporal and spatial patterns of movement. These movement patterns are currently unknown. This research will provide a valuable contribution to the understanding of shark ecology in the GOA and PWS and will document and help quantify predator/prey interactions in the region.

Shark tissue samples will be collected opportunistically in the field during directed sampling efforts and from various agencies for fatty acids, stable isotopes,and genetic analyses. Archived samples from this work are needed to address a potentially larger scope of future work on salmon sharks and other shark species of interest.

The Alaska Salmon Shark Assessment Project will cooperate with Jennifer Nielsens project: Defining Critical Habitat for Marine Reserves: Spatial and Temporal Distribution of Pacific Halibut in the Gulf of Alaska. We will work with Dr. Nielsen to deploy her PAT tags on sharks and will share all light sensor and depth data recovered from tags. This collaboration will be mutually beneficial to both projects.

University of Washington stock assessment specialist Dr. Vincent Gallucci has volunteered to provide technical consultation on randomized line transect sampling design and data analyses (Vincent Gallucci 2000 pers. comm.).

C. Location

Prince William Sound and Gulf of Alaska

COMMUNITY INVOLVEMENT AND TRADITIONAL KNOWLEDGE

A traditional and local knowledge component will be incorporated in this study. People from Cordova, Chenega, and Tatitlik will be asked to contribute their knowledge of shark temporal abundance and distribution. Community members may also be hired to recover PAT tags if they "pop-up" in PWS.

PROJECT DESIGN

A. Objectives and Hypotheses

The overall objective of the project is to develop salmon shark abundance and consumption estimates in PWS, with an emphasis on data collected from vessel based strip transects in Port Gravina and aerial survey counts from Bodkin and Udevitz (1999 pers. Comm.). Salmon shark

abundance, diet, and movement data collected by the project will be useful in assessing their role in the marine ecosystem. All permits necessary for this work are in place.

Primary Hypotheses

H1: Salmon shark abundances have increased in the GOA in response to a shift in the GOA of their primary prey (salmon) to the north as a result of global warming.

H2: Salmon shark abundances have increased in the GOA in response to changes abundance of high trophic level groundfish which are important salmon shark prey.

Project Objectives

1. *Deploy tags (PAT, SPOT, and data archival tags) and recover tag data for analyses

2. Construct a standardized index ratio of surface-to-subsurface distribution patterns from data collected from tags and hydroacoustic (down-sounder and side-scanning sonar) and ROV observations.

3. Estimate down-sounder and side-scanning sonar salmon shark detection probabilities

4. Estimate salmon shark abundance by analyzing surface-to-subsurface ratios, tag and aerial survey data.

5. Estimate salmon shark abundance in Port Gravina by analyzing directed line transect sampling data collected with real-time coordination of down-sounder, side-scanning sonar, ROV, and visual (surface) observations.

6. Acquire and analyze salmon shark stomachs for diet composition estimates.

7. Estimate whether the salmon shark population in PWS and the GOA is sufficiently large to exert significant influence on any prey fish population.

8. Collect non-lethal tissue samples for stable isotope tracers, send to Dr. Kline for analyses. Stable isotope analyses effectively provide empirical evidence of trophic relationships in marine food webs (Kline 1997).

9. Support salmon shark demographic analyses by collecting, analyzing, and sharing length, weight, sex, and maturity data.

10. Establish and foster improved shark bycatch records, sampling, and data sharing among agencies, universities, and other sources.

***Biotelemetry Data Objectives**:

1. PAT tags: large-scale geographic movement data, time spent at depth, ratios of surface-to-subsurface abundance, seasonal PWS residency patterns

2. SPOT tags: high resolution salmon shark movement data and seasonal PWS residency patterns

3. Archival tags: high resolution (depth and temperature every 1.5 minutes for 8.4 days) salmon shark body temperature, feeding periodicity, foraging depths, time at depth

B. Methods

Directed salmon shark field sampling:
We will use purse seine gear for catching salmon sharks. The sampling protocol for salmon sharks will be largely opportunistic and will target individual sharks seen at the surface.

1. Sharks will be sexed and measured for length, and weight (or estimated from length/girth measurements). After measurement, if a shark is to be released, tissue samples will be collected for stable isotope tracers, fatty acids, and genetic analyses. The shark will then be double tagged and released with a numbered ADF&G spaghetti tag (Floy). Sharks released with internal data loggers will be tagged on the dorsal fin with fluorescent Jumbo Roto tags (cattle ear tags) to facilitate later detection and recovery. If a shark is killed, vertebrae and stomach content samples will be collected and frozen for subsequent laboratory analysis. Maturity state will be recorded and urogenital tract collected and preserved in 10% formalin solution or frozen: presence or absence of eggs or embryos in females, and male clasper length will be recorded. A maximum of ten salmon sharks will be collected. Permits allowing this are in place.

2. Other noteworthy information will be recorded when possible, including: date and location of capture, water depth and surface temperature, feeding behavior, localized seasonal aggregations, predator-prey interactions, proximity to known prey concentrations (i.e. spawning events etc.).

3. Vertebrae samples will be frozen and sent to Ken Goldman at VIMS for age determination. Mr. Goldman will be producing an age-growth relationship and modeling the demographics of salmon sharks in Gulf of Alaska waters.

4. Stomach contents analyses methods will follow "Standardized diet compositions and trophic levels of sharks" (Cortes 1999).

Percentage of time spent at depth from PAT tags deployed on the sharks, and data archival tags deployed in shark stomachs will be used to construct an index ratio of surface-to-subsurface abundance. Down sounder, side-scanning sonar, and ROV underwater video observations of the vertical distribution and abundance of salmon will be collected in the field to support the tag data. Aerial abundance survey and statistical methods will follow the methodology for sea otter abundance estimates detailed in Bodkin and Udevitz (1999). Aerial salmon shark counts used in the analysis will be contributed by cooperating aerial survey projects. Assumptions regarding

detection probabilities will be supported by real-time coordination of aerial and vessel-based observations when possible. Aerial salmon shark data collected in 1999 is being analyzed (James Bodkin and Evelyn Brown 1999 pers. comm.). Analysis of standardized aerial survey counts of salmon sharks will be used to construct an estimate of salmon shark abundance in PWS.

Depth sounder and scanning sonar equipment and data interpretation will be provided by the contracted vessel captain. ABL research biologist Scott Johnson has volunteered to provide and operate a Deep Ocean Engineering ROV for the project.

C. Cooperating Agencies, Contracts, and Other Agency Assistance

Prince William Sound Science Center, via Tom Kline, will perform shark stable isotope analyses.

University of Washington stock assessment specialist Dr. Vincent Gallucci has volunteered to provide technical consultation on data analyses (Vincent Gallucci 2000 pers. comm.). This cooperative effort will enable high quality, low cost analyses of shark abundance indices, demographics, and trophic interactions in PWS and the GOA.

Alaska Department of Fish and Game will provide PWS aerial salmon shark counts, shark spaghetti tags and tagging equipment, oxytetracycline, and salmon shark stomachs and tissue samples.

United States Geological Survey will provide pop-up (PAT) satellite tags (Jennifer Nielsen) and PWS aerial salmon shark counts (Jim Bodkin).

University of Alaska Fairbanks (Evelyn Brown) will provide PWS aerial salmon shark counts.

Virginia Institute of Marine Science (Ken Goldman) will provide salmon shark stomachs.

SCHEDULE

A. Measurable Project Tasks (Milestones) for FY 00 (October 1, 1999-September 30, 2001)

February-March 2000:	Submit Argos System Use Agreement for Alaska shark Argos program; Order PTT's from Wildlife Computers
July 2000:	Conduct field data collections.
August 2000-December 2000:	Organize and analyze data from FY00 field season
January 2001:	Prepare for and attend annual restoration workshop
February- March 2001:	Prepare annual report

B. Completion Date

D. Budget Summary

Budget Category:	FY 00
Personnel	$26.4
Travel	$ 4.0
Contractual	$25.3
Commodities	$24.6
Equipment	$ 0.0
Subtotal	$80.3
General Administration	$ 5.7
Project Total	$86.0

PUBLICATIONS AND REPORTS

An EVOS annual report will describe the results and accomplishments of the research to date.

PROFESSIONAL CONFERENCES

The PI will attend the EVOS Annual Restoration Workshop in the winter of 2001.

NORMAL AGENCY MANAGEMENT

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

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

The information gathered in this study may be useful to understanding the lack of recovery of some non-recovering species (harbor seals, Pacific herring).

PRINCIPAL INVESTIGATOR

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Lee has been employed as a Fisheries Research Biologist at the Auke Bay Laboratory, NMFS for 3 years and has two years prior work experience in fisheries biology at ABL. He is currently a CO-PI on the EVOS Alaska Predator Ecosystem Experiment (APEX) Forage Fish Assessment Project (163A). He holds a B.S. degree (1992) in Fisheries Biology from Humboldt State University. He has extensive commercial fishing experience in Prince William Sound and has also fished commercially in Bristol Bay, Togiak, Cook Inlet, the Gulf of Alaska, and S.E. Alaska. He has worked on the APEX Forage Fish Component (163C) for over 3 years. He recently presented a paper at the International Pelagic Shark Workshop in Monterey California titled: Shark Abundance following Regime Shifts in the Gulf of Alaska as an Indicator of Trophic Community Restructuring.

Revision 3-23-00
Approved TC 12-16-99

Testing Satellite Tags as a Tool for Identifying Critical Habitat

Project Number:	00478
Restoration Category:	Research
Proposer:	J. Nielsen/USGS-BRD
Lead Trustee Agency:	DOI
Cooperating Agencies:	None
Alaska SeaLife Center:	Yes
New or Continued:	New
Duration:	1st yr. 1 yr. project
Cost FY 00:	$106.1
Cost FY 01:	$0.0
Cost FY 02:	$0.0
Geographic Area:	Prince William Sound, Gulf of Alaska
Injured Resource/Service:	Cutthroat trout, king salmon, halibut, ling cod

ABSTRACT

The definition of critical habitat in the marine environment is essential to the development of reserves or protected areas in relationship to a sustainable commercial or sport fishery. This project will assess and test the application of satellite archive, pop-up tags on marine fishes of the Gulf of Alaska. Software and tag technology will be adapted and developed for geolocation tracking using light, depth, and bathometry data from satellite pop-up tags. Tag application and light-geolocation relationships will be tested on live halibut brought into husbandry at the Alaska SeaLife Center and kept under an accelerated solar-shift regime mimicking standard conditions in the gulf. These data will be compared to light and depth readings taken from tags placed on live fish released into their natural habitat and to an array of tags attached to a stationary buoy in the gulf. The effectiveness of light sensors for geolocation, duration of light measurements, and data sequence design will be determined. These developments will assist in applications of this new tag technology in fisheries-independent habitat assessments for the nearshore and pelagic marine environments in the gulf.

INTRODUCTION

The definition of "critical habitat" in the marine environment for anadromous and pelagic fishes is essential to the development of reserves or protected areas (Anonymous, NOAA, 1999). In Alaska, the relationship of aquatic protected areas to subsistence, commercial, or sport fisheries is a critical factor in considerations of design and implementation of reserves. Resource protection and strategic use are not incompatible concepts when a sound foundation of scientific knowledge on the distribution and abundance of key species is incorporated into reserve planning and resource use, and if local community-based natural resource management is included in the analyses of such data (Getz et al. 1999). This proposal tests the application and sets the foundation for deployment of a new technology, satellite pop-up tags, in investigations into the temporal and spatial distribution of key anadromous and marine fish species in the Gulf of Alaska. Many aquatic species that fall under the jurisdiction of the Trustee Council in their efforts to restore the resources and services injured by the spill may benefit from the development and local adaptation of this technology. Fisheries-independent data on real-time position and monitoring of critical habitat use by Gulf of Alaska fish species will allow the organisms to speak directly to the managers of the resource without relying solely on information dependent on harvest recapture that most tagging technologies currently demand.

For many commercially important anadromous and marine fish species ocean-use and critical habitat remain uninvestigated with little or no scientific evidence to support distribution on temporal or spatial scales. The use of radio telemetry and satellite-linked tracking for studying fishes has experienced a recent exponential growth in the development of technologies and applications (Lucas et al. 1993; Eiler 1995; Sibert 2000). For example, the recent study of the effects of commercial halibut fishing on the Glacier Bay marine ecosystem by P.N. Hooge and S. J. Taggart of the USGS/BRD have shown limited but seasonally predictable movements of halibut within Glacier Bay (P. Hooge, USGS/BRD, personal communications). In addition to critical habitat designation, physiological telemetry can now be used to monitor energy expenditure, life history migrations, stage of life cycle, and environmental conditions critical to improving and validating habitat-use models for pelagic fishes (B. Block, Stanford University, personal communications).

Archival satellite technologies offer the fisheries research community a new technology that is required to resolve movement patterns, spatial and temporal habitat use, and stock structure of many migratory marine species found in the Gulf of Alaska. The critical advantage to this new technology is that it allows documentation of habitat use that is independent of any fisheries harvest. Conventional identification tags have been used since the early 1900s, but individuals must be recaptured before information is obtained. Hydroacoustic tags can provide multi-day records of location, depth, temperature and swimming speed in marine fishes, but their temporal and spatial scale is limited by the range of signal recovery and transmission duration in salt water. In 1996 the first generation of archive satellite "pop-up" tags were developed and deployed on pelagic fish.

The range of signal available at depth, sea water conductivity, required recapture of tagged fish, and/or the temporal scale of signal recoveries limit sonic and radio telemetry tags for fish found in the ocean. New technology involving microwave archive tags and satellite-linked telemetry with temperature, light, and pressure sensors can be used to identify critical habitat in near-shore and pelagic fishes that are unavailable with more conventional technologies. There are several versions of satellite pop-up tags currently developed for fish. One (PTT100) can store location data based on solar angle and a set number of average or instantaneous temperature

points (up to 60). This tag is commercially available from Microwave Telemetry, Inc. A second, the pop-up archival transmitting (PAT) tag, collects and stores data on depth, temperature, and light levels at user set intervals and transmits these data at a preselected time via Argos satellites. The PAT tags are available from Wildlife Computers. In studies of pelagic movements of Atlantic blue fin tuna, pop-up tags developed by both manufacturers gave very similar results following applications by two independent research groups. Recovery rates for PTT pop-up tags deployed by one European research group were low in 1999. It is unclear, however, if these poor recoveries are due to differences in survivorship of the fish, differences in attachment technique, or failure of the tags.

A more technical tag is in development which measures and records light intensity, hourly temperatures, and/or pressure for up to one year and downloads these data remotely to a satellite link from any location. These tags have limited commercial availability at this time, have been field tested on a limited number of deep-sea pelagic fishes (tuna and marlin), but can be made available in limited quantities for this study (P. Howey, Microwave Telemetry, Inc., personal communications). Size restrictions are a problem with the first series of satellite pop-up tags. These tags require large animals (around 70 lbs) for successful attachment. Smaller, more hydrodynamic tags are currently in development by several vendors and may be available for research in the near future.

Data archived by satellite tags include records of ambient and internal body temperature, pressure, and light. It is possible to estimate latitude (geoposition) for tag location at any given time from light intensity, temperature, and accurate temporal measurements of dawn and dusk (Hill 1994). The longitude determination is equally accurate throughout the year and at all locations except those where no dawn and dusk events are recorded. Latitude determinations are most accurate at the solstices and useless at the equinoxes. This is clearly a problem in Alaska waters where long crepuscular periods (winter) are followed by intense solar periods (summer). The accuracy of light-level measurements, duration of crepuscular events, atmospheric aberrations, and individual fish behavior can all impact the accuracy of geoposition estimates. A current error rate of 50-60 miles is not uncommon in the analyses of these data from temperate waters. We should expect a much wider error rate in Alaskan waters unless data collection and processing are adapted to local light conditions. Wildlife Computers is working on new analytical algorithms using time-series analyses of light sensor data for increased accuracy of geoposition estimates from pop-up tags. This approach seems very promising for areas, such as Alaska, where crepuscular light conditions alternate with long solar exposures.

Light sequence data from pop-up tags are downloaded to satellite relays in predetermined data sequences. These sequences can be set as individual records of light/temperature/pressure at set intervals, means of individual sequence data, or as data series sets (such as sets based on time series analyses). Data sequence, architecture, and analyses can be developed for local conditions at different times of the year increasing the effectiveness of geoposition estimates. *In situ* temperature records can be integrated with sea surface temperature (SST) to add rigor to geoposition estimates taken from tags recording near the surface. However, any correlation between SST and actual temperatures at various depths in the Gulf of Alaska remains unclear. A combination of temperature and pressure data can be used to evaluate fish behavior (time at surface, length of dive, time at depth, etc.), but a clear association between ocean bathometry and currents for the Gulf of Alaska and temperature/pressure at depths needs to be evaluated.

Satellite tags are attached externally to fish released back into their natural habitat. Tags release at a preprogrammed time, float to the surface, and transmit their data continuously to available satellites. The data are then available via satellite links to the individual researcher.

These data can be made available in real time to any user group after developed algorithms translate the satellite transmissions into temperature, pressure, and light data. Successful integration of satellite tag data into the EVOS Trustee Council's Gulf Ecosystem Monitoring (GEM) program will allow the development of a unique and continuous information base on natural use of critical marine habitat by migratory fishes due to the fact that tags can be programmed to detach at predetermined intervals and transmit location and other pertinent data over both short and long time intervals. This flexibility in data recovery from natural distributions of organisms will allow research scientists and managers to develop and test hypotheses concerning critical habitat use over temporal and spatial scales unavailable with any other tool.

One additional advantage to satellite tagging technology is the ease of application and data transfer to multiple user groups beyond the research scientist, making these data a potentially important link between fisheries, conservation, and management groups. This proposal suggests that data collected from archive tags deployed in the Gulf of Alaska be made available to local communities and interest groups in real-time through internet web links with a USGS/BRD web site dedicated to this study.

This proposal is intended to test the accuracy and efficiency of archive satellite tags for estimates of geoposition in the Gulf of Alaska. If successful these data can provide an effective database for analyses of critical habitat use in Alaska waters. This technology is clearly universal in its application and testing. A recent 5-day symposium was held in Hawaii on "Tagging and Tracking Marine Fish with Electronic Devices." This symposium had registered participants from 13 countries (Australia, Canada, France, Germany, Iceland, Iran, Italy, Japan, Mexico, New Zealand, Norway, Sweden, United Kingdom, and United States). There were 21 satellite-tracking presentations at the symposium covering case studies on four species of tuna, swordfish, marlin, Atlantic salmon, brown trout, Arctic char, and five species of sharks. Also included were six talks on new hardware and software application developments in satellite tagging technology. The PI for this project is currently editing the proceedings of this symposium. Clearly there are numerous data sets in development that will facilitate the application of satellite tags in Alaska waters. One research project scheduled for funding by EVOS (Alaska Shark Assessment Project #00396) has agreed to cooperate on the analyses of light and temperature data from pop-up tags deployed on sharks (Lee Hulbert, pers. comm.)

There are several developmental issues based on conditions endemic to Alaska that have not yet been addressed to date in the use of satellite tags. Primary is the issue of geolocation estimated from ambient light levels. Studies of satellite tags in the lower 48 states and Europe primarily rely on records of sunrise and sunset recorded by changes in light intensity on the tag data to establish approximate longitude and latitude locations for individual tags (fish). With the long duration of crepuscular light sequences in Alaska waters new light interpretative algorithms need to be developed for the Gulf of Alaska to provide an efficient tool for geolocation using satellite tags. This is critical to studies where we end up tracking animals over time in very shallow or very deep waters where variation in depth and temperature data will not provide collaborative evidence of fish locations. For best results these algorithms need to be developed and tested in conjunction with laboratory experiments of light conditions and sensor data and compared to data collected from an array of tags submerged at different depths on a stationary mooring line in the Gulf of Alaska.

Additional research needs to be undertaken on cost-effective tagging regimes for this area. These analyses would investigate species-specific tagging protocols, size and anchor location of tags as they affect survival rates (for both fish and tags), effects of coastal geology on tag recovery, release mechanisms appropriate for depth and scale of movement by different

species, and the effects of fish mortality and tag mortality on the interpretation of results. We also need to develop some platform for data exchange, crossover studies, and data archive capacity for ecosystem scale marine habitat analyses in the Gulf of Alaska. The latter objectives will require integration of satellite tag data with other significant geological, oceanographic, and climatic databases for this area.

The approach of this study is directed at multiple species, not individuals of any one species. Halibut were selected as the test organism at the Sea Life Center because of their general size in the Gulf of Alaska, their ease of capture and adaptation to captivity that will allow experiments of light intensity, tag sensitivity, and handling (tagging) stress under different natural and artificial conditions available at the Center. This proposal requests funding to initiate satellite telemetry studies incorporating three elements: 1) initiate and monitor satellite telemetry data from tags on captive fish under artificial light regimes that mimic crepuscular conditions in the Gulf of Alaska, on a few tagged fish released into their natural environment, and on a tag array placed *in situ* on a stationary buoy in the Gulf of Alaska; 2) develop data architecture (i.e. duration and sequence of data points) and analytical approaches (sequence mean or time series analysis) for estimates of geoposition from satellite pop-up tags in the Gulf of Alaska; 3) initial studies in captivity of tagging effects, efficiency, and physiological response in individual fish at Alaska Sea Life Center.

NEED FOR THE PROJECT

A. Statement of Problem

The development of marine reserves or protected areas in geographic localities with subsistence, commercial, and sport fisheries depend on sound scientific knowledge of "critical habitat" and ecosystem use at several temporal and spatial scales. Our knowledge of marine habitat use over time for different life stages and fish species in the Gulf of Alaska are currently limited to information from harvest statistics and antidotal information from resource users and managers (Int. Pac. Halibut Comm. 1987; Pelletier and Parma 1994), with the notable exception of recent work done on halibut in Glacier Bay (Chilton et al in press; Hooge and Taggart unpublished data). Knowledge of the distribution of individual fish over time within the Gulf of Alaska ecosystem is needed to make sound management decisions at the inception of reserves or protected areas. Without sound scientific support, initial development of marine reserves can create significant conflict among diverse user groups. Including local community based information in the deployment and recovery of these scientific data will be an effective tool in resource management. Documentation of individual fish behavior in economically and ecologically important species within the reserve will aid in the development of a common-ground database on fish distributions over time and space during the development of reserve boundaries and temporal management units within the reserve where frequent conflict-of-interest problems are expected to arise.

The marine environment imposes severe constraints on the type of electronic tags that can be used to monitor the behavior of fish in their natural environment. Seawater is highly conductive and radio waves do not propagate well in this medium. Recently marine biologists have developed new technologies in an effort to address this problem. Pop-up devices are externally attached to fish and are programmed to detach from the animal at a specific date, surface to the ocean, and transmit data to available satellites. The newest pop-up tags incorporate archive technology and transmit a full suite of data arrays to the satellite. To date this technology has been applied to large pelagic fish spending at least part of their time in temperate waters.

The developmental approach used in the acquisition and analyses of pop-up tag data need to be adapted to local climatic and solar conditions if this technology is to be effectively implemented in the Gulf of Alaska.

There are numerous data sets in development that will facilitate the application of satellite tags in Alaska waters. But there are several developmental issues based on conditions endemic to Alaska that have not yet been addressed. Primary is the issue of geolocation by light levels. Studies of satellite tags in the lower 48 states and Europe primarily rely on records of sunrise and sunset recorded by changes in light intensity on the tag data to establish approximate longitude and latitude locations for individual tags (fish). With the long duration of crepuscular light sequences in Alaska waters new light interpretative algorithms need to be developed for the Gulf of Alaska to provide an efficient tool for geolocation using satellite tags. This is critical to studies where we end up tracking animals over time in very shallow or very deep waters where variation in depth and temperature data will not provide collaborative evidence of fish locations.

Additional research needs to be undertaken on cost-effective tagging regimes for this area. This study would facilitate investigations of species-specific tagging protocols, size and anchor location of tags as they affect survival rates (for both fish and tags), effects of coastal geology on tag recovery, release mechanisms appropriate for depth and scale of movement by different species, and the effects of fish mortality and tag mortality on the interpretation of results. We also need to develop some platform for data exchange, crossover studies, and data archive capacity for ecosystem scale marine habitat analyses in the Gulf of Alaska. I anticipate that this latter objective will require integration of satellite tag data with other significant geological, oceanographic, and climatic databases for this area.

The approach of this study has always been one directed at multiple species found in their natural marine habitats. Halibut were selected as the test organism simply because of their ease of capture and adaptation to captivity that would allow experiments of light intensity, tag sensitivity, and handling (tagging) stress under different natural and artificial conditions we can manipulate at the Sea Life Center. Potential future applications directed at discovery and monitoring of ocean habitat use by critical Trustee fish species are broad. A clear understanding of marine salmonid life history and ocean forage migrations will only be possible with the development of this technology. Understanding temporal and spatial use of marine habitats by species, such as sharks, lingcod, rockfish, halibut, trout, and salmon will contribute significant information to fisheries resource management decisions in the Gulf of Alaska.

B. Rationale/Link to Restoration

Information collected during this study will contribute to our ability to use new technology to assess recovery and impediments to recovery (critical habitat) for economically and ecologically important fish species found in Prince William Sound and the Gulf of Alaska. The proposed work represents a sound initial scientific approach to increase our technological capacity to investigate the factors that affect population dynamics on multiple temporal and spatial scales and if successful, this technology will help in the definition of critical habitat for proposed marine reserves in the Gulf of Alaska. Without an understanding of the general underlying patterns of habitat use that dictate population change and species interaction within marine units or areas, we can not prescribe or limit specific activities within the reserve based on species distribution. Analysis of critical habitat use for different life history stages of key species will allow integration of sustainable use or limited harvest in the conservation and management of these species within the marine reserve. The development of satellite tag technology offers a promising window on this type of information.

Archival satellite technologies offer the fisheries research community a new technology that is required to resolve movement patterns, spatial and temporal habitat use, and stock structure of many migratory marine species found in the Gulf of Alaska. The critical advantage to this new technology is that it allows documentation of habitat use that is independent of any fisheries harvest. Conventional identification tags have been used since the early 1900s, but individuals must be recaptured before information is obtained. Hydroacoustic tags can provide multi-day records of location, depth, temperature and swimming speed in marine fishes, but their temporal and spatial scale is limited by the range of signal recovery and transmission duration. In 1996 the first generation of archive satellite "pop-up" tags were developed and deployed on pelagic fish. The data archived by satellite tags include records of ambient and internal body temperature, pressure, and light. It is possible to estimate latitude and longitude for tag location at any given time from changes in light intensity. Only after crepuscular 24hr light sequence data are developed for local conditions and integrated with the satellite data will the true potential of these tags be available to species in the Gulf of Alaska.

Satellite tags are attached externally to fish, release at a preprogrammed time, float to the surface, and then transmit their data continuously to ARGOS satellites. The data are then available via satellite links to the individual researcher. These data can be made available in real time to any user group after developed algorithms translate the satellite transmissions into temperature, pressure, and light data. Successful integration of satellite tag data into GEM's goals will allow the development of a unique and continuous information base on natural use of critical marine habitat by migratory fishes due to the fact that tags can be programmed to detach at predetermined intervals and transmit location and other pertinent data over both short and long time intervals. This flexibility in data recovery from natural distributions of organisms allows research scientists to develop and test hypotheses concerning critical habitat use over temporal and spatial scales unavailable with any other tool.

One additional advantage to satellite tagging technology is the ease of application and data transfer to multiple user groups beyond the research scientist, making these data a potentially important link between fisheries, conservation, and management groups. This proposal suggests that data collected from archive tags deployed in the Gulf of Alaska be made available to local communities and interest groups in real-time through internet web links with a USGS/BRD web site dedicated to this study.

C. Location

Data to be compiled will come from tags deployed in the Gulf of Alaska and tags in controlled light condition at the Sea Life Center. Initial physiological data concerning tagging effects and efficiencies of light intensity data will be assessed using a limited number of fish (6) in captivity at the Alaska Sea Life Center in Seward, AK. Tagging of four wild fish with satellite pop-up tags will take place in collaboration with the local sport and commercial fishing community. Tag array disposition on a stationary buoy in the Gulf of Alaska will be done in collaboration with the National Weather Service, National Marine Fisheries, and the US Coast Guard. Satellite data recovery, data architecture, data array analysis, and the development of a web-site for real-time data access to tag data will be done by the staff of the USGS/BRD Alaska Biological Science Center, in conjunction with tag vendors.

COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE

All efforts will be made throughout the project to incorporate participation in and provide

local involvement in the implementation and development of this project in relation to target populations and tagging localities. Project staff will be available to present information to local communities, internet access to real-time data from satellite tags will be made available at the local level as it becomes available to the PI. All articles, video, or photographs of the tagging study will be made available to the Trustee Council. The nature of the tagging study and the charismatic character of the fish subjects make this a potentially high profile public relations project for the recovery and Trustee Council.

PROJECT DESIGN

A. Objectives

1. Develop critical criteria for satellite telemetry data dedicated to geolocation of organisms in marine habitats within the Gulf of Alaska:

    a. Monitor satellite telemetry data derived from artificial light conditions simulating long crepuscular and intense solar periods on fish maintained in short-term captivity studies at the Alaska Sea Life Center

    b. Deploy pop-up tag array from a stationary buoy in the Gulf of Alaska and develop data sets on light, temperature, and pressure from direct *in situ* studies of tag efficiency and data architecture.

    c. Monitor and plot individual movement and geolocation estimates based on data derived from four tagged fish releases in the Gulf of Alaska

    d. Integrate all available light data bases taken from pop-up tags in the Gulf of Alaska, including NMFS's data on tagged sharks into analyses of geolocation on fish in the Gulf of Alaska

2. Study captivity effects, metabolic compensation, and fish physiology based on tagging efficiency (attachment methods, tag stability, fish response) for Pacific halibut brought into captivity at the Sea life Center

3. Summarize data available for different tag configuration and data architecture accessible via satellite links. Test efficiency of geolocation estimates based on tag studies and publish results in peer-reviewed scientific journals

4. Create a public access internet site for the display and development of study results with real-time deposition of tag recovery data throughout the duration of the project.

B. Methods

A total of 14 pop-up tags will be deployed under various conditions to gather and analyze data on estimates of geolocation in the Gulf of Alaska. Six fish will be collected in FY00 from the halibut sport fishery and transported live to the Alaska Sea Life Center for analyses of tag attachment, tagging efficiencies under different light conditions, and photo sensor precision.

Fish in captivity will be fitted with pop-up tags (3.5 g). Each tag is housed in a composite, positively buoyant, low-drag housing that is towed by the fish via a short "leader" attached to a tagging dart. The PI will monitor tag attachment effects with at least two veterinary scientists with a background in fish, and a representative from the satellite tag vendor. Tests will include attachment location effects, physiological stress during and after tagging, and stability of implantation over time.

Several features of the satellite tags will be tested from an array of tags deployed from a stationary buoy located in the Gulf of Alaska. This tag array will be used to test efficiency of light sensors at latitudes within the Gulf of Alaska, temperature cycles at depth, stability of pressure sensors at depth, and effective deployment of timed-release mechanisms in pop-up tags. The data downloaded from this artificial *in situ* array of tags will be compared to results we obtained from our artificial light experiments for halibut held in captivity under controlled conditions. The relative efficiencies of different data arrays, download capacity, and photo sensors for estimates of geoposition in conditions common to the Gulf of Alaska will be analyzed in these comparisons artificial and natural light conditions.

Estimates of actual fish location will be obtained from data collected from four live fish released with pop-up tags into the Gulf of Alaska and from coordination and data sharing with other research groups working with pop-up tags in the same area (i.e. NMFS's shark project). These data will then be compared and analyzed for rigor of geoposition estimates based of our findings from captivity light studies and the stationary tag array.

Conversion of satellite data to position and movement cycles for individual fish will be made using adaptations of existing conversion algorithms available from the vendor and our initial field trials of tags in the Gulf of Alaska. New approaches to estimating geoposition from light data using time series analyses will be tested in this study (R. Hill, Wildlife Computers, pers. comm.) Data for location and position for individual tags collected in the wild will be plotted by species on digitized maps of the Gulf of Alaska (two dimensional) incorporating any bathymetric data (three dimensional) available for this area using standard telemetry and GIS mapping methods (Swilhard and Slade 1985; Baltz 1990; Cressie 1991; Thompson et al. 1992).

The development of the internet link to tagging studies and results will run parallel to the ongoing field studies and tagging data development. The initial web site will be posted on the USGS/BRD Alaska Biological Science Center's home page.

C. Cooperating Agencies, Contracts, and Other Agency Assistance

This proposal relies on data collected by a number of research collaborators as yet unnamed (i.e. commercial or sport boat captains, fishing volunteers, and community internet links). Known collaborators include: Dan Mulcahy, DVM, USGS/BRD fish and wildlife veterinarian; Riley Wilson, DVM Anchorage Zoo; Roger Hill, Wildlife Computers; Dr. Paul Howey, Microwave Telemetry, Inc.; Philip Hooge and Spencer Taggart, USGS/BRD Glacier Bay; Dr. Barbara Block, Hopkins Marine Station, Stanford University; Dr. Heidi Dewar, the Pfleger Institute of Environmental Research; Dr. Steve McCormick, fish physiologist, NMFS, Conte Anadromous Fish Laboratory; and the staff of the Alaska Sea Life Center. Lee Hulbert of the National Marine Fisheries has volunteered collaboration on the analysis of light data collected from their shark pop-up tag study. All technical and clerical staff will be current employees of USDGS/BRD Alaska Biological Science Center or qualified individuals contracted directly for this project.

SCHEDULE

A. Measurable Project Tasks for FY 00 - 01

April 15 – May15:	Purchase satellite-linked tags, establish download links, develop field collection protocols, and prepare live tanks (3) for halibut at Alaska Sea Life Center. Consult with resource managers and local users on best populations to target for captivity and tagging studies.
May 16 – June 15:	Collect six Pacific halibut and transport to Alaska Sea Life Center. Time depends on availability of vessel.
June 16 – Sept. 15:	Captivity test on light data arrays using artificial lights and UV tank covers. Do analyses of halibut physiology, tagging effects and efficiency, and survival trials in captivity.
July 2000:	Field trials of environmental sensors in satellite tags in Gulf of Alaska. Deploy pop-up tag array on stationary buoy.
July 21 – Aug. 30:	Capture, tag, and release 4 halibut in Gulf of Alaska. Deploy tags to pop-up in 2-3 months.
Sept. 1 - Oct. 31:	Collect and analyze first data sets. Develop Web Page for study results and plot initial data. Consult on tagging applications and data interpretation. Develop oceanic temperature and bathymetry database.
Sept. 29 – Oct. 5:	Presentation of preliminary results at International Marine Biotechnology Conference Tagging Symposium
Nov.1 – Dec. 30:	Analyze final data from tagging recoveries in captivity and in the wild.
Dec. – Jan 2001:	Prepare data presentation and attend restoration meeting.
Feb. – Mar. 2001:	Compile data and write annul reports
April – Sept. 2001:	Integrate analyses from parallel studies of pop-up tags in Gulf of Alaska. Submit final report to EVOS on study results.

B. Project Milestones and Endpoints

All EVOS costs for this project will be billed in FY00.

Due to late implementation of study plan and funding, USGS/BRD data analyses will continue into FY2001.

Project will be completed upon submission of the final report prior to Sept. 30, 2001.

C. Completion Date

All project objectives will be met during FY2000-2001.

PUBLICATIONS AND REPORTS

A final report of activities will be submitted to the Restoration Office on or before 30 September 2001.

Manuscript containing final results and recommendations will be submitted to a peer-reviewed scientific journal for publication in FY01.

Website development and maintenance of our tagging database will be available FY00-01. At the end of the project we will transfer the internet site to a webmaster designated by the Trustee Council.

PROFESSIONAL CONFERENCES

International Marine Biotechnology Conference (IMBC) 2000
American Society of Ichthyologists and Herpetologists FY01
American Fisheries Society FY02

NORMAL AGENCY MANAGEMENT

The work proposed here is not part of normal agency management and is related specifically to research addressing oil spill restoration concerns. No similar work has been conducted, is currently being conducted, or is planned using agency funds.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

This research provides fundamental information needed for the implementation and development a new technology dedicated to the identification of critical marine reserve areas in Prince William Sound and the Gulf of Alaska. The definition of critical marine habitat for economically and ecologically important fish species will serve as a cornerstone for future Trustee sponsored conservation and use management proposals under the GEM program. The major objectives of this work require interaction with several other investigators and integration of all available data that are relevant to the question of critical marine habitat in the Gulf of Alaska.

PROPOSED PRINCIPAL INVESTIGATOR

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PERSONNEL QUALIFICATIONS

Jennifer Nielsen is Fisheries Supervisor and Research Biologist (GS14) with the Alaska Biological Science Center, USGS Biological Resources Division. She has conducted salmonid and fisheries research throughout the western Pacific for the past 20 years. Dr. Nielsen is a Associate Professor at the University of Alaska, Fairbanks in the School of Fisheries and Ocean Sciences. From 1995 - 1999 she was a visiting scientist at Hopkins Marine Station, Stanford University, where the first experiments on satellite pop-up tags were conducted on blue fin tuna. From 1995 - 1999, she was an Adjunct Professor in Ichthyology and Fisheries at the University of California, Berkeley and Moss Landing Marine Laboratory, and served on the Scientific Review Board for the Monterey Bay Aquarium. Dr. Nielsen has published over 30 peer-reviewed journal publications and book chapters, numerous technical reports, and gives frequent national and international presentations at scientific meetings addressing research issues in fish conservation, behavior, evolution, and genetics. Her work on salmonid fishes is recognized internationally for its contribution and focus in fisheries conservation and management.

Revision 3-14-00
Approved TC 2-29-00

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1997 - September 30, 1998

Budget Category:	Authorized FFY 1999	Proposed FFY 2000
Personnel	$0.0	$26.4
Travel	$0.0	$4.0
Contractual	$0.0	$25.3
Commodities	$0.0	$24.6
Equipment	$0.0	$0.0
Subtotal	$0.0	$80.3
General Administration	$0.0	$5.7
Project Total	$0.0	$86.0
Full-time Equivalents (FTE)	0.0	0.5
Other Resources		

LONG RANGE FUNDING REQUIREMENTS

Estimated FFY 2001	Estimated FFY 2002
$100.0	$0.0

Dollar amounts are shown in thousands of dollars.

Comments: This project investigates salmon shark abundance indices, movements, demographics, and trophic interactions in the eastern Gulf of Alaska (GOA) and Prince William Sound (PWS). State-of-the-art acoustic telemetry tags and satellite tags will be employed to describe salmon shark movements and migrations, and critical feeding areas and depths.

2000

Project Number: 00396
Project Title: Alaska Shark Assessment Project
Agency: NOAA

FORM 3A
AGENCY
PROJECT
DETAIL

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

Personnel Costs:			GS/Range/ Step	Months Budgeted	Monthly Costs	Overtime	Proposed FFY 2000
	Name	Position Description					
	L. Hulbert	PI	GS9	6.0	4,400		26.4
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
		Subtotal		6.0	4,400	0	
						Personnel Total	$26.4

Travel Costs:		Ticket Price	Round Trips	Total Days	Daily Per Diem	Proposed FFY 2000
	Description					
	Juneau to Cordova (Lee Hulbert)	374	1	13	225	2.0
	Juneau to Cordova (Scott Johnson)	374	1	4	225	1.0
	Homer to Cordova (Scott Myers, ADFG invitational travel)	100	1	13	150	1.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
					Travel Total	$4.0

2000

Project Number: 00396
Project Title: Alaska Shark Assessment Project
Agency: NOAA

FORM 3B
Personnel
& Travel
DETAIL

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

Contractual Costs:	Proposed
Description	FFY 2000
vessel charter (11 days at $1,575/day)	17.3
fuel charges for vessel	2.0
shipping	2.0
ARGOS platform ($350/tagx3 PAT tags plus 2 SPOT tag charges= $1.5K-5.0K)	3.0
seine net repair	1.0
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$25.3

Commodities Costs:	Proposed
Description	FFY 2000
Wildlife Computers PAT tag ($4.2k per tag x 3 tags)	12.6
Wildlife Computers SPOT tag ($2.5K per tag x 2 tags)	5.0
VEMCO data loggers (14 @ $500 each)	7.0
Commodities Total	$24.6

2000

Project Number: 00396
Project Title: Alaska Shark Assessment Project
Agency: NOAA

FORM 3B
Contractual
&
Commoditie

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

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FFY 2000
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
Those purchases associated with replacement equipment should be indicated by placement of an R.		**New Equipment Total**	$0.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency
ROV		NOAA
scale		NOAA
sonar		NOAA
purse seine		ADFG

2000

Project Number: 00396
Project Title: Alaska Shark Assessment Project
Agency: NOAA

FORM 3B
Equipment
DETAIL

Revision 3/28/00
Approved TC 12-16-99

2000 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 2000

Budget Category:	Actual FY 1999	Proposed FY 2000
Personnel		$15.5
Travel		$1.0
Contractual		$5.5
Commodities		$0.9
Equipment		$51.4
Subtotal		$74.3
General Administration		$2.7
Project Total		$77.0
Full-time Equivalents (FTE)		0.8

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

Dollar amounts are shown in thousands of dollars.

Other Resources

USGS/BRD will provide $43.5 support directed to the completion of this study in FY00

FY00

Prepared:4/15/99

Project Number: 00478
Project Title:Testing satellite tags as a tool for idenifying critical habitat
Agency: DOI-BRD

FORM 3A
TRUSTEE
AGENCY
SUMMARY

2000 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1999 - September 30, 2000

Personnel Costs*:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 2000
J. Nielsen*	Fisheries Supervisor	GS14/01	3.0	7.2		0.0
TBA	Fisheries Project Leader	GS9/01	5.0	3.1		15.5
D. Mulcahy*	Fish/Wild. Veterinarian	GS13/05	0.5	6.8		0.0
D.Douglas*	Fish/Wild Scientists	GS12/05	0.5	6.0		0.0
TBA**	Aquaculture Technician	ASC grade	0.1	3.6		0.0
TBA**	ASC Veterinarian	ASC grade	0.1	6.4		0.0
						0.0
						0.0
*all personnel costs will be covered by USGS/BRD						0.0
** peresonnel costs covered in SeaLife Center bench fees						0.0
						0.0
	Subtotal		9.2	33.1	0.0	
					Personnel Total	$15.5

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 2000
Anchorage-Homer for sampling	120.0	3	4	160.0	1.00
PI & Vendor travel at USGS/BRD costs					0.00
					0.00
					0.00
					0.00
					0.00
					0.00
					0.00
					0.00
				Travel Total	1.00

FY00

Prepared:4/15/99

Project Number: 00478
Project Title: Testing satellite tags as a tool for identifying critical habitat
Agency: DOI-BRD

FORM 3B
Personnel
& Travel
DETAIL

2000 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 2000

Contractual Costs:	Proposed
Description	FY 2000
Private longline fishers (R. Wilson)	2.0
Research vessel lease (private) - 2 days	1.9
Satellite link recovery costs	1.6
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$5.5

Commodities Costs:	Proposed
Description	FY 2000
Materials and supplies - misc.	0.9
Commodities Total	$0.9

FY00

Prepared:4/15/99

Project Number: 00478
Project Title: Testing satellite tags as a tool for idenifying critical habitat
Agency: DOI-BRD

FORM 3B
Contractual & Commodities DETAIL

2000 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 2000

New Equipment Purchases:	Number	Unit	Proposed
Description	of Units	Price	FY 2000
Pop-up tags (light only) (6 @ 2700 ea.)	6	2700.0	16.2
Pop-up light/pressure tags (8 @4400 ea)	8	4400.0	35.2
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
Those purchases associated with replacement equipment should be indicated by placement of an R.		**New Equipment Total**	$51.4

Existing Equipment Usage:	Number	Inventory
Description	of Units	Agency

KENAI HABITAT RESTORATION & RECREATION ENHANCEMENT PROJECT

Project Number:	00180-CLO
Restoration Category:	Habitat Improvement
Proposer:	ADNR/USFS
Lead Trustee Agency:	ADNR
Cooperating Agencies:	ADFG, USFS
Duration:	One Year
Cost FY 00:	$19.1
Geographic Area:	Kenai Peninsula
Injured Resource/Service:	Pink salmon, sockeye salmon, Dolly Varden, commercial fishing, subsistence, recreation & tourism.

ABSTRACT

Adverse impacts to the banks of the Kenai River total approximately 19 miles of the river's 166 mile shoreline. Included in this total are 5.4 river miles of degraded shoreline on public land. Riparian habitats have been impacted by trampling, vegetation loss and structural development. This riparian zone provides important habitat for pink salmon, sockeye salmon and Dolly Varden, species injured by the Exxon Valdez oil spill. The project's objectives are to restore injured fish habitat, protect fish and wildlife habitat, enhance and direct recreation and preserve the values and biophysical functions that the riparian habitat contributes to the watershed. Restoration/enhancement techniques will include revegetation, streambank restoration, elevated boardwalks, floating docks, access stairs, fencing, signs, and educational interpretive displays. This proposal funds final report writing.

INTRODUCTION

This project is a continuation of the Kenai River Habitat Restoration and Recreation Enhancement Project that began in 1996. The objectives of this project are to:

1. Restore and protect fish habitat on the Kenai River,

2. Improve existing recreational access to the Kenai River watershed in a manner that restores and protects riparian fish and wildlife habitat,

3. Provide information to the public that promotes their understanding of the river's ecology and proper use of its resources.

Public lands on the Kenai Peninsula, including those acquired with Exxon Valdez oil spill joint settlement funds, contain important habitat for several species injured by the spill and provide recreation services for tens of thousands of Alaska residents and tourists. Kenai River fish support a large commercial fishery, a commercial sport fishing industry, a subsistence fishery, and a recreational sport fishery. In the aggregate, revenues generated by sportfishing, commercial fishing and river-based tourism represent a significant and growing proportion of the local economy.

The riparian zone, the transitional area that lies between the river's channel and the uplands, provides important fish and wildlife habitat and plays a major role in the hydrology of the watershed by helping to control floods and erosion. This vegetated area functions as a buffer and filter system between upland development and the river, thereby maintaining water quality by absorbing nutrients, accumulating and stabilizing sediments, and removing heavy metals and pollutants that are a result of urban development and which enter the river from surface runoff. It is also the area where a significant portion of the Kenai River's sportfishing and other recreational activities are concentrated.

Degradation of the river's streambanks, riparian vegetation and fish habitat has the potential of jeopardizing its long term productivity and degrading the quality of the recreational experience. This project proposes revegetation, streambank restoration, and public access improvements that will promote pink and sockeye salmon and Dolly Varden habitat protection and restoration, as well as enhancement of recreational services in the Kenai River watershed. The project also proposes to design and construct educational and interpretive displays that will inform the public of the proper manner in which to access and use the river's resources.

Restoration and enhancement proposals on public lands extending from the outlet of Kenai Lake to the mouth of the Kenai River (Figure 1), were nominated by public

landowners and evaluated by an Interdisciplinary Team (IDT) of biologists and resource managers using specific threshold and evaluation criteria (Table 1). The IDT designed the qualifying criteria used to evaluate and rank the proposals by considering a variety of factors, including the degree of damage at a site and the effects that each proposal will have on fish habitat, recreation, and the surrounding environment.

All proposals had to meet threshold criteria before the evaluation criteria were applied. The scores are a method of ranking those proposals that best achieve the overall project's goals for habitat restoration, compatible recreation enhancement, and educational value. In an attempt to identify the most cost-effective proposals and obtain maximum benefits from available funds, it was decided to compare the relative restoration benefits of the proposals in terms of costs. To facilitate that determination, the results of the evaluation process, i.e. the scores, were plotted against the estimated costs.

Conceptual restoration and enhancement plans were presented to the IDT for evaluation. Final engineered plans were provided to ADFG/ADNR prior to construction. Choice of building materials and construction methods are the responsibility of the landowner (but subject to IDT review) and must employ restoration techniques permittable by regulatory agencies (ADFG, ADNR, and the Army Corps of Engineers).

The project was proposed to last for three years, beginning in 1996. Projects approved for funding in 1997 will be completed in 1998. Monitoring of funded proposals will be carried out by ADFG/ADNR to ensure the proposals are constructed and function as designed. Monitoring will also be used to gather information regarding effectiveness of restoration techniques.

Twelve nominations (sites) were chosen for restoration/enhancement. Construction status of these sites is as follows:

- Kenai Dunes (Completed)
- Rotary Park (Completed)
- Endicott Sonar Site (Completed)
- Ciechanski (Completed)
- Big Eddy (Completed)
- Funny River (Completed)
- Bing's Landing (Completed)
- Kobylarz (Completed)
- Cone (Completed)
- Centennial Park (Completed)
- Slikok Creek [Phase I (In Progress); Phase II (In Progress)]

- Russian River [Phase I (Complete); Phase II (Complete);
  Phase III (In Progress)]

Signs and interpretive displays were erected at each project site. They include:

- 24 signs that identify the funding source for each project.
- Ten displays dealing with protection of the river's resources.
- Six displays depicting aquatic insects as in important element of the river ecosystem as it relates to salmon fry.
- Four displays depicting interesting facts about salmon fry.

Table 1

Threshold Criteria

1. The project will protect, restore or enhance the historic functional attributes of a site and the surrounding area.
2. The project is located on public land.
3. The managing agency agrees to endorse the project.
4. The managing agency agrees to future maintenance and management of the project in a manner that facilitates and is consistent with the restoration or enhancement endpoint (#1).
5. All elements of the project can be permitted.
6. The project is not a mitigation requirement.

Nomination must be in compliance with all Threshold Criteria.

Evaluation Criteria

1. Potential Habitat Value
   What is the potential habitat value of the project? [Score_ = (20/10/5) x 3.5]

2. Potential Recreation Value
   What is the potential recreation value of the project? [Score = (20/10/5) x 2.5]

3. Disturbance Level
   What is the level of disturbance (human impact) in relation to habitat/recreation values? [Score = (20/10/5) x 2.0]

4. Rate
   To what extent will the project decrease the amount of time needed for riparian habitat to recover? [Score = (20/10/5) x 1.0]

5. Collateral Impacts
   What is the potential for adverse impacts to natural or cultural resources or to the nearby human community resulting from this project?
   [Inverse relationship: Score = (5/10/20) x 3.0]

6. Design/Effectiveness
   How would you rate the project's design to its expected effectiveness?
   [Score = (20/10/5) x 2.0]

7. Vulnerability
   Is the protected, restored or enhanced site vulnerable to natural or human-induced degradation. [Inverse relationship: Score = (5/10/20) x 2.0]

NEED FOR THE PROJECT

A. Statement of Problem

Use of the Kenai River watershed is degrading fish habitat along the riparian zone of the mainstem and, to a lesser degree, the tributaries of the river. Streambanks that provide essential fish habitat are being trampled and denuded of vegetation leading to increasing rates of erosion and sedimentation. Both commercial and residential developments are altering shorelines, changing patterns of runoff and creating the potential for the discharge of non-point source pollutants into the river. Federal and state resource agencies have limited ability to manage these problems that have the potential of threatening the productivity and world class recreational value of this river system.

Commercial fishing, subsistence, recreation and tourism (including sport fishing) are services that were reduced or lost because of the spill. Within the Kenai River watershed, the resources that support these services that were injured by the Exxon Valdez oil spill include pink and sockeye salmon and Dolly Varden. Chinook and coho salmon also contribute significantly to these services. The Exxon Valdez Oil Spill Restoration Plan states that the Kenai River sockeye salmon population is not recovering and that: With regard to sockeye salmon, the objective of habitat protection is to ensure maintenance of adequate water quality, riparian habitat, and intertidal habitat.

The restoration strategy articulated in the restoration plan for recreation and tourism focuses on the: Preservation and improvement of the recreational and tourism values of the spill area. The Plan goes on to discuss strategies for promoting recovery of commercial fishing, recreation and tourism by:...increasing the availability, reliability, or quality of the resource on which the service depends.

What is needed within the Kenai River watershed is an integrated approach that protects resource habitats, restores degraded streambanks and riparian vegetation, maintains productivity and promotes appropriate, sustained human use of the river.

B. Rationale

The work proposed by this project is a continuation of the on-going effort needed to protect and restore fishery resources. Continuing loss of habitat will exacerbate the injury caused by the spill to both resources and services and lead to diminished productivity. This, in turn, diminishes the value of the commercial, subsistence and sport fisheries and the quality of recreation on the river with significant, adverse implications for the local economy.

The present condition of North America's native fish fauna is attributable, in part, to the degradation of aquatic ecosystems and habitat (FEMAT Report, 1993). Loss and degradation of freshwater habitats are the most frequent factors responsible for the decline of anadromous salmonid stocks (Nehlsen, et. al. 1991). Along with habitat modification or loss, changes in water quality and quantity are often cited as causative factors for degradation of aquatic systems and declines in anadromous fish populations.

The Kenai River Cumulative Impacts Assessment of Development Impacts on Fish Habitat (Liepitz, 1994) was designed to identify and evaluate the cumulative impacts of development actions including public and private land use impacts on Kenai River fish habitat. The study documented that : 11.1 percent to 12.4 percent (18.4 to 20.6 miles) of the river's 134 miles of upland and 32 miles of island shoreline and nearshore habitats have been impacted by bank trampling, vegetation denuding, and structural development along the river's banks. Degraded public land along the Kenai River includes 5.4 miles of trampled riparian habitat and 3.5 miles of developed shoreline.

Based on a review of historic recreation use patterns and habitat impacts in the Slikok Creek and Russian River areas, the project will protect, restore, stabilize, or rehabilitate streambanks where resource damage is occurring; enhance or close existing access points and movement corridors; or re-direct users to other areas of the river on a temporary or long term basis. These actions will be based on the need to facilitate human use of the river in a way that protects fish habitat and minimizes degradation of other sensitive and/or pristine habitats.

This project is designed to promote streambank stability, increase vegetative cover, and mitigate accelerated erosion and sedimentation for the benefit of pink salmon, sockeye salmon, Dolly Varden and other fish species that migrate and rear along the river's banks. Techniques used to achieve these goals will include the use of elevated, grated boardwalks, river access stairs, fishing platforms, and other riparian habitat improvement and protection techniques. These techniques will, at the same time, restore and enhance sportfishing. One example is elevated, grated boardwalks, constructed to protect revegetating streambanks, that will provide river access to anglers with a minimum of impact to the recovering habitat. Post-construction monitoring will examine the effects of the method and the amount of recreational use that occurs in the area.

The education component of the project will produce user information and interpretive displays at strategically located access points along the Russian River and at Slikok Creek. These displays will provide users with information on the natural history of the river's fish, their habitats, ecology of the river system and the best methods that they can use to maximize their recreational experience with a minimum of impact to the watershed and its resources. Signs placed adjacent to work sites will describe the on-going restoration effort and direct the public away from recovering vegetation.

C. Location

All work on the final report preparation will be conducted in Anchorage, Alaska with site visits to projects along the Kenai River.

COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE

This project was fully integrated with on-going agency recreation management, permitting and regional planning activities affecting the Kenai River watershed. This includes coordination with the Kenai Peninsula Borough, City of Kenai, Kenai City Council, City of Soldotna, Soldotna City Council, Kenai Peninsula Borough Assembly, and local interest groups.

PROJECT DESIGN

A. Objectives

1. Complete the final report for the project

B. Methods

C. Cooperating Agencies, Contracts and Other Agency Assistance

ADNR will coordinate and draft the final report for this project.

SCHEDULE

A. Measurable Project Tasks for FY 99

April 15, 2000: Final Report Due

B. Project Milestones and Endpoints

April 15, 2000: Final Report Due.

NORMAL AGENCY MANAGEMENT

The impacts affecting the Kenai River are occurring at a rate and magnitude far in excess of the management resources that are available to mitigate or restore habitat damage. The proposed project supplements existing efforts to reverse this trend. Moreover, none of the riparian habitat on small parcels that the Trustee Council is acquiring on the Kenai River has been surveyed or evaluated for restoration work. Additional issues relevant to state agency management of the Kenai River are to be found in the following section.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

Coordination will occur with agency staffs in DNR, ADF&G and the USFS. Their expertise will be used in defining management objectives, developing criteria, evaluating and ranking potential project sites, conducting archaeological and historical reviews and clearances, performing design to include preparing plans and specifications, bidding construction projects, oversight of project construction, permitting, monitoring public use, and enforcing site restrictions.

Federal funding through the USDA Forest Service has made possible many additional restoration projects in the Russian River area for fish habitat and river bank vegetation. Such projects include closing river banks from foot traffic, constructing access point stairways into river, and revegetating eroded river bank areas. One vital program the Forest Service implemented is Streamwatch, a cadre of volunteers, who are at the Russian River and locations on the Kenai River during fishing season to talk with anglers about their impacts to the river banks. Since its inception in 1994, the Streamwatch Program has doubled in size and has become a resource utilized by other federal, state, and local agencies. Key to the program is the Forest Service leadership, and partnerships with Kenai River Sportfishing Inc. (who provide funding for the program) and Facilities Management Inc. (who provide a free campsite).

The project built upon pilot efforts that implemented or developed for the river. In 1994, boardwalks were installed near the Soldotna airport and on numerous private parcels; exclosures have been used with a high degree of success along portions of the Russian River and in units of the state park system. State permitting procedures have also resulted in numerous bank stabilization projects that maintain or enhance fish habitat by using spruce tree revetments, root wads, live willow cuttings, and other protective measures.

The state and federal governments also committed funds to accomplish several of the objectives identified by this project. Fish and Game Exxon Valdez criminal settlement funds ($3 million) have been dedicated for the construction of habitat protection

demonstration projects and land acquisition on the Kenai River. The U.S. Fish and Wildlife Service provided challenge grant funding to assist the ADF&G demonstration projects. The National Marine Fisheries Service provided the ADF&G with an additional one million dollars for streambank improvements under an appropriation requested by Senator Stevens. ADNR restitution funds ($7 million) were used, in part, to construct boardwalks and access platforms that protect streambanks at heavily used state park units at Morgan's Landing, Bing's Landing, and Slikok Creek. Dingle-Johnson funds are being used to provide recreational access, streambank revegetation, and streambank protection structures at The Pillars project site.

The intense public use pressures and development activities on the Kenai River threaten to overwhelm the limited budgets available to resource agencies attempting to manage the river for resource protection and sustained recreational use. That is why supplementary funding is so important. This project, along with those utilizing other available funds, provided a cost-effective method to protect streambanks and minimize further habitat degradation.

EXPLANATION OF CHANGES IN CONTINUING PROJECTS

None.

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PERSONNEL

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Anchorage, AK 99503

2000 EXXON VALDEZ T[illegible]EE COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 2000

Budget Category:	Authorized FY 1999	Proposed FY 2000
Personnel		$14.4
Travel		$0.4
Contractual		$2.0
Commodities		$0.0
Equipment		$0.0
Subtotal	$0.0	$16.8
General Administration		$2.3
Project Total	$0.0	$19.1
Full-time Equivalents (FTE)		0.2
Other Resources		

LONG RANGE FUNDING REQUIREMENTS					
		Estimated FY 2001	Estimated FY 2002		

Dollar amounts are shown in thousands of dollars.

Comments:
This request is for final report writing for this project.

FY00

Prepared:
4/2/99

Project Number: 00180-CLO
Project Title: Kenai River Restoration & Recreation Enhancement
Agency: ADNR

FORM 3A
TRUSTEE
AGENCY
SUMMARY

2000 EXXON VALDEZ T...TEE COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 2000

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 2000
	Natural Resource Manager		2.0	7.2		14.4
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		2.0	7.2	0.0	
					Personnel Total	$14.4

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 2000
					0.0
Travel to Kenai	0.2	1	1	0.2	0.4
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$0.4

FY00

Project Number: 00180-CLO
Project Title: Kenai River Restoration & Recreation Enhancement
Agency: ADNR

FORM 3B
Personnel
& Travel
DETAIL

Prepared:

4/2/99

2000 EXXON VALDEZ TI 'EE COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 2000

Contractual Costs:	Proposed
Description	FY 2000
Printing and binding	2.0
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$2.0

Commodities Costs:	Proposed
Description	FY 2000
Commodities Total	$0.0

FY00

Prepared:

Project Number: 00180-CLO
Project Title: Kenai River Restoration & Recreation Enhancement
Agency: ADNR

FORM 3B
Contractual & Commodities DETAIL

2000 EXXON VALDEZ T TEE COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 2000

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FY 2000
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
Those purchases associated with replacement equipment should be indicated by placement of an R.		**New Equipment Total**	$0.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency

FY00

Project Number: 00180-CLO
Project Title: Kenai River Restoration & Recreation Enhancement
Agency: ADNR

FORM 3B
Equipment
DETAIL

Prepared:

4/2/99

Construction of a Linkage Map for the Pink Salmon Genome

Project Number:	00190
Restoration Category:	Research
Proposer:	Fred W. Allendorf University of Montana
Lead Trustee Agency:	ADFG
Alaska SeaLife Center:	yes
Duration:	5th year, 7-year project
Cost FY 00:	$211,700 plus ADFG GA ($14.8) = $226.5
Cost FY 01:	$225,000 plus ADFG GA ($15.8) = $240.8
Geographic Area:	Prince William Sound
Injured Resource:	Pink salmon

ABSTRACT

We will continue experiments at the Alaska SeaLife Center (ASLC) that use the linkage map we constructed in previous years to test for organismal effects of regions of the genome on phenotypes that affect traits that are important to recovery of pink salmon (e.g., growth and survival). Progeny produced from wild pink salmon collected from Likes Creek in August 1998 will be released from the ASLC in May 1999; this experiment will be repeated in 1999. Sexually mature adults from the 1998 cohort will return to the ASLC in August 2000. We will compare genotypes in released fry and returning adults to test for genetic differences in marine survival and other life history traits (e.g., body size, egg number, and egg size).

INTRODUCTION

This is a continuation of our project to construct a genetic linkage map for the pink salmon (*Oncorhynchus gorbuscha*) genome. Such a map was proposed initially to provide the necessary platform to identify genetic damage in pink salmon inhabiting oiled streams following the March 1989 *Exxon Valdez* oil spill (EVOS). We have initiated a series of experiments based at the Alaska SeaLife Center (ASLC) to identify regions of the genome that affect various organismal phenotypes and to test for the effects of natural selection on regions of the genome used in describing genetic population structure. This research will aid recovery efforts with pink salmon, including estimation of straying rates, description of stock structure, and testing if marine survival and other organismal measures of phenotypic variation have a genetic basis.

This project began in FY 96. However, we did not receive authorization to proceed until half-way through FY 96 (March 1996). We have completed our two initial objectives that included identifying several hundred genetic markers and using them to construct a linkage map. We are now using the ASLC to continue experiments that apply the linkage map to an understanding of the fundamental population biology and genetics of pink salmon.

We continue to pursue additional funding for this research through other sources. Eleanor Steinberg, currently a graduate student in the Department of Zoology at the University of Washington, has submitted a National Science Foundation (NSF) proposal for a Postdoctoral Research Fellowship in Biological Informatics to assist us in the data analysis of the current proposed research (DBI-9974243). In addition, the renewal proposal (DEB-9903910) for NSF grant (Conservation and genetics of Pacific salmonids; DEB-9300135) included an objective to test for the effects of inbreeding on fitness of pink salmon using the returning adults in August 2000.

Genetic linkage maps have provided the necessary information for understanding genetic variation in species since the rediscovery of Mendel's principles early in this century. A genetic map plays a similar role for a geneticist that a geographical map plays for the explorer of new territories. For many years, genetic maps could only be constructed in a very few model species that were suitable for extensive genetic manipulation (e.g., *Drosophila* and mice). Recent advances in molecular genetics now make it possible to uncover enough genetic markers to construct a detailed genetic linkage map in almost any species (Postlethwait et al. 1994).

This work was originally designed to support work with pink salmon under the project *Oil-Related Embryo Mortalities* (Restoration Study \191A). The objective of that project was to identify germline mutations in pink salmon exposed to oil. Genetic damage induced by oil may either be small changes in nucleotide sequence (microlesions) or large-scale changes in chromosome structure (macrolesions). A detailed genetic map for pink salmon would be invaluable for interpreting the results of Restoration Study \191A in several ways. First, it would be possible by following the inheritance of any DNA lesions to determine if they are micro- or macro-lesions. Second, these lesions could be mapped to determine if they are randomly spread throughout the genome or if they occur at mutational "hot spots" that are susceptible to oil induced damage. However, Restoration Study \191A is no longer ongoing, and thus our future work will concentrate on our original Objectives 5 and 6 as described in this proposal.

NEED FOR THE PROJECT

A. Statement of Problem

Elevated embryo mortalities were detected in populations of pink salmon inhabiting oiled streams following the spill. These increased rates of mortality persisted through the 1993 field season, three generations after the oil spill, suggesting that genetic damage may have occurred as a result of exposure to oil during early developmental life-stages. The consequences of the putative genetic damage include impaired physiological function of individuals and reduced reproductive capacity of pink salmon populations (Bue et al. 1998).

The aggregate of evidence from field studies and incubation experiments suggests that embryos exposed to oil in 1989 and 1990 accumulated deleterious mutations in the germline (Bue et al. 1998). This hypothesis of genetic damage is consistent with previous field observations and laboratory experiments on the effects of crude oil on early life stages of fish. 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). Roy et al. (1999) have recently reported evidence of molecular genetic damage to pink salmon embryos exposed to crude oil.

Mironov (1969) observed reduced survival of fish embryos and larvae exposed to very low aqueous doses (1 ul oil/l seawater) of oil. Longwell (1977) reported genetic damage in pelagic embryos affected by the ArgoMerchant oil spill. Moles et al. (1987) confirmed that pink salmon embryos 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 that incubated in oiled areas than in non-oiled areas. It is likely that the same type of damage may have occurred in pink salmon and other species in Prince William Sound, and this damage could have affected the germline of exposed individuals (Malkin 1994; Bue et al. 1998).

Molecular genetic techniques have been used extensively to describe population structure of Pacific salmon (Utter et al. 1993; Gharrett and Smoker 1994; Seeb et al. 1998). Genetic divergence among populations has been interpreted as largely reflecting the patterns of exchange of individuals among populations (gene flow) and random changes in frequency of selectively neutral alleles within populations (genetic drift) (Allendorf and Phelps 1981; Waples 1995). This is a useful approach that allows description of the pattern and amount of gene flow among populations.

This approach to describe population structure is based upon the assumption that the molecular markers used are not affected by natural selection. That is, it is assumed that the patterns of divergence in allele frequencies among populations are the result of gene flow and genetic drift. However, even weak natural selection may have a substantial effect on the pattern of genetic divergence among populations (Allendorf 1983). Zhivotovsky et al. (1994) have recently questioned the description of genetic population structure of pink salmon and suggested

that natural selection may have an important effect on allozyme frequency divergence in pink salmon.

The molecular markers used may be affected by natural selection even though the markers themselves are not the target of selection. Even loci that are selectively neutral themselves and have no effect on the phenotype are expected to be affected by the action of natural selection at closely linked loci (Slatkin 1995). Apparent heterozygous advantage ("associative overdominance") can result at neutral loci by linkage disequilibrium with nearby loci that are affected by natural selection (Pamilo and Pálsson 1998).

It has been notoriously difficult to detect and measure the effects of natural selection in natural populations (Lewontin 1991). Comparing the distribution of genotypes in a single cohort followed through different life history stages is the most powerful method to detect natural selection (p. 303, Lynch and Walsh, in preparation). The facilities at the ASLC provide an exceptional opportunity to measure lifetime fitness of pink salmon from fertilization to sexual maturity of molecular genetic markers spread throughout the genome identified in previous years of this project.

B. Rationale

This research will provide a powerful test of the assumption of the absence of natural selection affecting molecular markers. This assumption is the foundation of interpreting patterns of genetic divergence among populations as reflecting patterns of genetic exchange. Evidence of natural selection affecting the molecular markers would cause a major change in the interpretation of genetic variation in natural populations of pink salmon and other species. This will be true whether the selection is acting on the markers or chromosomal segments linked to the marker being followed. Recent results from molecular studies of the genome suggest that natural selection may play a greater role than previously thought in determining the structure of the genome, including the organization of genes and chromosomes, as well as the patterns and amounts of genetic variation present (Hurst 1999).

The recovery objective for pink salmon is healthy and productive populations that exist at prespill levels or levels in unoiled areas. An indication of recovery is when egg mortality in oiled areas match prespill or levels in unoiled areas. A genetic map would be essential for detecting and understanding causes of reduced egg and embryo survival in oiled areas (Bue et al. 1998). The genetic damage caused by exposure to oil may persist longer in populations of pink salmon than in other vertebrates because of the tetraploid nature of the salmonid genome. Salmonid fishes went through a tetraploid event some 25 million years ago that duplicated their entire genome (Allendorf and Thorgaard 1984). The extra genes in pink salmon may mask the effects of mutational damage caused by recessive deleterious alleles. The effects of these deleterious mutations may be uncovered in subsequent generations.

C. Location

Gametes for the inheritance studies and linkage map were collected from Prince William Sound in collaboration with the project Oil-Related Embryo Mortalities (Restoration Study \191A). Embryo incubation took place at the Genetics Lab facilities of ADFG. The laboratory analyses were done at the University of Montana and the ADFG genetics lab in Anchorage.

We began in FY 1998 to use the ASLC Research Facilities at Seward for experiments designed to test for natural selection at loci throughout the genome of pink salmon. Sexually mature pink salmon used in the experimental matings were collected from Thumb Cove in Resurrection Bay. The progeny are currently being raised at the ASLC.

COMMUNITY INVOLVEMENT

This is a specialized project that will not benefit directly from the knowledge of local/traditional people. We will hire local residents when possible for assistance (e.g., collecting and maintaining fish). As a professional educator in a university, I am very committed to educational efforts. I am interested in suggestions of other opportunities for informational meetings in the communities of Prince William Sound, including the ASLC in Seward, and articles in the Trustee Council newsletter.

PROJECT DESIGN

A. Objectives

Our initial primary objective was to construct a detailed genetic linkage map for pink salmon by analyzing the genetic transmission of several hundred DNA polymorphisms. Pink salmon have 26 pairs of chromosomes (2N=52; Allendorf and Thorgaard 1984), and, therefore, should have a total of 27 linkage-groups: 25 autosomes, an X-chromosome, and a Y-chromosome. We plan to map enough variable markers so that a new marker can be assigned with high probability to one of the 27 linkage groups. It was impossible to know how many markers this would require because we did not know the total length of the pink salmon linkage map. The linkage map of the zebrafish (*Danio rerio*) has been estimated to be 2900 centimorgans (cM; Johnson et al. 1996) and that of the medaka (*Oryzias latipes*) to be 2480 cM (Wada et al. 1995). There currently are efforts to include zebrafish among genome projects of model species sponsored by the National Institutes of Health under the Human Genome Project (Roush 1997). Such a massive effort in zebrafish would provide extremely helpful information for understanding the genome of salmonid fishes.

We expected the pink salmon map in females to be large because of the polyploid ancestry of salmonids. Young et al. (1998) recently have published a rainbow trout (*Oncorhynchus mykiss*) linkage map based upon recombination rates in males and estimated the total map to be 2628 cM. However, the linkage map in males will be shorter than in females because of the reduced recombination rate in male salmonids (Johnson et al. 1987a). We initially anticipated that it would be necessary to map over 500 markers to ensure that new markers can be assigned to an existing linkage group with high probability (Van der Beek and Van Arendonk 1993). For

example, 99% of all loci in the zebrafish were estimated to be located within 20 cM of a marker on the map based upon an earlier report using 414 markers (Postlethwait et al. 1994).

This project originally had the following overall specific objectives:

1. Develop several hundred variable DNA markers in pink salmon and test them for Mendelian inheritance.

2. Construct a linkage map based upon joint segregation patterns of the DNA polymorphisms detected in previous objective.

3. Map putative lesions identified in Restoration Study \191A.

4. Test for Mendelian inheritance of markers throughout the genome in progeny of fish exposed to oil. Regions that show aberrant segregation ratios in progeny of fish exposed to oil and normal 1:1 ratios in fish not exposed to oil would be candidates for oil-induced lesions.

5. Test for regions of the genome that are associated with traits of adaptive significance (e.g., marine mortality or run-timing).

6. Test if protein markers (allozymes) are under natural selection such that they may not provide accurate information about the genetic structure and amount of gene flow among populations.

We have completed Objective 1; Objective 2 will be completed by the end of FY99. We cannot pursue Objective 3 because Restoration Study /191A did not identify any putative lesions for mapping. At present, we do not intend to pursue Objective 4 because Restoration Study \191A is no longer ongoing. However, this type of experiment to detect oil-induced lesions could be pursued in the future at the ASLC. The primary focus in FY 00 will be Objectives 5 and 6; we propose to use the linkage map to test for the phenotypic effects and adaptive significance of molecular markers throughout the genome of pink salmon.

B. Methods

OBJECTIVES 1 & 2

Our map was constructed using gynogenetic haploid and diploid progeny from an individual female. This is the same procedure that has been used to build the zebrafish linkage map (Postlethwait et al. 1994). Stanley (1983) reported that haploid embryos of Atlantic salmon (*Salmo salar*) will develop until just prior to the stage of hatching if development of the eggs is activated by sperm in which the DNA has been inactivated by UV-radiation. We have used this technique routinely with fishes of the genus *Oncorhynchus* (Forbes et al. 1994; Spruell et al. 1999). This allows us to follow the segregation and linkage relationships in haploid progeny from females. The use of haploid progeny avoids possible difficulties of dominance with some types of DNA markers because recessive alleles are not obscured by their dominant alternatives in haploids

(Lie et al. 1994). Our map is based on 585 segregating markers in 94 haploid progeny from a single pink salmon female (95-103) that returned to Armin F. Koernig hatchery in Prince William Sound in August 1995). We also have placed a number of so-called "landmark" loci on the map in the last year.

Differences in meiosis between male and female salmonids have been found in all species that have been examined (Allendorf and Thorgaard 1984; Johnson et al. 1987a). There generally is greater recombination in females than in males (Johnson et al. 1987a; Allendorf et al. 1994). In addition, only disomic inheritance has been reported in females. However, in males some loci show patterns of segregation that approach those expected with tetrasomic inheritance (Allendorf and Thorgaard 1984). We will have to test for segregation and linkage in males as well as females because of these sex-specific differences.

Construction of a full linkage map is a large task. We developed as many time and labor saving procedures as possible (Archibald 1994). Our linkage map was constructed by computer assisted analysis (MapMaker, Lander et al. 1987). We have been assisted by Mark Daly of the Whitehead Institute at MIT in using this program. We will compare the recombination rates based upon this map to rates of selected pairs of loci in males. The reduced recombination rates in salmonid males means that it will be easier to assign new markers to a linkage group using male parents. We will test joint segregation of individual markers from different linkage groups identified in females to determine if some of these separate linkage groups in females are linked in males and are therefore syntenic (on the same chromosome).

A useful genetic map contains genetic markers that are abundant, randomly distributed throughout the genome, highly polymorphic, and readily detectable in many laboratories (Jacob et al. 1995). We began using random amplified polymorphic DNA (RAPD) markers because they fit these criteria and they have been used successfully in constructing linkage maps in zebrafish and medaka (Johnson et al. 1996; Wada et al. 1995). We have switched to two other types of genetic markers that are superior to RAPDs in this work.

PINEs: There are a variety of repetitive DNA elements that are scattered throughout the genome of salmonid fishes. Greene and Seeb (1997) have described a technique that uses the sequences from a SINE (short interspersed element) and a transposon to detect many DNA polymorphisms. They have called this technique SINE-printing. We have modified this technique using other types of repetitive elements for our mapping study to detect a class of molecular markers that we call PINEs (paired interspersed nuclear elements; Spruell et al. 1999).

Kido et al. (1991) described 3 SINEs in salmonid fishes. They documented the presence of two such elements, *Hpa*I and *Sma*I, in pink salmon. Spruell and Thorgaard (1996) subsequently reported the presence of the 5'-end of the third element, *Fok*I, in pink salmon. Goodier and Davidson (1994) confirmed that salmonids also contain the transposon *Tc*1, a member of another class of repetitive elements. Both SINEs and transposons occur in high copy number and are believed to be ubiquitously dispersed throughout the genome, making them ideal candidates for genomic mapping efforts.

We have used DNA sequences from four types of repetitive elements as polymerase chain reaction (PCR) primers to generate multiple DNA fragments from a single PCR reaction in pink salmon. The theoretical basis for this procedure is similar to the use of the human SINE AluI to identify human chromosomes in somatic cell hybridization experiments (Nelson et al. 1989). Primers complementary to one end of the element are oriented such that they initiate DNA synthesis from the end of the element, progressing into the surrounding genomic DNA. A single primer or combinations of primers may be used to generate multilocus patterns. Greene and Seeb (1997) used this technique to confirm the parentage of pink salmon fry, demonstrating the potential utility of including these fragments in our mapping study. We have used 12 different pairs of PINE primers to detect 162 segregating markers in our reference family.

AFLPs: Amplification fragment length polymorphisms have been used extensively in the construction of genomic maps in plants (Maheswaran et al. 1997; Becker et al. 1995). AFLP analysis consists of three steps (Vos et al. 1995). The first step is the "restriction/ligation" step. Two restriction enzymes are used to cut the genomic DNA into many fragments. Double stranded adapters that are specific to the restriction sites are then ligated onto the fragments. The second step is the "pre-selective amplification". During this step the restriction fragments are amplified using two primers that are specific to the synthetic adapters. Each of these primers includes an additional one base extension into the genomic DNA fragment flanked by the adapters. This step amplifies only DNA fragments with those two bases on either end, reducing the number of DNA fragments available for subsequent amplification. The final step, "selective amplification," uses an aliquot of the pre-selective products as DNA template. Amplification is conducted with primers that are specific to the synthetic adapters with three "selective" bases extending into the genomic DNA fragment. The increasing specificity of the primers used to amplify the fragments results in clean, reproducible banding patterns.

The AFLP technique is especially advantageous for two reasons. First, many bands are produced per reaction and, therefore, more scoreable polymorphic loci are produced per unit effort. Second, the selective amplification step uses a subsample of the PCR products of the preamplification. Up to 133 selective amplifications can be completed from a single pre-amplification that originally used only 0.5 µg of genomic DNA. Much more genomic DNA is needed to produce fewer bands using other methods such as RAPDs. This is an important consideration when dealing with the limited amount of tissue available from haploid embryos.

Gene-Centromere Map:

We have estimated recombination rates between over 300 loci and their centromeres using half-tetrad analysis (Lindner et al. manuscript). Half-tetrad analysis can be performed if two of the four products from a single meiosis are recovered. Half-tetrads provide a valuable approach to detect chiasma interference and to estimate gene-centromere recombination rates (Zhao and Speed 1998). We produced meiotic half-tetrads in pink salmon by inhibiting the second meiotic division so that the polar body is retained. This results in gynogenetic diploid individuals that receive two chromosome sets from their female parent and none from their male parent (Thorgaard et al. 1983). This procedure allows analysis of meiosis II (MII) half-tetrads as classified by Zhao and Speed (1998).

During meiosis I, first division segregation, a heterozygous female will produce all homozygous half-tetrads unless a crossover occurs. A crossover will result in an equal proportion of heterozygous and homozygous half-tetrads. During MII, second division segregation, a heterozygous female will also produce homozygous half-tetrads. However a crossover will result in only heterozygous half-tetrads. The proportion of heterozygotes is a measure of the frequency of second division segregation, y. The maximum value for y is 0.66 unless there is chiasma interference which will inhibit subsequent crossovers in the same interval on the chromosome. The presence of strong chiasma interference has been reported in salmonids (Thorgaard et al 1983, Allendorf et al. 1986) and other fish species.

Gene-centromere distances were estimated by the proportion of gynogenetic diploid progeny that were heterozygous (y). Heterozygotes will be produced only if there is a crossover between the centromere and that marker since gynogenetic progeny are the result of second polar body retention (Thorgaard et al. 1983). These recombination rates are a function of the distance the marker is located from the centromere, the gene-centromere distance. Once markers that are tightly linked to centromeres have been identified, additional markers linked to the centromeric markers can be assigned to a specific chromosome (Johnson et al. 1996). This allows us to fill the gaps between linkage groups and thereby reduce the number of linkage groups, as well as confirm linkages identified with the haploids.

Heterozygotes cannot be differentiated from the dominant homozygote at dominant markers. To estimate the proportion of heterozygotes at these markers, we assumed equal numbers of each homozygote class. The frequency of second division segregation (y) can then be estimated by

$$y = \frac{N_t - (2\ N_{aa})}{N_t}$$

where N_t is the total number of progeny screened and N_{aa} is the observed number of recessive homozygotes.

The distribution of proportion of heterozygotes in gynogenetic diploid progeny (y) for all loci (Fig. 1) indicates that the markers we are scoring are distributed along the length of the chromosomes. However, markers types are distributed differently. Figure 1 shows the distribution of y values for PINEs, AFLPs, and microsatellites. AFLP loci are much more centromeric than the other classes of loci ($P<0.001$). The mean y for AFLP loci is 0.40, in comparison to a mean y of 0.69 for both PINEs and microsatellites. The distribution of y at nine allozyme loci is similar to the other non-AFLP markers (0.63; Table 1).

[FIGURE 1 in WORD file (fig-1.doc)]

[TABLE 1 in WORD file (table-1.doc)]

The clustering of markers can be explained in two fundamentally different ways. First, the gene-centromere distances of markers are genetic distances that may not reflect the physical location of markers. For example, there are regions of the chromosome in which recombination is

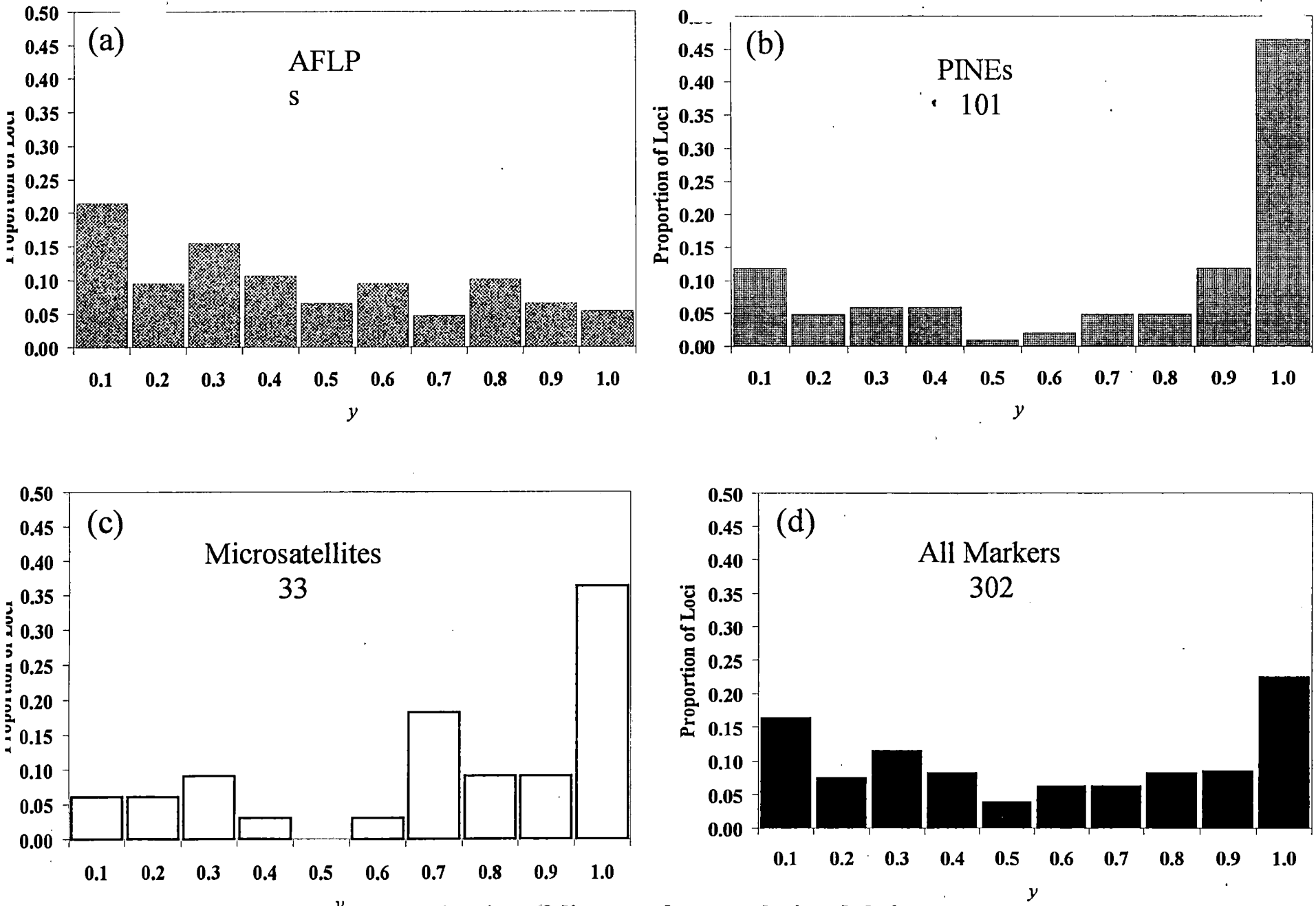


Figure 1. Distribution of distances between loci and their centromeres.

Table 1. Half-tetrad genotypes at nine allozyme loci.

Locus	Family	Maternal Genotype	Progeny *11*	Progeny *12*	Progeny *22*	Proportion heterozygotes *(y)*	Chi-square* (df)
ADA2	A95-103	*100/90*	1	52	1	0.96	0.00
CKC2	A95-103	*105/100*	23	16	18	0.28	0.61
G3PDH1	V96-19	*100/60*	0	79	0	1.00	-----
G3PDH2	V96-19	*100/90*	29	16	29	0.22	0.00
GDA1	A95-103	*108/100*	17	23	19	0.39	0.11
	A95-120	*118/108*	11	26	12	0.53	0.04
	V96-02	*108/100*	6	14	10	0.47	1.00
	Total		34	63	41	0.46	2.15 (4)
PEPB1	V96-13	*138/100*	22	4	16	0.10	0.95
PEPD2	A95-103	*120/100*	3	49	1	0.92	1.00
	A95-114	*120/100*	3	43	2	0.90	0.20
	A95-120	*120/100*	0	31	1	0.97	1.00
	V96-13	*100/80*	3	47	4	0.87	0.14
	V96-19	*100/80*	2	75	3	0.94	0.20
	Total		11	245	11	0.92	3.45 (8)
sAAT3	A95-103	*100/91*	5	47	7	0.80	0.33
	A95-114	*100/91*	8	43	8	0.73	0.00
	V96-13	*100/91*	2	7	3	0.58	0.20
	Total		15	97	18	0.75	2.57 (4)
sAAT4	A95-120	*210/100*	1	46	1	0.96	0.00
	V96-02	*290/210*	0	27	0	1.00	-----
	V96-13	*210/100*	0	49	3	0.94	3.00
	Total		1	122	4	0.96	1.57 (4)

*Chi-square test for equal numbers of homozygotes (1 df). Chi-square (df) in the total row is the contingency chi-square value for differences in y between families.

suppressed. Markers will cluster in these regions based on linkage analysis despite being physically distributed uniformly. In addition, all markers beyond 50cM from the centromere will be assigned a y of 1.0 using half-tetrad analysis if there is complete crossover interference; this will cause a clustering of all distal loci.

Alternatively, markers may be physically arranged along the chromosome in clusters. If so, the physical distance would correspond to the spatial distribution estimated by gene-centromere distances. In this case, clustering of markers would reflect that loci tend to occur in particular chromosomal regions. We can compare the results from various marker types and use the results of mapping in other taxa to begin to differentiate between these two hypotheses.

Suppression of recombination in centromeric regions has been well documented. Roberts (1965) first described this phenomenon in *Drosophila* and estimated a reduction in recombination of up to 40% around the centromere. More recently, Tanksley et al. (1992) observed clustering of markers on a linkage map of tomato and concluded that this was due to a ten-fold reduction in recombination that corresponded to centromeric heterochromatin. This conclusion was supported using additional evidence from physical map of tomato to locate centromeres (Ganal et al. 1989). Based on these results, we might expect an accumulation of markers in centromeric regions.

Our data support the clustering of AFLPs in centromeric regions (Figure 1a). Half-tetrad analysis on several other taxa also show a non-uniform distribution of AFLP-based markers. Qi et al. (1998) assigned 51% of the AFLP markers in barley to centromeric clusters. Similarly, Keim et al. (1997) reported a clustering of AFLP markers in soybean. AFLPs were also found in centromeric clusters in *Arabidopsis thaliana* (Alonso-Blanco et al. 1998).

Young et al. (1998) inferred from their haploid linkage map that AFLPs are also centromeric in rainbow trout. This is based on the presence of a cluster of tightly linked AFLPs at the center of most of their linkage groups. This clustering includes a much higher proportion of AFLPs than we have observed in pink salmon. However, comparisons between the rainbow trout map and the gene-centromere distances estimated in pink salmon must take into consideration the difference in recombination rate between males and females. The rainbow trout map was constructed using androgenetically derived homozygous lines (thus, a male map). Our gene-centromere data from pink salmon estimate recombination in females. It has been previously reported that the recombination in males is lower than in females. (May and Johnson 1989). Thus, we expect a tighter clustering of markers around the centromere in males than in females.

It is possible that the distribution of AFLPs reflects a bias in the base composition of certain genomic regions. In both our study and that of Young et al. (1998) the restriction enzymes *Eco*RI and *Mse*I were used to generate the AFLP fragments. The recognition sites for these enzymes (GAATTC and TTAA respectively) are highly biased toward A and T. At least some centromeric regions are also known to be >90% AT (Pluta et al. 1995). This base pair composition bias may result in an accumulation of AFLPs near the centromeres. In addition, Young et al. (1998) used an A as the first selective nucleotide on both primers. We also used an A on the *Mse*I primer, but we used a C on the *Eco*RI primer. Thus, if there is a centromeric bias

in AFLPs resulting from regional differences in genomic composition, we would expect the AFLPs examined in rainbow trout to be even more biased toward AT rich sequences.

PINEs provide a good fit to our expectations assuming a random distribution of markers. PINEs markers are clustered in centromeric regions as expected if there is suppressed recombination in this area. PINEs with *y* values approaching one are also common, perhaps reflecting the maximum distance from the centromere that can be detected using gene-centromere analysis. We might expect PINEs to most closely approximate a random distribution of markers due to the origin of the primers. We have produced PINEs using four different classes of repeats, SINEs (*Hpa*I, *Fok*I, *Sma*I), a LINE (*RSg1*), a transposon (*Tc*1) and a minisatellite (33.6+2). Each of these elements is inserted into the genome by a different mechanism and is influenced by a different suite of evolutionary constraints. The majority of PINE fragments that we have mapped are primed by two different primers.

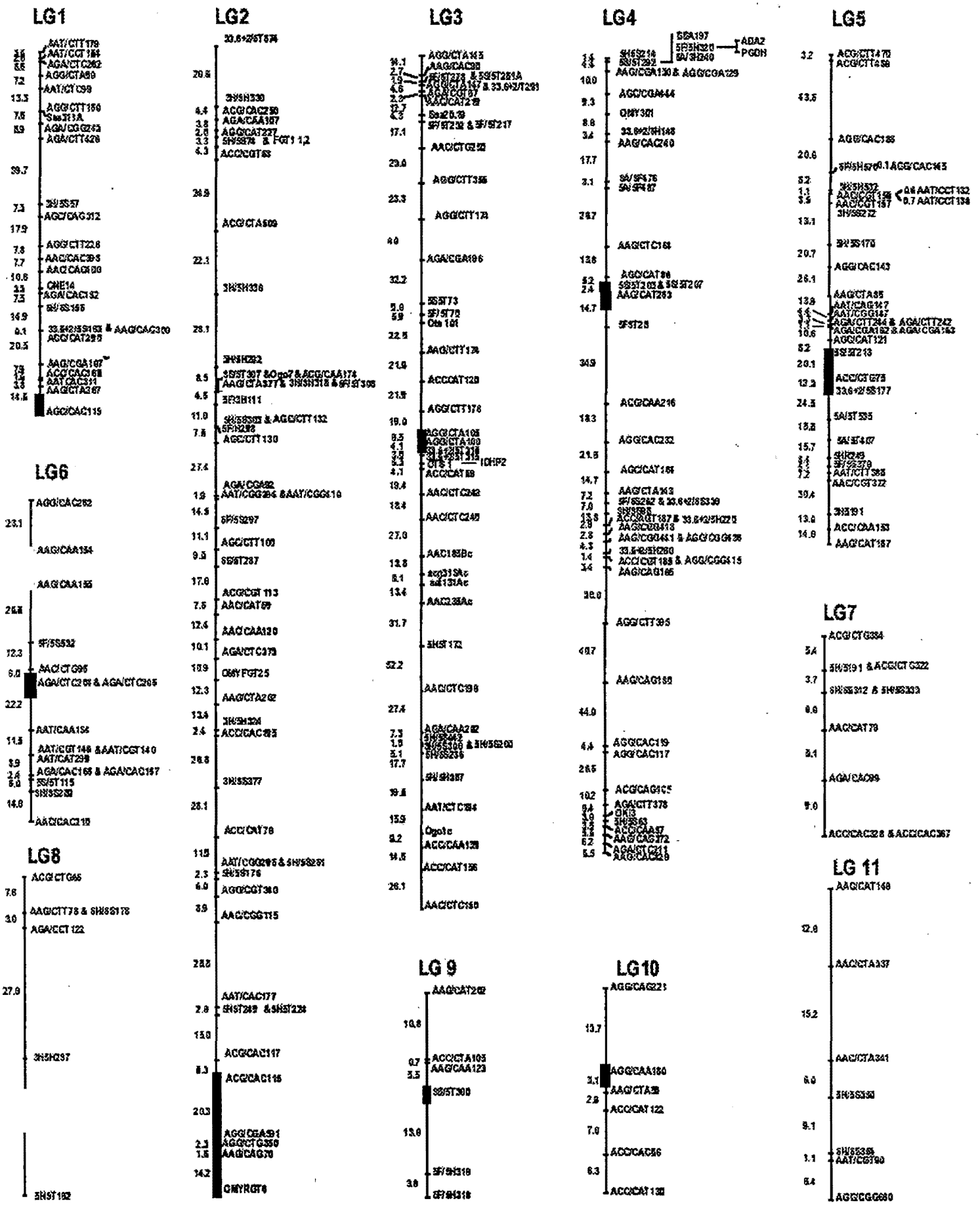
Greene and Seeb (1997) reported the centromeric distribution of fragments amplified using PINE primers homologous to *Sma*I and *Tc*1. Due to the lack of haploid segregation data from the same female, they were unable to detect markers with large *y* values because they are not variable in gynogenetic-diploids. Our data do not indicate a tendency for PINEs to be centromeric. However, our results are concordant with Greene and Seeb (1997) if the markers with a *y* greater than 0.7 are eliminated from our data.

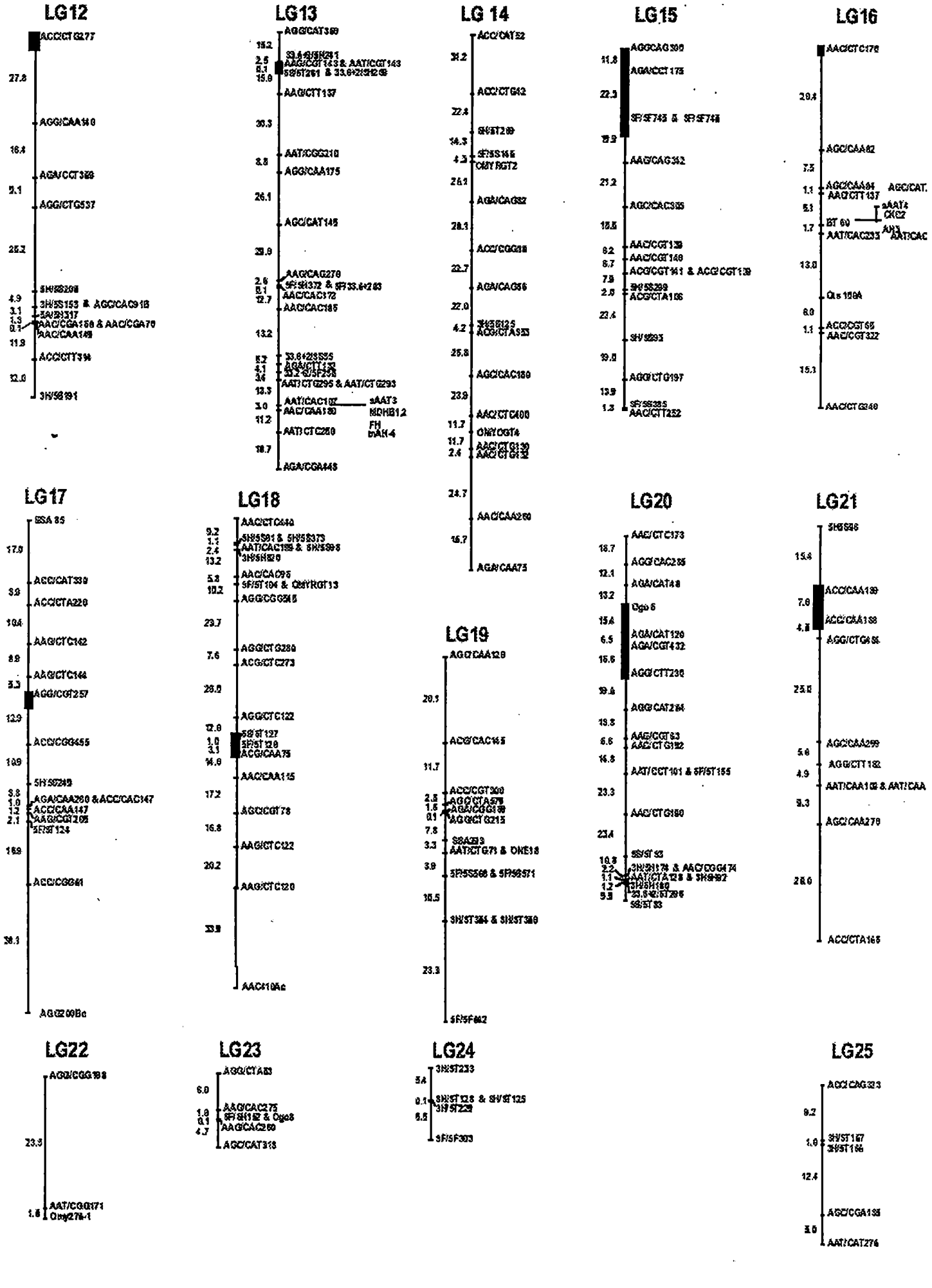
It is important to identify any biases in the distribution of types of markers being used in the construction and consolidation of a linkage map. The AFLP technique provides many polymorphic markers and requires less DNA than the other techniques used, an important consideration for the analysis of haploid embryos (Spruell et al. 1999). The centromeric clustering of AFLPs may limit the utility of these markers for mapping distal regions of chromosomes. This clustering may limit our ability to consolidate maps based exclusively on AFLPs. Centromeric clustering of AFLPs may also reduce the likelihood of identifying QTLs using only this technique. However, there are also benefits of the AFLP distribution. Johnson et al. (1996) describe the use of gene-centromere distances and markers near the centromere to consolidate the zebrafish linkage map. If a similar approach is to be used in salmonids, the availability of centromeric AFLPs should assist in that process. Other types of markers known to be more ubiquitously distributed can then be used to map the remainder of the genome.

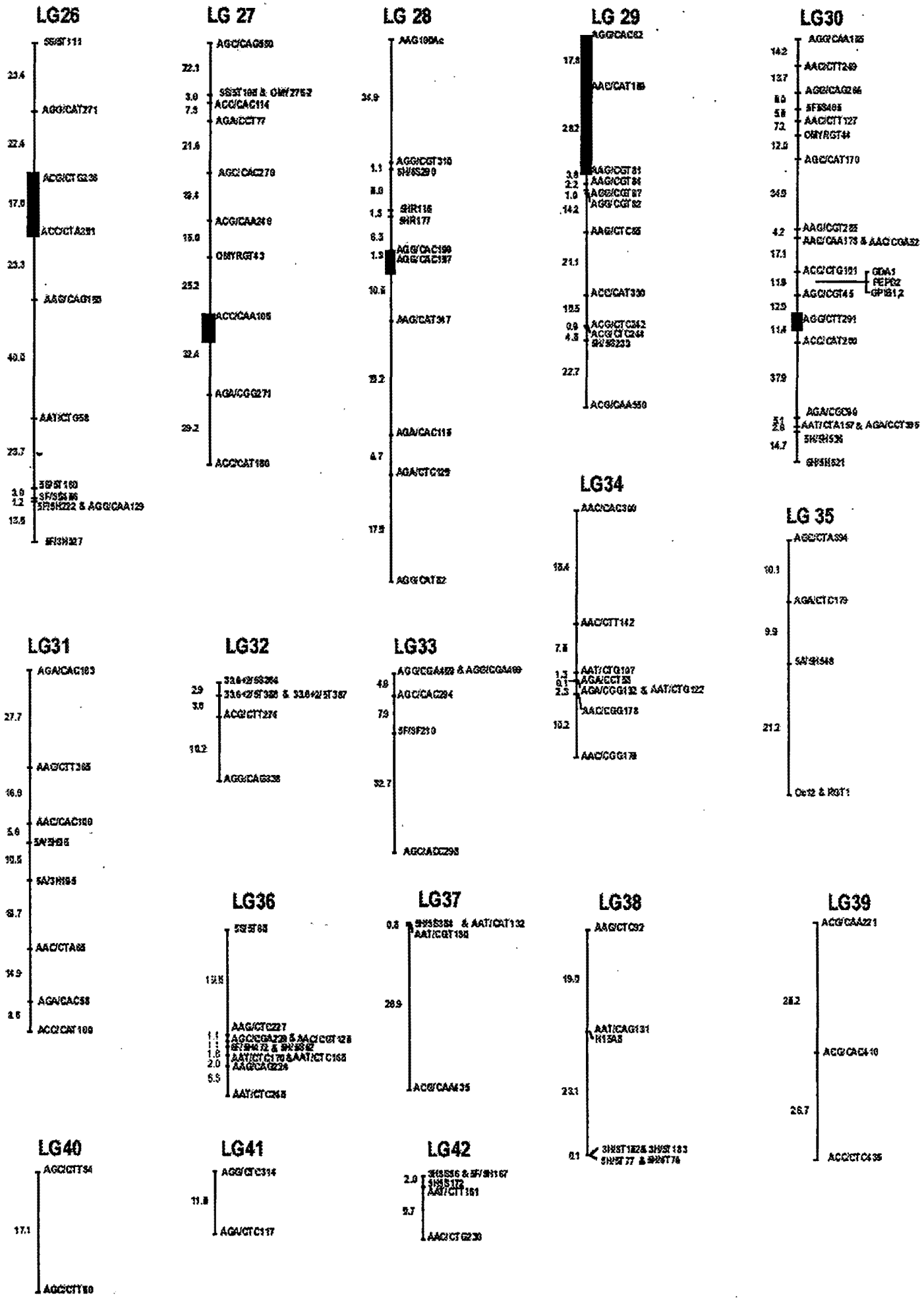
The Linkage Map:

We have described the segregation of 585 markers in haploid progeny from female 95-103; we have also mapped 13 allozyme loci in gynogenetic-diploid progeny from this same female. We have assigned 559 of the 598 markers to one of 42 linkage groups covering a distance of 5352 cM (Figure 2; Tables 2 and 3). Only 26 markers remain unlinked. The estimated size of the pink salmon linkage map based on these data is 6872 cM. This includes 5352 cM mapped in Figure 1, an estimated 260 cM to account for the distance from the end markers to their adjacent telomeres, and an estimated 1260 cM in unfilled gaps in the map. The haploid pink salmon genome is approximately 2.72 billion base pairs or 2.72 million kilobase pairs

Figure 2. Genetic linkage map of pink salmon based on the inheritance of 598 polymorphic loci. Numbers to the left indicate recombination rates (cM). Locus names are to the right. Centromeres are indicated by black rectangles.




LG12
ACC/CTG277
27.8
AGG/CAA140
16.4
AGA/CCT328
5.1
AGG/CTG537
25.2
SH/SS208
4.9
SH/SS153 & AGC/CAC918
3.1
SH/SH317
1.9
0.1
AAC/CGA156 & AAC/CGA70
AAC/CAA149
11.9
ACC/CTT316
12.0
SH/SS191
LG13
AGG/CAT359
15.2
2.5
6.1
15.0
AAG/CTT137
35.3
AAT/CGG210
8.8
AGG/CAA175
26.1
AGC/CAT145
29.9
2.6
0.1
12.7
AAG/CAG270
AAC/CAC172
AAG/CAC185
13.2
5.2
4.1
3.6
13.3
3.0
11.2
18.7
AAT/CTG295 & AAT/CTG293
AAT/CAC102
AAC/CAA150
AAT/CTC250
sAAT3
MDH3,1,2
FH
bAH-4
AGA/CGA448
LG 14
ACC/CAT52
30.2
ACC/CTG42
22.4
SH/ST289
14.3
4.3
SH/SS165
CMYRGT2
26.1
AGA/CAG52
28.1
ACC/CGG258
22.7
AGA/CAG56
22.0
4.2
SH/SS125
ACG/CTA523
25.8
AGC/CAC180
23.9
AAC/CTC400
11.7
CMYCGT4
11.7
2.4
24.7
AAC/CAA260
16.7
AGA/CAA75
LG15
AGG/CAG390
11.8
AGA/CCT175
22.3
SH/SF745 & SH/SF748
19.9
AAG/CAG352
21.2
AGC/CAC335
18.5
8.2
AAC/CGT139
8.7
AAC/CGT140
ACG/CGT141 & ACG/CGT139
7.9
2.9
SH/SS209
ACG/CTA166
23.4
SH/SS293
19.5
AGG/CTG197
13.9
1.3
SH/SS335
AAC/CTT252
LG16
AAC/CTC176
29.4
AGC/CAA82
7.5
1.1
AGC/CAA84
AAC/CTT137
AGC/CAT.
5.1
1.7
sAAT4
CK/C2
ST 60
AH3
AAT/CAC233
AAT/CAC
13.0
Qte 159A
6.0
1.1
ACC/CGT65
AAC/CGT322
15.1
AAC/CTG340
LG17
SSA 85
17.9
ACC/CAT339
3.9
ACC/CTA220
10.4
AAG/CTC162
8.9
AAG/CTC144
5.3
AGG/CGT257
12.9
ACC/CGG455
10.9
SH/SS249
3.8
1.0
1.2
2.1
AGA/CAA260 & ACC/CAC147
ACC/CAA147
AAG/CGT205
SF/ST124
15.9
ACC/CGG461
38.1
AGC/209Bc
LG18
AAC/CTC440
9.2
1.1
2.4
13.2
SH/SS91 & SH/SS373
AAT/CAC155 & SH/SS96
SH/SH320
5.8
10.2
AAC/CAC95
SF/ST104 & CMYRGT13
AGG/CGG515
23.7
AGG/CTG280
7.6
ACG/CTC273
28.0
AGG/CTC122
12.6
1.0
3.1
16.9
SF/ST127
SF/ST120
ACG/CAA75
AAC/CAA115
17.2
AGC/CGT78
16.8
AAG/CTC122
20.2
AAG/CTC120
33.8
AAC/10Ac
LG19
AGC/CAA120
20.3
ACC/CAC145
11.7
ACC/CGT260
2.5
1.5
0.1
7.8
3.3
3.9
16.5
AGC/CTA278
AGA/CGG198
AGG/CTG215
SSA289
AAT/CTG71 & CME18
SF/SS566 & SF/SS571
SH/ST384 & SH/ST389
23.3
SF/SF662
LG20
AAC/CTC173
18.7
AGC/CAC235
12.1
AGA/CAT48
13.2
15.4
6.5
15.6
Oge 6
AGA/CAT120
AGA/CGT432
AGG/CTT230
19.6
AGG/CAT284
13.8
6.6
16.8
23.3
AAG/CGT83
AAC/CTG182
AAT/CCT101 & SF/ST155
AAC/CTG180
23.4
10.8
2.2
1.1
1.2
5.3
SS/ST53
SH/SH178 & AAC/CGG474
AAT/CTA128 & SH/SH97
SH/SH180
25.8/25/296
SS/ST53
LG21
SH/SS36
15.8
ACC/CAA139
7.0
4.8
ACC/CAA158
AGG/CTG455
25.0
AGC/CAA299
5.6
AGG/CTT182
4.9
AAT/CAA158 & AAT/CAA
9.3
AGC/CAA279
28.6
ACC/CTA165
LG22
AGG/CGG198
23.5
AAT/CGG171
1.6
Cmy278-1
LG23
AGG/CTA83
6.0
AAG/CAC275
1.0
0.1
4.7
SF/SH152 & Oge8
AAG/CAC260
AGC/CAT318
LG24
SH/ST233
5.4
0.1
5.5
SH/ST128 & SH/ST125
SH/ST229
SF/SF303
LG25
AGC/CAG323
9.2
1.0
12.4
3.0
SH/ST187
SH/ST186
AGC/CGA188
AAT/CAT276


LG26
LG 27
LG 28
LG 29
LG30
LG34
LG 35
LG31
LG32
LG33
LG36
LG37
LG38
LG39
LG40
LG41
LG42

(kbp; Johnson et al. 1987b); thus, we estimate approximately 391 kbp/cM. Our results are consistent with the maps constructed in other fishes (Table 4).

Table 2. Summary of Pink Salmon Linkage Groups

Number of markers in linkage group	Number of linkage groups	Average size (cM)
2-5	12	27.2
6-10	10	50.3
11-15	8	122.5
16-20	4	204.7
21-25	4	213.2
26-30	0	-----
31-35	1	354.1
36-40	0	-----
41-45	2	532.8
>50	1	470.4

Table 3. Summary of Marker Types on the Pink Salmon Map

Marker type	Total loci	Number assigned	Percent assigned
AFLPs	393	372	95
PINEs	162	157	97
Microsatellites	30	30	100
Allozymes	13	13	100
	---	---	---
Total	598	572	96

[FIGURE 2 in WORD files (fig-2a.doc; fig-2b.doc; fig-2c.doc)]

[TABLE 4 in WORD file (table-4.doc)]

Putting "Landmarks" on the Map

Table 4. Comparison of linkage maps from seven teleost fishes. Total number of markers included on the map are given. Sex refers to which sex the map is based on , F= female and M= male. LOD (log odds) is one of the criteria used for construction of the map using MapMaker linkage analysis program.

	Pink Salmon	Rainbow Trout Young et al. 1998	Zebrafish Johnson et al. 1996	Zebrafish Knapik et al. 1998	Medaka Wada et al. 1995	Tilapia Kocher et al. 1998	Xiphophorus Morizot et al. 1991
Number of Markers	598	476	652	705	170	174	76
Number of Linkage Group	42	42	29	25	28	30	17
Number of Chromosomes	26	30	25	25	24	22	24
Sex	F	M	F	F & M	M	F	M & F
Estimated size (cM)	6872	2627	2720	2350	2480	1000-1200	1400-2600
kbp/cM	391	913	625	708	323	833-1000	300
LOD	3	3	3	3.5	3	3	3

Our primary effort in FY99 has been to consolidate the map and to place other loci on the map so that the map can be used by other genetic investigators working with pink salmon. The primary types of so-called "anchor loci" we have used are allozymes and microsatellites that are currently being used in pink salmon population genetic studies (O'Brien et al. 1993). We will also map other loci that are available and of special interest and usefulness (e.g., growth hormone loci, Forbes et al. 1994, and the major histocompatibility complex, Katagiri et al. 1996; Miller and Withler 1996; Shum et al. 1996). These landmark loci will be used to test for differences in the linkage map between odd- and even-year pink salmon. In addition, we will test for differences in recombination rates, crossover interference, and residual tetrasomic inheritance between males and females (Allendorf and Danzmann 1997).

We have placed 30 microsatellite loci on the map in collaboration with Drs. Roy Danzmann, Moira Ferguson, and Takashi Sakamoto at the University of Guelph in Ontario. These microsatellite loci are found in 17 linkage groups.

We have also placed 13 allozyme loci that are polymorphic in Prince William Sound pink salmon (Seeb et al. 1996; Habicht et al. 1998) on the map. We have used gynogenetic-diploids from female 95-103 and several normal diploid families (Table 5) in collaboration with the ADFG Genetics Lab.

We have also initiated collaboration with John Postlethwait at the University of Oregon to develop anchor loci from the zebrafish linkage map that can be placed on the pink salmon linkage map. We have sent pink salmon DNA to Postlethwait's lab at the University of Oregon. They will test 24 zebrafish primers under different PCR conditions with pink salmon DNA. If a reasonable proportion of these primers amplify the correct gene product, we will screen over 400 primer pairs to identify ones that work on pink salmon. We will then screen the products of these primers to place the ones that are variable on the pink salmon map. The Postlethwait lab plans to place 4,000 genes on the zebrafish linkage map over the next few years. They have agreed to place priority on those gene for which there are also sequences available in GenBank for salmonids (e.g., MHC; Miller & Withler 1996; Shum et al. 1996).

Postlethwait et al. (1998) recently placed 144 known genes on the zebrafish linkage map. They concluded that two polyploidization events occurred in a common ancestor before the divergence of fish and mammals resulting in four paralogous copies of each chromosome segment in each lineage. Postlethwait and his colleagues have subsequently placed another 150 genes on the zebrafish map that further support this conclusion (personal communication). We are not requesting any funds in this proposal to support the work with Postlethwait; we requested funds from the National Science Foundation to support this collaboration.

OBJECTIVES 5 & 6

The completion of a genome map for pink salmon allows us to address important genetic issues related to two other Components of the Pink Salmon Restoration Program. The numerous genetic markers identified in the course of this study will provide greatly increased

Table 5. Summary of linkages in normal diploid families between allozymes and microsatellites

Loci	Fam	Inform. Parent	N	r	Chi-sq (1 df)
sAAT3 - FH	A14	Fem	86	0.337	9.12
sAAT3 - sMDHB1,2	A14	Fem	89	0.112	53.49
sAAT4 - STR60	A104	Fem	21	0.238	5.76
ADA2 - PGDH	A120	Mal	56	0.125	31.50
ADA2 - SSA197	A103	Fem	42	0.024	38.10
	A120	Mal	18	0.111	10.89
CKC2 - STR60	A103	Fem	46	0.348	4.26
FH - MDHB1,2	A14	Fem	86	0.291	15.07
bGALA - G3PDH1	V2	Mal	75	0.346	7.05
GDA1 - PEPD2	A8	Mal	82	0.012	78.05
	A20	Mal	95	0.105	59.21
	A29	Mal	45	0.000	45.00
G3PDH1 - PEPLT	V5	Mal	75	0.240	20.28
GPIB1,2 - PEPD2	V2	Mal	75	0.013	71.05
sIDHP2 - OTS1	A29	Mal	41	0.366	2.95
	A104	Fem	33	0.303	5.12
PGDH - SSA197	A120	Mal	20	0.050	16.20

power and resolution to identify stocks of pink salmon on a very fine scale (Stock Separation and Management). The genetic map also allows us to test for the presence of genes having major effects on phenotypes of importance for the management of pink salmon, and to test for phenotypes associated with specific combinations of multilocus genotypes (Lander and Schork 1994). These genetic markers will be of great value in genetically identifying fish from supplementation programs and detecting their ecological and genetic interactions with wild fish (Supplementation).

This aspect of the research is being performed at the ASLC research facilities. Over 70,000 marked fish will be released in spring of 1999; surviving individuals will be collected when they return to the facility at sexual maturity. A sample of the fish will be collected at release and analyzed so that their genetic characteristics prior to the marine phase of the life cycle can be described. We will test for genetic effects on phenotypes of special importance by comparing the genotypes of the released fish with the genotypes of the returning fish. This will allow us to test for genes with a major effect on marine survival. We will test for loci or regions of the genome that have a large effect on phenotypes of interest, so-called quantitative trait loci (QTL's). For example, Jackson et al. (1998) recently have presented evidence for QTL's that affect upper temperature tolerance in rainbow trout linked to two of 24 polymorphic loci that they examined. Mousseau et al. (1998) have used a similar approach to estimate heritabilities for weight, length, and age at sexual maturation in chinook salmon (*Oncorhynchus tshawytscha*).

Previous work has demonstrated genetic differences between early and late run fish, and that differences in run-timing has a genetic basis (Smoker et al. in press). We will compare the genotypes of fish returning to the facility at different times to test for genes with a major effect on run timing. We will use a suite of genetic markers spread uniformly throughout the genome. Regions of the genome that show major associations with run-timing can then be examined in more detail by comparing additional markers within that region. A similar approach using only 10 protein markers in hatchery rainbow trout revealed several regions of the genome associated with time of spawning (Leary et al. 1989). Sakamoto et al. (manuscript) have reported similar results on the basis of 54 microsatellite loci.

Karl and Avise (1992) reported concordant patterns of genetic differentiation for mitochondrial DNA and four nuclear DNA loci in the American oyster (*Crassostrea virginica*) along the east coast of North America. In contrast, previous allozyme studies had not detected these genetic differences among these same populations. Karl and Avise concluded that the pattern observed for the DNA markers reflected the historical patterns of isolation and gene flow among these populations while this pattern is obscured in the allozymes because of "balancing selection" at the allozyme loci. Similar results have been reported in the Atlantic cod (Pogson et al. 1995). These results provide an important challenge to the generally accepted utility of allozyme markers for describing historical patterns and amounts of gene flow between populations. That is, if allozymes are under strong natural selection then they may not provide accurate information about the genetic structure and amount of gene flow among populations.

Restoration Projects 95320D and 96196 have described the genetic population structure in Prince William Sound (PWS) odd- and even-year fish at allozyme loci and mitochondrial DNA (mtDNA) (Seeb et al 1996; Habicht et al. 1998). These studies reported small but statistically

significant genetic allele frequency differences among streams, and concluded that pink salmon in PWS should be managed taking into account subpopulation structure rather than as a single panmictic population. As is usually done in such studies, these authors assumed that the genes they examined were selectively neutral (that is, not affected by natural selection). However, the estimates of these authors could be severe overestimates of the actual amount of gene flow if "balancing" selection is maintaining similar frequencies (Karl and Avise 1992; Pogson et al. 1995). That is, there may be much less gene flow among populations than is suggested by these studies.

Zhivotovsky et al. (1994) have reviewed population genetic data of pink salmon and concluded that the interpretations concerning amounts and patterns of gene flow are questionable because even weak natural selection could have a major effect on genetic divergence among populations of pink salmon. A series of papers by Altukhov and his colleagues have provided evidence for phenotypic and fitness effects of genetic variation at allozyme loci in pink salmon (Altukhov 1990; Altukhov et al. 1987, 1989; Dubrova et al. 1995; Kartavtsev 1992). These papers argue that genotypes at allozyme loci have a significant effect on marine survival, growth rate, and several other important factors.

The clearest and perhaps most important effects have been demonstrated on marine survival and growth rates. Pink salmon that are more heterozygous at allozyme loci have greater viability and growth rates than more homozygous individuals (Altukhov et al. 1991; Zhivotovsky et al. 1987; Kartavtsev 1992). Table 4 shows the distribution of individual heterozygosities at four allozyme loci in fry before release into salt water and returning adult spawners in odd-year pink salmon from the Sakhalin Island (Altukhov et al. 1987). We would expect the heterozygosities in fry and adults to be similar if the genotypes at these loci are not associated with survival. The significantly higher heterozygosity in the returning adults (0.619) than in the fry (0.424) indicates that individuals that were more heterozygous at the four loci had greater marine survival.

Altukhov et al. (1991) found a significant positive regression ($r=0.14$; $P<0.01$) between individual heterozygosity at these same four allozyme loci and body length of fry immediately preceding downstream migration from a hatchery on the Sakhalin Island. Kartavtsev (1992) reported a similar relationship in a different experiment with pink salmon from Sakhalin island ($r=0.23$; $P<0.001$). Previous studies with salmonids have found that size has an important effect on survival (Hunt 1969).

Similar results have been reported in other salmonid species for many phenotypes of evolutionary importance (e.g., developmental rate, egg size, and disease resistance; reviewed by Ferguson 1992). Positive associations between heterozygosity at allozyme loci and important phenotypic characters, such as growth rate, survival, fertility, disease resistance, developmental rate, and developmental stability, have been described in many organisms (reviewed by Zouros and Foltz 1986; Allendorf and Leary 1986).

Table 6. Distribution of Heterozygosity at Four Allozyme Loci in Pink Salmon from Sakhalin Island

Age-class	Number of het. loci*			Average het.
	0	1	2-4	
Fry	0.620 (559)	0.336 (302)	0.044 (40)	0.424 (901)
Adults	0.495 (300)	0.391 (237)	0.144 (69)	0.619 (606)

χ^2 =37.3
d.f. = 2
P<0.001

* values are the frequencies (and number) of individuals with the indicated number of heterozygous loci

The mechanism underlying these associations remains unknown. The most likely possible explanations are (1) the associations are the consequence of heterozygosity at the loci examined, or (2) the loci examined may be in linkage disequilibrium with other loci that affect the traits being studied (associative overdominance; Leary et al. 1987). It has been argued that these relationships between multiple locus heterozygosity and phenotypes have been found with allozymes because these loci are important in ATP production and protein catabolism (Koehn et al. 1988). We propose to distinguish between these hypotheses by using the linkage map to compare the effects of different markers on marine survival and other traits. If the enzyme loci themselves are responsible for this effect, then we would expect to find an association between enzyme genotypes and survival, but not between genotypes at DNA markers spread throughout the nuclear genome. However, if we find a similar association using DNA markers, this would suggest that the effect is due to chromosomal segments and not the enzyme loci themselves.

We believe that it is unlikely that the enzyme loci themselves are responsible for the observed relationships. Nevertheless, regardless of the underlying mechanisms of these associations, even weak heterozygous advantage (or associative overdominance) would act to maintain similar allele frequencies in different populations in the absence of significant gene flow (Allendorf 1983). This could cause a large overestimation of the actual amount of gene flow among PWS pink salmon populations. For example, just a 10% selective advantage of heterozygotes will cause a 10-fold over estimation of the amount of migration in the case where local populations have an effective size of 100 and an average 0.5 migrants per generation (Allendorf 1983). Altukhov et al. (1987) have estimated an average selective advantage of approximately 25% at four allozyme loci in pink salmon.

There are a series of questions that we will ask in this aspect of the research. The primary question is are there regions of the genome that have a significant effect on survival during the marine phase of the life cycle? Secondarily, we will ask if allozyme markers tend to occur in those

regions that affect survival. We will also determine whether the mode of selection is directional or favors heterozygotes.

Experimental Design

In August 1998, 150 (75 male and 75 female) mature pink salmon were collected from Likes Creek, Resurrection Bay, and transported to the ASLC for controlled matings. We made 75 families of full-sibs by crossing one male and one female. Two hundred progeny from each family were collected for inheritance analysis. We then selected 50 of these families on the basis of egg number and survival during incubation for the release experiment. These families were pooled together into a single tank in March shortly after hatching; one of these families was inadvertently not included in the pool. In May 1999, approximately 1,500 progeny from each of these 49 single-pair mating families will be released from the ASLC facility. Surviving progeny will return in August 2000. Given an expected return rate of 4%, thousands of individuals will be recovered for genetic and morphological analyses (50-100 fish per family).

We have genotyped the parental fish at 34 polymorphic allozyme loci, 15 microsatellite loci, and two PCR-based loci encoding genes known to have important phenotypic effects (a growth hormone locus *GH-2*, Spruell et al. 1999) and one of the loci in the major histocompatibility complex, *MHC-α1*, Miller and Withler 1997). We are currently using the ProbMax computer program (Danzmann 1997) to assign progeny to families. We generated 100 hypothetical progeny from each of the 49 families and then used them to test our power of placing progeny in families on the basis of 34 allozyme loci and just 10 of the 15 PCR-based loci. Only one out of 4,900 progeny was placed into the wrong family.

We have also examined the adult fish for length, egg number, and meristic counts for four bilateral traits to measure developmental stability (Leary et al. 1992). The males have significantly greater variance in length than females ($P<0.01$). Beacham et al. (1988) have described a similar result in pink salmon from throughout British Columbia. In addition, males were significantly more asymmetric for the four bilateral traits ($P<0.02$). This is a surprising results because our work with rainbow trout showed that these traits are determined long before sexual maturity. The difference in FA between males and females must then either result from an early effect of gender or to differential survival of fish with different amounts of FA in the marine environment. There is a significant relationship between fluctuating asymmetry and heterozygosity at allozyme loci in males ($P<0.05$) but not in females.

We will sample 1,000 progeny when the fry are released to test for a relationship between multiple locus heterozygosity, length, and condition factor both within and between families. We will sex the fish using a sex-linked PCR-marker (Spruell et al. 1999) to test if the morphological differences in length and fluctuating asymmetry are already present at this early age.

This is an extremely powerful experimental design that will allow us to measure a multitude of parameters for the first time with pink salmon or any salmonid fish. The most powerful aspect of this experiment will be the capability of measuring fitness for individual loci spread throughout the genome. In the case of males, fitness will be estimated by survivorship (viability) from egg to return at sexual maturity. In the case of females, we will use both

survivorship and the number of eggs produced so that we can take into account both viability and fecundity. We will also be able to estimate the heritabilities of a variety of traits (e.g., size at sexual maturity) by parent-offspring regression (Mousseau et al. 1998; Leary et al. 1985).

Perhaps the most significant aspect of the proposed research is the power to detect the effects of natural selection on loci spread throughout the genome. Comparison of genotypes in thousands of fry during the freshwater phase of their life cycle and in this same cohort when they return as adults will allow a powerful test for regions of the genome that affect survival. The failure to detect differential survival would provide strong evidence for the assumption of selective neutrality of genetic markers used to describe population structure.

We believe that the most likely result is that there will be some regions of the genome associated with differential survival. This experimental design will allow us to determine what proportion of the genome is affected and how strong the effect is. Also, we will be able to test if this differential survival is associated with regions of the genome marked by allozyme loci.

We plan to repeat this experiment with odd-year pink salmon in August 1999. We will again collect adults from Likes Creek and release their progeny from the ASLC in spring of 2000. This cohort should return in summer of 2001.

C. Cooperating Agencies, Contracts, and Other Agency Assistance

The ADFG Genetics Lab is no longer funded to assist us in the work at the ASLC. Therefore, we will either have to contract out the allozyme analysis or hire an additional person to perform this analysis in our lab. Based on preliminary contract costs estimates, it will be less expensive to do the analysis in our lab.

SCHEDULE

A. Measurable Project Tasks for FY 00 (1 Oct 99 - 30 Sep 00)

1 Oct 99 - 30 Apr 00:	Rear experimental progeny from 1999 cohort at ASLC.
1 Oct 99 - 31 Dec 99:	Perform genetic analysis of adults used in experimental matings to produce 1999 cohort.
1 Oct 99 - 31 Dec 99:	Continue genetic analysis of fry from 1998 cohort sampled prior to released in May 99.
1 Jan 00 - 30 Sep 00:	Perform genetic analysis of 1999 cohort produced in experimental matings.
1 Jul 00 - 30 Sep 00:	Begin analysis of returning sexually mature fish from the 1998 cohort.

B. Project Milestones and Endpoints

Objective 1: This objective has been completed.

Objective 2: This objective will be completed by the end of FY 99.

Objective 3: This objective will not be pursued.

Objective 4: This objective will not be pursued.

Objective 5: This objective will not be completed by the end of year 5.

Objective 6: This objective will not be completed by the end of year 5.

C. Completion Date

We initially proposed to continue this work for five years. However, our release experiments were delayed until the ASLC facilities were available. The analysis of these fish will not be able to be completed until after the close of year 5. The 1998 cohort fish released in the spring of 1999 will return at the end of year five. The 1999 cohort fish released in the spring of 2000 will return at the end of year six. We anticipate seeking funds to continue pursuing Objectives 5 and 6 after year 5.

PUBLICATIONS AND REPORTS

Allendorf, F. W., P. Spruell, K. L. Knudsen, K. R. Lindner and K. L. Pilgrim. 1997. Construction of a Linkage Map for the Pink Salmon Genome, *Exxon Valdez* Oil Spill Restoration Project Annual Report (Restoration Project 97190), University of Montana, Missoula, Montana.

Allendorf, F. W., P. Spruell, K. L. Knudsen, K. R. Lindner, D.J. Reedy, and K. L. Pilgrim. 1998. Construction of a Linkage Map for the Pink Salmon Genome, *Exxon Valdez* Oil Spill Restoration Project Annual Report (Restoration Project 98190), University of Montana, Missoula, Montana.

Spruell, P., B.A. Greene, C. Habicht, K.L. Knudsen, K.R. Lindner, J.B. Olsen, K.L. Pilgrim, G.K. Sage, J.E. Seeb, and F.W. Allendorf. 1999. Inheritance of nuclear DNA markers in gynogenetic haploid pink salmon (*Oncorhynchus gorbuscha*). Journal of Heredity 90:289-296.

Lindner, K.R., J. E. Seeb, C. Habicht, E. Kretschmer, D. J. Reedy, P. Spruell, and F. W. Allendorf. Manuscript. Gene-centromere mapping of 302 loci in pink salmon by half-tetrad analysis. Genome.

Lindner, K.R., P. Spruell, C. Habicht, J. E. Seeb, H. Zhao, and F. W. Allendorf. In preparation. A linkage map for pink salmon based on gynogenetic haploids and half-tetrads. To be submitted to Genetics.

PROFESSIONAL CONFERENCES

We anticipate presenting our results at professional and scientific meetings. We do not know at present the specifics of these presentations in FY 00.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

This work has been done in collaboration with James E. Seeb, Principal Geneticist, ADFG. The inheritance experiments were performed in coordination with the project Oil-Related Embryo Mortalities (Restoration Study \191A). Dr. Seeb is no longer funded to collaborate with us in this Restoration Study.

This work is related to my ongoing genetic research with salmonid fishes that has been supported by the National Science Foundation since 1980. Many of the techniques and approaches proposed here are based upon the results of that research. I also intend to continue seeking support from NSF that will complement the research proposed here. A genetic map for pink salmon will allow us to address a number of fundamental questions in the conservation and genetics of pink salmon and other *Oncorhynchus* species.

EXPLANATION OF CHANGES IN CONTINUING PROJECTS

The changes in this proposal reflect more rapid than anticipated progress in constructing the map, the discontinuation of Restoration Study \191A, and the decision not to fund our ADFG collaborators on this project. We have had to increase our budget by one full-time person to perform all of the allozyme analysis and for increased travel.

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PRINCIPLE INVESTIGATOR

FRED W. ALLENDORF: Principal Investigator

BIRTH: 29 April 1947; Philadelphia, Pennsylvania

MILITARY SERVICE: U.S. Army, 1965-1968 (Vietnam, 1966-1967)

EDUCATION:
B.S., Zoology, Pennsylvania State University, 1971
M.S., Fisheries, University of Washington, 1973
Ph.D., Genetics and Fisheries, University of Washington, 1975 (co-directors, Joe Felsenstein and Fred Utter)

POSITIONS:

1975-1976 Lektor, Department of Genetics and Ecology, Aarhus University, Denmark
1976-1979 Assistant Professor of Zoology, University of Montana
1978-1979 NATO Fellow, Genetics Research Unit, University of Nottingham, England
1979-1984 Associate Professor of Zoology, University of Montana
1983-1984 Visiting Scientist, Department of Genetics, Univ. of California, Davis
1984-1989 Professor of Zoology, University of Montana
1989-1990 Program Director, Population Biology and Physiological Ecology, National Science Foundation (NSF)
1992-1993 Visiting Professor, University of Oregon
1990- Professor of Biology, University of Montana
1993-1996 Director, Organismal Biology and Ecology Graduate Program, University of Montana

HONORS:
NATO/NSF Postdoctoral Fellowship, University of Nottingham, 1978-1979
European Molecular Biology Organisation (EMBO), Fellowship, University of Stockholm, 1979
Distinguished Scholar Award, University of Montana, June 1985
Burlington Northern Faculty Achievement Award for Research, University of Montana, June 1987
Elected Fellow, American Association for the Advancement of Science (AAAS), February 1987
Burlington Northern Faculty Achievement Award for Research, University of Montana, May 1991
Elected Member, AAAS Council (Biological Sciences Division), 1996-1998
President, American Genetic Association, 1997

MAJOR GRANTS:

National Science Foundation Research Grant, EPSCR, 1980-1983, $70,000
National Science Foundation Research Grant, Population Biology, 1980-1982, $60,000

National Science Foundation Research Grant, 1983-1986, $121,000
National Science Foundation, Faculty Research Opportunity Award, 1986, $10,000
United States Department of Agriculture Grant, Aquaculture, 1983-1985, $43,000
National Science Foundation Research Grant, 1986-1989, $148,000
National Science Foundation, Dissertation Research Grant, 1988-1990, $9,850
National Science Foundation Research Grant, 1989-1993, $150,000
National Science Foundation Research Grant, Conservation and Restoration Biology, 1993-1998, $270,000

ASSOCIATE EDITORSHIPS:
Evolution (1987-1990)
Journal of Heredity (1986-1989)
Progressive Fish Culturist (1986-1989)
Molecular Biology and Evolution (1994-1996)

EDITORIAL BOARDS:
Molecular Biology and Evolution (1983-1989)
Conservation Biology (1990-1993)
Molecular Ecology (1991-present)

PROFESSIONAL SERVICE:

Panel Member, Population Biology and Physiological Ecology, NSF (1987-1989)
Panel Member, International Program, National Science Foundation (1987)
Panel Member, Conservation and Restoration Biology, NSF (1991-1992; 1995)
Council Member, The American Genetic Association (1986-1989)
Genetics Nomenclature Committee, American Fisheries Society (1986-present)
Member, Committee on the Protection and Management of Pacific Northwest Anadromous Salmonids, National Research Council (1992-present)
Chair, Committee of Visitors, Systematic and Population Biology Programs, NSF (1993)

PROFESSIONAL SOCIETIES:
Society for the Study of Evolution
American Society of Naturalists
Genetics Society of America
Society for Conservation Biology
American Association for the Advancement of Science
American Society of Ichthyologists and Herpetologists
American Fisheries Society
American Genetic Association
Desert Fishes Council
Ecological Society of America
Montana Native Plant Society
Society of Systematic Biologists
Society for Molecular Biology and Evolution

BOOK CHAPTERS:

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Spruell, P., A.R. Hemmingsen, P.J. Howell, N. Kanda, and F.W. Allendorf. In revision. Conservation genetics of bull trout: Geographic distribution of variation at microsatellite loci. Molecular Ecology.

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OTHER KEY PERSONNEL

Paul Spruell will be responsible for direct oversight of all the activities in the laboratory, for statistical analysis, and for paper preparation. Eleanor Steinberg has applied for an NSF Postdoctoral Research Fellowship in Biological Informatics to assist with data analysis. Kate Lindner and Kathy Knudsen will be responsible for all laboratory procedures (extraction of DNA, PCR analysis, and gel electrophoresis).

Paul Spruell: Research Scientist

BORN: August 14, 1965 Bloomington, IL USA

EDUCATION:

B.S. Ecology, Ethology and Evolution, University of Illinois 1987
M.S. Fisheries and Wildlife, Michigan State University 1989
Ph.D. Zoology, Washington State University 1994

AWARDS

Guy Brislawn Award for the Outstanding WSU Zoology graduate student. 1994.

SOCIETIES

American Fisheries Society 1987-present
American Society of Ichthyologists and Herpetologists 1993-present

RESEARCH INTERESTS

Conservation genetics of fishes

Population genetics of fishes
Alternate reproductive strategies in fishes
Application of molecular tools to conservation and management
Evolutionary biology and systematics of fishes

POSITIONS

Post-doctoral Research Associate, University of Montana	08/95-present
Post-doctoral Research Associate, Washington State University	11/94-08/95
Post-doctoral Research Associate, S.U.N.Y-Stony Brook	08/94-11/94
Graduate Assistant, Washington State University	08/89-08/94
Graduate Assistant, Michigan State University	06/83-08/89

PUBLICATIONS:

Dissertations and Thesis:

Spruell, P. 1989. Evaluation of triploid induction in chinook salmon using microwave radiation and growth comparisons of diploid and triploid chinook salmon. M.S. thesis. Michigan State University.

Spruell, P. 1994. DNA fingerprinting of fishes using tandemly repeated and interspersed DNA sequences. Ph.D. dissertation. Washington State University.

Primary Literature:

Spruell, P., S. A. Cummings, Y. Kim, and G. H. Thorgaard. 1994. Comparison of three anadromous rainbow trout populations using DNA fingerprinting and mixed DNA samples. Can. J. Fish. Aquat. Sci. 51 (Suppl. 1): 252-257.

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Thorgaard, G. H., P. Spruell, P. A. Wheeler, A. S. Peek, J. Valentine, and B. Hilton. 1995. Incidence of albinos as an indicator of induced triploidy in rainbow trout. Aquaculture 137: 121-130.

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Eleanor Steinberg: Proposed NSF Postdoctoral Fellow

EDUCATION

B.A. Zoology, University of California-Berkeley, 1989
Ph.D. Zoology, University of Washington, expected June 1999

AWARDS

Outstanding Student Paper Award, Third Place (1998 Society for Conservation Biology Meeting, Sydney, Australia), Travel Award to Society of Conservation Biology Meeting in Australia (NSF), MCB/Fred Hutchinson Cancer Center Award for Graduate Student Research in Molecular Ecology (University of WA), Tuition and Travel Award, Summer Program in Statistical Genetics (North Carolina State University), Richard C. Snyder Award for Research in Vertebrate Biology (University of WA).

POSITIONS

Trainee in Mathematical Biology (NSF Graduate Fellowship, University of WA), Teaching Assistant (Molecular Evolution, Ecology, Vertebrate Natural History, Animal Diversity, Introductory Physiology courses at University of WA), Research Assistant (Peter Kareiva; University of WA), Consulting Biologist (The Nature Conservancy, Seattle, WA; U.S. Fish and Wildlife Service, Sacramento, CA; H.T. Harvey and Associates, Alviso, CA; Parametrix Incorporated, Kirkland, WA).
PUBLICATIONS

Dissertation:

Phylogeography and population structure of pocket gophers (*Thomomys mazama*) assessed with microsatellites, mitochondrial DNA and models.

Primary Literature:

Steinberg, E.K. and J.L. Patton. In press. Genetic structure and the geography of speciation in subterranean rodents: opportunities and constraints on evolutionary diversification. *The Biology of Subterranean Rodents: Evolutionary Challenges and Opportunities* (E.A Lacey, G.N. Cameron, and J.L. Patton, eds.), University of Chicago Press, Chicago.

Steinberg, E.K. and C.E. Jordan. 1997. Using molecular genetics to learn about the ecology of

threatened species: the allure and illusion of measuring genetic structure in natural populations. Pp. 440-460 in *Conservation Biology for the Coming Decade* (P. Fiedler and P. Kareiva, eds.). Chapman and Hall, New York.

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Hartway, C. and E.K. Steinberg. 1997. The influence of pocket gopher disturbance on the distribution and diversity of plants in western Washington prairies. *Proceedings of The Ecology and Conservation of the South Puget Sound Prairie Landscape.*

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2000 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 2000

Budget Category:	Authorized FY 1999	Proposed FY 2000
Personnel		$0.0
Travel		$0.0
Contractual		$211.7
Commodities		$0.0
Equipment		$0.0
Subtotal	$0.0	$211.7
General Administration		$14.8
Project Total	$0.0	$226.5
Full-time Equivalents (FTE)		2.7
Other Resources		

LONG RANGE FUNDING REQUIREMENTS					
		Estimated FY 2001	Estimated FY 2002		
		$240.8	$240.8		

Dollar amounts are shown in thousands of dollars.

Comments:

FY00

Prepared:

Project Number: 00190
Project Title: Construction of a Linkage Map for the Pink Salmon Genome
Agency: Alaska Department of Fish and Game

FORM 3A
TRUSTEE
AGENCY
SUMMARY

2000 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 2000

Budget Category:	Authorized FY 1999	Proposed FY 2000
Personnel	$103.8	$123.3
Travel	$9.6	$12.6
Contractual	$0.0	$0.0
Commodities	$28.3	$36.5
Equipment	$0.0	$0.0
Subtotal	$141.7	$172.4
Indirect	$33.3	$39.3
Project Total	$175.0	$211.7
Full-time Equivalents (FTE)	2.2	2.7
Other Resources		

LONG RANGE FUNDING REQUIREMENTS

Estimated FY 2001	Estimated FY 2002
$225,000.0	$225,000.0

Dollar amounts are shown in thousands of dollars.

Comments:

Indirect cost is based on the University of Montana rate of 43.7% of salaries and wages.

Travel costs are included to attend the Trustee Council Annual Restoration Workshop.

Travel costs are included to attend the Technical Review Session.

Travel costs are included to allow attendance at a national meeting to present our results.

Costs have increased to cover additional travel to the ASLC and allozyme analysis due to non-funding of our ADFG collaborators.

Costs are included to cover writing the annual report.

Costs are included to cover manuscript preparation and page charges for articles published in FY 00.

FY00

Prepared: April, 1999

Project Number: 00190
Project Title: Construction of a Linkage Map for the Pink Salmon Genome
Name: University of Montana

FORM 4A
Non-Trustee
SUMMARY

2000 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 2000

Personnel Costs:			Months	Monthly		Proposed
Name	Position Description		Budgeted	Costs	Overtime	FY 2000
F. Allendorf	Project Director		2.0	10.2		20.4
P. Spruell	Research Scientist		3.0	4.5		13.5
K. Knudsen	Research Specialist		3.0	4.2		12.6
K. Lindner	Research Assistant		12.0	3.2		38.4
Vacant	Research Assistant		12.0	3.2		38.4
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		32.0	25.3	0.0	
					Personnel Total	$123.3

Travel Costs:		Ticket	Round	Total	Daily	Proposed
Description		Price	Trips	Days	Per Diem	FY 2000
						0.0
Missoula to Anchorage for Trustee Council Annual Workshop		0.7	1	3	0.1	1.0
						0.0
Missoula to Seward to release 1999 cohort of pink salmon		0.8	1	5	0.1	1.3
						0.0
Missoula to Seward to collect returning pink salmon from the 1998 cohort		0.8	3	60	0.1	8.4
						0.0
Travel to a national meeting to present our results		0.7	1	3	0.1	1.0
						0.0
Missoula to Anchorage for Technical Review Session		0.7	1	2	0.1	0.9
						0.0
						0.0
					Travel Total	$12.6

FY00

Project Number: 00190
Project Title: Construction of a Linkage Map for the Pink Salmon Genome
Name: University of Montana

FORM 4B
Personnel
& Travel
DETAIL

Prepared: April, 1999

2000 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 2000

Contractual Costs:	Proposed FY 2000
Description	
Contractual Total	$0.0

Commodities Costs:	Proposed FY 2000
Description	
Materials and supplies for DNA and allozyme analysis	22.3
FMBIO fluorescent scanner service and maintenance contract	8.0
Equipment repair and maintenance	5.5
Communications	0.7
Commodities Total	$36.5

FY00

Project Number: 00190
Project Title: Construction of a Linkage Map for the Pink Salmon Genome
Name: University of Montana

FORM 4B
Contractual & Commodities DETAIL

Prepared: April, 1999

2000 EXXON VALDEZ TRUS[illegible] COUNCIL PROJECT BUDGET
October 1, 1999 - September 30, 2000

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FY 2000
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
Those purchases associated with replacement equipment should be indicated by placement of an R.		**New Equipment Total**	$0.0

Existing Equipment Usage: Description	Number of Units	
Hitachi FMBIO 100 Fluorescent Imaging Scanner	1	

FY00

Project Number: 00190
Project Title: Construction of a Linkage Map for the Pink Salmon Genome
Name: University of Montana

FORM 4B
Equipment
DETAIL

Prepared: April, 1999

Pristane Monitoring in Mussels

Project Number:	00195
Restoration Category:	Research and Monitoring
Proposer:	Jeffrey W. Short and Patricia M. Harris NMFS, Auke Bay Laboratory ABL Program Manager: Dr. Stan Rice NOAA Program Manager: Bruce Wright
Lead Trustee Agency:	NOAA
Cooperating Agencies:	None
Alaska Sea Life Center:	No
Duration:	Indefinite
Cost FY00:	$ 30,200
Cost FY01:	$ 30,000
Cost FY02:	$ 30,000
Cost FY03:	$ 30,000
Geographic Area:	Prince William Sound
Injured Resource/Service:	Pink Salmon, Pacific Herring

ABSTRACT

For the last 5 years, this project has focussed on elucidating the transport mechanism of pristane from *Neocalanus spp.* copepods into mussels during spring in Prince William Sound (PWS), and on monitoring the seasonal variation of pristane in these mussels. Results from these prior years indicate that the current network of stations sampled twice during May is sufficient to provide a 1-year advance indication of significant failure in the production of these copepods within PWS. Because these copepods are the key species linking primary productivity with higher trophic levels in PWS, a population failure would have serious ecosystem effects, including reduced catches of salmonids. Beginning this year the research component of this project will be dropped, and the sampling effort reduced considerably as guided by previous research. The objective of this monitoring effort is to provide advance warning of a "reverse regime shift" in PWS.

INTRODUCTION

This project has been funded for each of the last 5 years to investigate how pristane is transported from its source, *Neocalanus spp.* copepods, into mussels during spring in Prince William Sound (PWS). Previous work funded by this project has (1) elucidated the basic transport mechanism, which involves ingestion of *Neocalanus spp.* by juvenile fish followed by defecation of pristane - laden feces over mussel beds, (2) established that the seasonal timing of pristane incorporation into mussels always increases sharply in April and reaches a peak in May. and (3) shown that the network of 30 sampling stations monitored previously in PWS is probably necessary to cope with the high geographic variability found inter-annually. These results strongly suggest that monitoring this network of sampling stations twice during May, when pristane concentrations peak in mussels, could provide a reliable indicator of a *Neocalanus spp.* population crash, which would have serious ramifications for the rest of the PWS ecosystem, including commercial fisheries.

The carrying-capacity of Prince William Sound (PWS) for pink salmon depends crucially on the springtime abundance of large calanoid copepods, especially *Neocalanus spp.* The ultimate source of these oceanic copepods is the pelagic Gulf of Alaska, from which coastal populations are annually replenished. Prolonged interuption of this annual replenishment would almost certainly lead to a precipitous decline in the pink salmon carrying-capacity of PWS, and there is some evidence that such declines have occurred in the past. The pristane monitoring program proposed here would provide a 1-year advance warning should such a decline recur, at an annual cost of $30K/yr. This would provide time for economic adjustment by the commercial fishing industry and PWSAC hatcheries, and would alert the interested scientific community to an opportunity to study an impending ecosystem shift in real time.

Neocalanus spp. are the dominant zooplankters during spring in PWS because of their life-history pattern, the presence of suitable overwintering habitat in PWS, and the proximity of PWS to the GOA. Adult *Neocalanus plumchrus* reproduce in winter at depths below about 300 m, and developing copepodites migrate to the surface to graze the spring phytoplankton bloom. Their grazing is so efficient that they typically account for more than 90% of the zooplankton biomass in April and May, when juvenile pink salmon begin near-shore marine residence. The required deep-water winter habitat is present throughout much of the northwesterly part of PWS, but is elsewhere usually absent on the northern continental shelf of the GOA. Within PWS, developing copepodites suffer heavy predation, and survivors tend to be advected out of the Sound and then westward by the Alaska Coastal Current (ACC) before their migration to deeper water in mid-summer. The over-wintering populations of *Neocalanus spp.* in PWS are replenished from pelagic GOA populations through cross-shelf advection into the Sound from the east.

The ability of the GOA to supply *Neocalanus spp.* to coastal depressions such as in PWS has increased substantially over the past few decades. Zooplankton biomass about doubled in the GOA from the early 1960s to the early 1980s, which resulted in much higher abundances adjacent to the continental shelf of the northern GOA (Brodeur and Ware, 1992, Fish. Oceanog. 1:32). This was attended by a concurrent increase in salmon catch rates. In PWS, pink salmon catches increased by a factor of 5 in 1979 compared with the resat of that decade, and chum

salmon showed a similar increase in 1980. Catches of both species have remained well above norms for the 1970s ever since. This suggests a dramatic improvement in survival of juveniles these two species in 1978 inside PWS, perhaps a consequence of the 1977 "regime shift" thought to have affected the atmospheric and ocean current circulation of the GOA. A shift in the opposite direction, leading to a contraction of *Neocalanus spp* abundances in the GOA and conequent decimation of near-shore populations such as within PWS, could be expected to result in a precipitous decline in juvenile salmonid survival within the Sound. Loss of the efficient phytoplankton grazer in early spring would result in much more of the primary productivity becoming shunted to the benthos, and unavailable to the developing salmonids.

The proposed project would assess large inter-annual changes in abundances of *Neocalanus spp* within PWS by monitoring concentrations of pristane in mussels during spring. Pristane is a hydrocarbon biosynthesized from chlorophyll by herbivorous copepods in the genera *Calanus* and *Neocalanus*. These copepods are the only proven modern marine source of pristane (Avigan & Blumer, 1968, J. Lipid Res. 9:350;), and they typically contain concentrations that approach 1% dry weight (i.e. 10,000,000 ppb). As a branched alkane, pristane is highly lipophilic and resistant to metabolic degradation. Pristane concentrations that range to 70,000 ppb (dry weight) are found in filter feeding organisms such as mussels and some clams in PWS during spring. Research at the Auke Bay Laboratory (ABL) sponsored in part by this project in previous years has established that in PWS, pristane is incorporated into mussels through ingestion of fecal material produced by juvenile fish preying on *Neocalanus spp.* Requirements for high concentrations of pristane to appear in mussels include high abundances both of *Neocalanus spp.* and of juvenile fish predators within a few 10s of meters of mussel beds. Juvenile pink salmon are particularly effective at transferring pristane from *Neocalanus spp.* to mussels because they spend much of their early marine residence preying almost exclusively on these copepods and defecating directly above mussel beds. Other ABL experiments have confirmed that the presence of *Neocalanus spp.* alone is not sufficient to result in much transfer of pristane to mussels in PWS.

The above results confirm that analysis of pristane in mussels may be used to monitor the PWS marine ecosystem. Dramatic increases in pristane concentrations are a regular seasonal feature of PWS, having appeared in 13 of 14 years monitored during the last 22. The exception was 1977, the year monitoring began, and the ensuing year was the last year of depressed salmon catches in PWS. This is consistent with the scenario described above regarding the introduction of and dependence of pink salmon on *Neocalanus spp.* in PWS, and strongly suggests that failure to detect much pristane in mussels during spring would foreshadow a dramatic decline in salmonid survival to the following year. Poor survival would result from the absence of *Neocalanus spp.*, thereby un-coupling primary production from juvenile salmon in PWS and eroding the carrying-capacity of the Sound.

This proposal signals the transition of this project from a research and monitoring project to a purely monitoring one. This transition exploits the results of the research phase to permit an efficient monitoring design at minimum cost. Two samplings are proposed, one each in late April and late May, to address the temporal variability of the spring peak of pristane concentrations in mussels observed during prior years, and to verify the absence of pristane if

observed during the first sampling. The current network of sampling stations is retained because geographic variability is high, and most of the sampling costs are fixed, so drastic reductions in the number of sampling stations are necessary to achieve significant cost reductions.

NEED FOR THE PROJECT

A. Statement of Problem

Determination of the causes of the dramatic declines in populations of pink salmon, herring and fish-eating seabirds following the *Exxon Valdez* oil spill requires an assessment of the natural factors that affect recruitment and survival of these species, because any negative effects of the spill may be confounded by these natural factors. In addition, natural factors impose constraints on the recovery potential of these species. Pink salmon have been identified as recovering; herring, pigeon guillemots, cormorants, and marbled murrelets are identified as not recovered. If population declines of these species are the result of changes in the basic ecology of Prince William Sound due to natural phenomena (e.g. El Nino), then recovery of these populations to pre-spill levels may not be possible, and the criteria for recovery must recognize these changes.

B. Rationale

The proposed project will continue to provide information that may be used to evaluate the effect of natural constraints on the recovery of Prince William Sound pink salmon and herring populations and secondarily, on fish-eating marine birds. Annual monitoring of pristane concentrations in mussels will permit an indirect evaluation of the effects of juvenile survival on recruitment.

It is proposed that this basic monitoring be supported indefinitely as a forecasting "insurance policy" for PWS fisheries in the event of a reversion to ecosystem conditions typical of the late 1960's and early 1970's, when the salmon recruitment was much lower than at present. Such conditions could recur if *Calanus* and *Neocalanus spp.* populations in the GOA contract in response to a regime shift in oceanic currents, and thereby fail to re-populate the marine depression system of northwestern PWS. Absence of these over-wintering zooplankters in PWS would substantially un-couple primary from secondary production the following spring, resulting in a sharply reduced forage base for juvenile salmonids and other zooplanktivorous fishes. This could lead to a corresponding reduction in recruitment for the affected species. The ability to forecast such events could substantially ameliorate the consequent adverse economic impacts.

C. Location

Mussel samples will be collected in Prince William Sound and will be analyzed for pristane concentrations at the Auke Bay Laboratory, Juneau, Alaska. The identification of important productive areas in PWS and inter-annual productivity data will be useful to local fishery and hatchery managers. Educational materials and the brochure will be most appropriate for residents and students of Prince William Sound, but will also be available for others.

COMMUNITY INVOLVEMENT

We will continue to involve Prince William Sound residents in this project to share knowledge and interest in PWS ecosystems and to reduce sampling costs. Since 1994, the Prince William Sound Aquaculture Association has collected mussels near their 4 hatcheries at the appropriate times and stored them until the end of the season for pick-up. This year students with Youth Area Watch (Project 99210) and independent students will again be collecting mussels near their hometowns, Tatitlek, Whittier, Chenega, Kenny Cove, Valdez, Cordova, and Seward, and may be assisting with collections at other sites. We will provide materials for each participating school that explains the rationale of the project, and compares specific results for each school with the results for the whole effort. The underlying biology of this project gets to the heart of how the sound turns sunlight into fish, which we believe can provide a very useful local teaching resource. Youth Area Watch students will also continue to participate in a 1 day workshop at Auke Bay Laboratory on laboratory analysis techniques for pristane in mussels.

PROJECT DESIGN

A. Objectives

In 2000 and onward this project has 1 objective:

1. Measure pristane concentrations in mussels collected during late April and again in late May from 30 stations in Prince William Sound to evaluate inter-annual variability.

B. Methods

The project objective will be addressed by determining the variability of pristane concentrations in mussels (*Mytilus trossulus*) from 30 sites in PWS during late April and again in late May. Collected mussels will be stored frozen and analyzed for whole-body pristane concentration. Mussels (20) will be collected from selected mussel beds and placed into a plastic bag together with collection documentation (i.e. date, time, location, collector). Selected mussels will ideally be in the length range 20 - 45 mm. Mussels are collected along a transect parallel with the shoreline; 1 mussel is collected every consecutive meter. Previous results archived in the *Exxon Valdez* restoration database for hydrocarbons indicates that pristane concentrations in mussels collected in this way are representative of entire mussel beds.

Pristane concentrations in mussels will be compared with mean concentrations from corresponding stations collected during the period 1994 - 1999, when *Neocalanus spp.* was abundant during spring in PWS. Consistent failure to detect one-tenth of this mean at all stations and at both sampling times will be used as criteria for a significant (and serious) decline in in the *Neocalanus spp.* forage base. Statistical modelling studies conducted in prior years indicate that such a decline would be extremely significant in the statistical sense; the factor of 10 is used becuse declines of this magnitude (or larger) are suggested by the postulated replenishment-

failure mechanism described above (see Introduction).

The chemical analysis of pristane involves pentane extraction of macerated tissues, lipid removal with silica gel, and separation and measurement of pristane by gas chromatography equipped with a flame ionization detector. Pristane measurement will use the internal standard method, with deuterated hexadecane and deuterated eicosane added to the pentane initially as the internal standard. Pristane identification will be based on retention time relative to the internal standard. Quality control samples include method blanks, spiked method blanks, and reference sample analyzed with each batch of 20 samples to verify method accuracy, precision, and absence of laboratory introduced artifacts and interferences. Recovery of the internal standard will be determine by adding a second internal standard prior to instrumental analysis. Method detection limits will be assessed annually for the mussel tissue matrix, and these detection limits will be assumed for the other matrixes analyzed. Based on previous performance, we anticipate accuracy of ∀ 15% of National Institute of Science and Technology (NIST)-certified values for the spiked blank and reference samples, precision of 95% of reference samples within ∀ 15% of sample means, and laboratory artifacts below detection limits more than 99% of the time. This level of analytical performance will insure that variability due to sample analysis is negligible compared with variability among replicate mussel samples.

Percent moisture will also be determined in samples so that results may be analyzed on dry weight weight bases. Dry weights will be determined by heating samples at 60 C to constant final weight.

Because there is no other practical way of estimating energy conversion from *Neocalanus* to their near-shore predators over a broad geographic area such as PWS, there are no alternative methodologies to consider here.

C. Contracts and Other Agency Assistance

There will be no contracts under this project.

SCHEDULE

A. Measurable Project Tasks for FY99

FY00:

Apr 15 - May 30: Collect mussel samples.

Jun 1 - Sep 30: Analyze 1999 samples for pristane, summarize results in a report

B. Project Milestones and Endpoints

Write report by Sep. 30, 2000

C. Completion Date

Sep. 30, 2000

PUBLICATIONS AND REPORTS

An annual report will be produced by September 30, 2000.

NORMAL AGENCY MANAGEMENT

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

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

We are cooperating closely with Youth Area Watch (99210), which is providing us with samples and to whom we are providing training and educational materials.

EXPLANATION OF CHANGES IN CONTINUING PROJECTS

The changes are all reductions in scope resulting from transition to a purely monitoring project.

PROPOSED PRINCIPAL INVESTIGATOR

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PRINCIPAL INVESTIGATOR

Jeffrey W. Short

Education:
BS, 1972, University of California, Riverside (Biochemistry & Philosophy)
MS, 1982, University of California, Santa Cruz (Physical Chemistry)

Relevant Experience:
1989- Present: Established and managed the hydrocarbon analysis facility at ABL to analyze hydrocarbon samples generated by the *Exxon Valdez* NRDA effort (about 20% of these samples were analyzed at ABL).
1989 - 1992: Principal Investigator, Exxon Valdez project Air/Water #3: Determination of petroleum hydrocarbons in seawater by direct chemical analysis and through the use of caged mussels deployed along the path of the oil spill.
1991 - 1996: Principal Investigator, Exxon Valdez project Subtidal #8: Development of computer-based statistical methods for global examination of sediment and mussel hydrocarbon data produced for the Exxon Valdez NRDA effort for systematic bias, and for identification of probable sources of hydrocarbons. In addition, this project produced both hard-copy and computer display maps of all the sediment and mussel hydrocarbon data.
1994 - 1995: Initiated data analysis and pilot projects that established the role of pristane in Prince William Sound.
1996-1997 Principal Investigator 96195 and 97195

OTHER KEY PERSONNEL

Patricia M. Harris

Education: University of Alaska Fairbanks; B.S. Biological Science 1966
Graduate work at U of A Fairbanks, U of A Southeast, University of British Columbia

Relevant Experience:
1989-1992: Co-principal investigator of NRDA study Subtidal 3, was responsible for field logistics and sample collection and assisted in data analysis and report preparation; also assisted other NRDA projects in field collections.
1992 -1996: participated in study design, field work, proposal preparation, data analysis, and report preparation for mussel bed monitoring and restoration (R103-96090).
1994-1997 Participated in logistic planning, sampling, and community involvement coordination for the pilot pristane project ,96195, and 97195.

Relevant publications: Co-author of final reports for NRDA study Subtidal 3 and several publications pertaining to distribution of *Exxon Valdez* oil in mussels and underlying sediments. Several public presentations of oil-related scientific research.

Responsibilities: Coordinate sample collection logistics and collect mussel samples; data analysis; report and proposal preparation; and preparation of science educational materials, posters, and reports.

2000 EXXO)EZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 2000

Budget Category:	Authorized FY 1999	Proposed FY 2000						
Personnel	$44.2	$16.6						
Travel	$41.6	$6.0						
Contractual	$0.3	$1.5						
Commodities	$4.3	$3.5						
Equipment		$0.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	$90.4	$27.6			Estimated FY 2001	Estimated FY 2002		
General Administration	$6.6	$2.6						
Project Total	$97.0	$30.2			$30.0	$30.0		
Full-time Equivalents (FTE)		0.2						
	Dollar amounts are shown in thousands of dollars.							
Other Resources		23.3K						

Comments:

NOAA contribution: Principle Investigator, Senior Research Chemist Jeff Short 1.5 months@13.8 K, Zoologist Pat Harris 1.5 mo @ 9.5K for a total NOAA contribution of 23.3K.

FY00

Prepared: 4/13/99

Project Number: 00195
Project Title: Pristane Monitoring in Mussels
Agency: National Oceanic and Atmospheric Administration

FORM 3A TRUSTEE AGENCY SUMMARY

2000 EXXOI)EZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 2000

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 2000
Pat Harris	Zoologist	11/4	1.0	6.3		6.3
Josie Lunasin	Chemist	9/6	1.0	5.6		5.6
Jeff Short	Senior Research Chemist	13/6	0.5	9.3		4.7
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		2.5	21.2	0.0	
					Personnel Total	$16.6

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 2000
anchorage Workshop	0.4	2	4	0.2	1.6
					0.0
Cordova	0.4	2	8	0.2	2.4
					0.0
air charter 2 days @ 1K/day	1.0	2			2.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$6.0

FY00

Prepared: 4/13/99

Project Number: 00195
Project Title: Pristane Monitoring in Mussels
Agency: National Oceanic and Atmospheric Administration

FORM 3B
Personnel & Travel DETAIL

2000 EXXO)EZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 2000

Contractual Costs:	Proposed
Description	FY 2000
Temporary labor to analyze pristane samples	1.5
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$1.5

Commodities Costs:	Proposed
Description	FY 2000
Chemicals, glassware and chemistry laboratory supplies to analyze samples	3.5
Commodities Total	$3.5

FY00

Prepared: 4/13/99

Project Number: 00195
Project Title: Pristane Monitoring in Mussels
Agency: National Oceanic and Atmospheric Administration

FORM 3B
Contractual & Commodities DETAIL

2000 EXXO)EZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 2000

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FY 2000
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
Those purchases associated with replacement equipment should be indicated by placement of an		**New Equipment Total**	$0.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency

FY00

Project Number: 00195
Project Title: Pristane Monitoring in Mussels
Agency: National Oceanic and Atmospheric Administration

FORM 3B Equipment DETAIL

Prepared: 4/13/99

Youth Area Watch

Project Number:	00210
Research Category:	General Restoration
Proposer:	Chugach School District
Lead Trustee Agency:	ADF&G
Cooperating Agency:	DNR
Alaska SeaLife Center:	Yes
Duration:	5th year, seven year project
Cost FY 99:	$123,100
Cost FY 00:	$115,000
Cost FY 01:	$100,000
Cost FY 02:	$90,000
Geographic Area:	Prince William Sound and Resurrection Bay including: Cordova Harbor and Orca Inlet, Port San Juan and Evans Island, Tatitlek Narrows, Boulder Bay, Landlocked Bay and the Lower Cook Inlet.
Injured Resource/Service:	Harbor seal, mussels, subtidal and intertidal communities, subsistence, passive uses.

ABSTRACT

Youth Area Watch links students in the oil spill impacted area with research and monitoring projects funded through the Trustee Council. The project involves students in the restoration process and provides these individuals the skills to participate in oil spill restoration now and in the future. Youth conduct research identified and deligated by principal investigators who have indicated interest in working with students. Youth Area Watch fosters long-term commitment to the goals set out in the restoration plan and is a positive community investment in that process. Participating communities include: Tatitlek, Chenega Bay, Cordova, Nanwalek, Port Graham, Seldovia, Seward, Valdez, Whittier and a remote site within the Chugach School District.

INTRODUCTION

Since the inception of Youth Area Watch, coordination between research and restoration projects and the communities affected by the oil spill continues to increase. Resulting from many factors, community involvement in the restoration process continues to grow and strengthen; Youth Area Watch is an example of this coordinated effort through the connection that students, the communities and researchers maintain. This relationship creates an environment where youth are encouraged to interpret the data collected and apply the information to the ecosystem.

Students from the oil spill impacted communities are screened and selected for participation in Youth Area Watch at the beginning of each school year. Those showing an interest, academic ability and concern for the oil spill effects on local ecosystems are invited to represent their community as a student of the project. Students work with principal investigators of research projects and community facilitators, as well as independently to achieve the set project objectives.

Four core research projects funded by the Trustee Council serve as the central link for all Youth Area Watch activities. Initial cooperating projects include pristane mussel analysis (00195), harbor seal management and biological sampling (00244F), surf scoter life history and ecology (00273) and oceanographic data collection in conjunction with the noted Trustee Council funded projects. These projects continue to work with Youth Area Watch, providing specific research activities for students to conduct and training protocol for those duties. According to protocol, students collect samples and data for the cooperating research and monitoring projects. The samples and data are compiled by a Youth Area Watch project coordinator located in Anchorage and sent on to the principal investigator of the respective projects. Information on the data collected is maintained by the project coordinator for project analysis conducted by the students during group project sessions.

Yearly, students select a local restoration project to conduct. This year, students will begin by completing a planning process during the winter months. Students work with local Community Involvement coordinators to integrate, where possible their knowledge and expertise.

Students will post project information on their web site for the public to view. This information will be updated throughout the project year.

NEED FOR THE PROJECT

A. Statement of Problem

Youth Area Watch, identified by the Trustee Council as a "general restoration" project, is committed to collecting the requisite samples and data for principal investigators of research projects to make informed decisions concerning the ecology of oil spill impacted areas. Research and restoration project PI's identify needed data collection within the oil

spill impacted communities that in many instances can best be facilitated through local involvement of community residents.

Given the finite resources available for project activities, cost containment is necessary. By working with local community youth, information can be collected at a minimal cost. In addition, a greater quantity of data from an increased number of sites throughout the year can be accomplished by Youth Area Watch project activities.

As a part of the Memorandum of Agreement and Consent Decree approved by the U.S. District Court, "meaningful public participation in the injury and assessment and restoration process" is recognized as an important component of the restoration process. While there are a variety of instituted mechanisms for this involvement, Youth Area Watch offers positive examples of meaningful public participation expressed by the oil spill impacted communities through the involvement of community facilitators (Community Involvement \052A) and other community-based projects. The project continues to receive strong support both within the communities that it is conducted as well as among the principal investigators involved with the youth.

B. Rationale/Link to Restoration

Community-based participation in ecosystem restoration is supported by recent research. Graduate field ecology work conducted through SUNY, Stony Brook applied co-management principles to revitalize the Oak Brush Plains Preserve of Long Island, New York (Block, p. 38). In this exercise, a local group familiar with the environment assisted in replanting and management efforts while the researcher actively participated in their experiential activities so that cooperative management strategies could best be achieved. This approach is supported by research techniques used in other ecological restoration projects such as fisheries (Pinkerton) and tropical rain forests (Allen). Furthermore, the link between Native cultures and environmental revitalization has gained significant support as a mechanism for sustaining ecological practices within communities (Rogers-Martinez). Given this research, appropriate extension is made to youth within the restoration region so that "the issue of how people will inhabit, utilize and maintain the area in a manner that sustains its integrity" can be addressed (Block, p. 38).

Youth Area Watch is based on the commitment by principal investigators of research and restoration projects to involve students in their work. Participating projects are funded by the Trustee Council and have met the guidelines under the settlement. It is through the cooperating projects that Youth Area Watch holds an interest in the immediate restoration activities.

As a long-term goal, project activities are expected to provide the foundation for long-term commitment to restoration of the impacted area to pre-spill levels. Involvement of youth in research and monitoring activities is essential to developing local commitment to the restoration plan adopted by the Trustee Council. Cooperating PI's request precise and detailed sampling/data collection from the youth. Students, in turn, have increased their knowledge and participation through their connection to the projects. As a result, students are now stakeholders in the restoration process.

C. Location

While Youth Area Watch is administered through the Chugach School District's main office in Anchorage by project coordinators, project activities currently take place in the nine participating communities, a remote site and in the oil spill impacted area. Local communities include Chenega Bay, Cordova, Port Graham, Nanwalek, Seldovia, Seward, Tatitlek, Valdez and Whittier.

The science teacher (site teacher) within each of the nine communities oversees the day-to-day activities pertaining to the project. Project coordinators travel to the local communities to facilitate in-class integration of project activities and off-shore research in specific locations of importance to the identified research projects. Local projects activities identified by each site occur at or near the community. In the case of the remote site, project coordinators and a principal investigator travel to the location to work one-on-one with the student and provide periodic oversight.

COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE

One of the main goals of Youth Area Watch is to facilitate community involvement of the restoration process at a primary and secondary school age. It is through community interest and participation that the project has had a positive impact on students. Ultimately, long-term impacts, to include local ongoing restoration and ecosystem sustainability are anticipated as youth conduct established research and apply this knowledge to community efforts to understand and preserve species affected by the oil spill. As a result, communities continue to request participation in Youth Area Watch.

Local oil spill impacted communities are involved and participate in Youth Area Watch. The local facilitators of Community Involvement (/052A) continue to work closely with students and the community Youth Area Watch activities to involve youth. Local facilitators and parents of participating youth assist with various aspects of project activities such as serving as chaperones, providing traditional ecological knowledge and coordinating opportunities for youth to work with local projects. Through this cooperative effort, information is exchanged between projects and across generations.

As a component of the project scope, students at each site are asked to identify a local project that they will conduct. Through these local projects, students gain a greater understanding of what the research and restoration process means at the community level, as well as an interest in meaningful project outcomes.

PROJECT DESIGN

A. Objectives

Selected students from the identified communities participate in research and restoration activities set out by Alaska Department of Fish and Game principal investigators, NOAA staff, University of Alaska, Fairbanks biologists and other project principal investigators working with Youth Area Watch. As part of an area watch project that works with existing research and restoration projects, students collect samples and data that is then provided to the respective projects.

Youth Area Watch objectives include:

1. Research project principal investigators interacting with students.
2. Identifying all research and data collection activities.
3. Updating memoranda of agreement with school districts.
4. Completing site teacher orientation.
5. Conducting school orientations for students on Youth Area Watch.
6. Selecting students to participate in Youth Area Watch.
7. Conducting site teacher training on project activity protocol.
8. Completing the student project orientation and training.
9. Conducting oceanographic data collection.
10. Assisting local hunters/technicians collecting harbor seal biological samples.
11. Conducting a local research/restoration project.
12. Maintaining a Youth Area Watch web site.
13. Collecting blue mussels for pristane/mussel analysis.
14. Conducting surf scoter monitoring.
15. Facilitating project follow-up training for site teachers.

B. Methods

The Chugach School District currently works with the Kenai Peninsula Borough School District, Cordova School District and Valdez School District through memoranda of agreement so that the communities of Chenega Bay, Cordova, Seward, Tatitlek, Valdez and Whittier may participate. School districts will operate under the existing agreements during the forth project year.

Youth Area Watch project coordinators work with the principal investigators of the cooperating projects to solidify project expectations. Protocol is established for sample/data analysis. In addition, principal investigators commit to working with the students for a period of time during the training and/or data collection stage.

The Chugach School District developed an application and screening tool to select students for participation in the project. Up to 28 students will be selected from the communities to be a part of Youth Area Watch. While the distribution may vary according to the interest and ability of students that apply, it is expected that the distribution will be as follows: two student from Chenega Bay, three students from Cordova, two student from Port Graham, two students from Nanwalek, two students from Seldovia, six students from Seward, three students from Tatitlek, four students from Valdez, three student from Whittier and one remote site student.

Prior to the beginning of school in the fall, participating Youth Area Watch teachers at the local sites will come together for an orientation session facilitated by project coordinators. It is anticipated that site teachers will again receive protocol training directly from principal investigators. This training will occur at one community site and the training will be videotaped for future referral.

Youth Area Watch relies on the participation of research projects, sites and program resources to successfully fulfill the project objectives. Throughout the project year, students travel to research vessels, specific project sites near their community and research labs in the process of project activity completion. In the past year, Youth Area Watch was able to coordinate with projects conducting research cruises and work cooperatively on task completion while sharing the costs of vessel hiring. In the FY98, Youth Area Watch coordinators assisted with the coordination of harbor seal protocol training. It is expected that this type of cooperative effort will continue in the present and coming years.

Students will participate in the four core research projects as a group. This will consist of coming together as a group to work on collection protocol, as well as conducting activities for these projects in their community. In addition, students will participate in local projects that pertain to their geographic area. It is during the local project work that students receive a high degree of one-on-one interaction and involvement with principal investigators and their research.

Ongoing Youth Area Watch research and restoration projects include:

1. Pristane/mussel analysis, Project Number 00195. Jeff Short and Pat Harris at the NOAA Auke Bay laboratory study the pristane levels in blue mussels. There are approximately thirty mussel collection sites in Prince William Sound. Students will continue to collect mussels twice a month at sites appropriate for collection according to set protocol. During the fall and winter months, students are responsible for overall mussel bed seasonal watch. Students will tag, identify mussel bed characteristics and predator/prey activities.
2. Harbor seal management and biological sampling, Project Number 00244F. The project is conducted by Monica Reidel of the Alaska Native Harbor Seal Commission, in cooperation with Vicki Vanek from the Department of Fish and Game in Kodiak. After they have participated in traditional ecological knowledge and protocol training, students will pair up with local technicians/hunters and assist with bio-sampling activities. Students collect different parts of the seal, including the skin, blubber, teeth and stomach. Adherence to sampling protocol is ensured by working directly with the local hunters.
3. Surf Scoter Life History and Ecology: Linking Satellite Technology with Traditional Knowledge to Conserve the Resource, Project Number 00273. The principal investigator is Dan Rosenberg. The project studies the population of surf scoters in Prince William Sound and the lower Cook Inlet. This local resource is one of particular importance to subsistence. Youth will assist in capturing and monitoring the scoters to define the breeding, molting and wintering areas.

4. Observational Physical Oceanography in Prince William Sound. While the SEA project for which students collected data is closing out in FY99, the information will be collected in conjunction with the other projects; data will be sent to Pat Harris (/195) and Dan Rosenburg (/273). Project activities will include looking at the physical oceanography of the Sound and efforts will be made to coordinate this data collection with Long-Term Oceanographic Monitoring (/340) where appropriate. Physical oceanography activities will include measuring basic oceanographic features such as temperature, salinity and weather conditions. Research activities include, 1) temperature: reversing thermometer units and a temperature logger will be monitored by students at research sites, 2) salinity: students monitor the water salinity at location where temperature is taken, and 3) weather station: weather station instruments are installed at each site so that students can measure wind speed and direction, air temperature and barometric pressure.

In addition to the four core projects that Youth Area Watch students participates in, each site is selecting a restoration project to work on in their local community. This restoration activity is something that the students select and not necessarily a project that is currently funded by the Trustee Council. However, local projects are closely linked to existing restoration activities.

This year, local projects include: addressing the outfall from the local cannery in Cordova; identifying traditional subsistence uses in Seldovia; assisting SeaLife Center staff in rearticulating carcasses in Seward; studying at ballast water exchange from tankers in Valdez; and assisting with the kittiwake project (/338) in Whittier.

Coordination between Youth Area Watch and participating research projects remains strong. Where possible, research vessel costs are shared to maximize resources for project activities. In the case of the pristane/mussel project, Youth Area Watch has paid for the biologist's chartered flights to sites for mussel collection to allow students to participate in the process. In other instances, time and resources are contributed by participating projects to Youth Area Watch.

Objectives and Activities

Objective 1: Youth Area Watch students will interact with research project principal investigators, gaining a greater understanding of the affects of the oil spill on the ecosystem.

Activity 1: Principal investigators commit to working with students directly at least once during the project year.[1]

Activity 2: Students work beside principal investigators during field work.

[1] It is expected that additional contact occur throughout the project year, though not necessarily in person. Research project PIs receive updates and samples according to the protocol set out for students.

Activity 3: Students independently conduct activities set out by the principal investigators.

Activity 4: Students draw conclusions from their independent work to be reported at the annual Science Review.

Activity 5: Students work with Community Involvement (/052) local facilitators and community members to increase awareness of restoration activities and the status of the ecosystem.

Objective 2: Project coordinators identify all research and data collection activities to be conducted by students at all sites participating in Youth Area Watch.

Activity 1: Project coordinators meet with the principal investigators or delegate project research personnel either by phone or in person to set student activity parameters.

Activity 2: Activity protocol be forwarded by the principal investigator or delegate, including sample and data forwarding process, to project coordinators.

Activity 3: Project coordinators finalize project activities for site teacher and students.

Objective 3: Project coordinators update memoranda of agreement with the Valdez School District, Cordova School District, and Kenai Peninsula Borough School District for participation in Youth Area Watch.

Activity 1: Project coordinators contact each school district to evaluate the current agreement, make any necessary changes.

Activity 2: Site teachers are identified by each school district for the participating communities.

Objective 4: Site teachers receive Youth Area Watch project orientation.

Activity 1: Project coordinators develop an orientation and training session plan in consultation with research project principal investigators.

Activity 2: Project coordinators set a date in the latter part of August to conduct orientation. Site teachers are contacted to determine the most appropriate dates.

Activity 3: Project coordinators perform site teacher orientation and training.

Objective 5: Project coordinators conduct school orientations on Youth Area Watch.

Activity 1: Project coordinator travels to each participating school site prior to beginning the project year.

Activity 2: Project coordinators present Youth Area Watch to community science classes. Students that have participated in prior years will be asked to assist.

Activity 3: Students will be informed of the process to apply and participate in Youth Area Watch '00.

Objective 6: Students are selected to participate in Youth Area Watch.

Activity 1: Project coordinator distributes student applications to project sites. All village council/tribal offices (Chenega Bay, Seward, Tatitlek, Valdez) will receive application forms, as well as the Valdez, Cordova and Kenai Peninsula Borough School Districts for their respective community sites.

Activity 2: Project coordinators convene a committee to review student applications for Youth Area Watch participation. The committee is comprised of Chugach School District staff and may be assisted by participating school district staff and community facilitators (/052).

Activity 3: The review committee examines applications and select students based on science interests, academic achievement, maturity and site teacher recommendation.

Objective 7: Project coordinators conduct site teacher training on project activity protocol.

Activity 1: Project coordinators set a date in late September for site teacher protocol training and coordination

Activity 2: Project coordinators request the attendance of research project principal investigators at the site teacher orientation.

Activity 3: Project coordinators facilitate a protocol training session to ensure that correct information and research practices are followed by students during the project year.

Objective 8: Project coordinators complete the student project orientation and

training. All participating students from the community sites collectively meet at the Seward SeaLife Center for the Youth Area Watch introduction and preliminary activity participation.

Activity 1: Project coordinators work with SeaLife Center staff to determine appropriate dates for orientation.

Activity 2: The project coordinators invite research project principal investigators to participate in the student orientation.

Activity 3: The Youth Area Watch principal investigator coordinates travel arrangements for student participation in the orientation.

Activity 4: In cooperation with the research project principal investigator(s), project coordinators conduct the student orientation to Youth Area Watch goals, responsibilities and activities. Students learn about the ecosystems, and identifying ways in which project activities fit into the biotic cycle.

Objective 9: Students conduct oceanographic data collection in their local communities. Site teachers oversee these activities.

Activity 1: Students take daily water temperature and depth reading at their local site. The water is tested for salinity during this measurement as well.

Activity 2: A weather station are installed at each site under the supervision of the site teacher. Students measure the wind speed and direction, air temperature and barometric pressure.

Activity 3: Data is collected at each site and transmitted to the project coordinator periodically.

Objective 10: Students assist local hunters/technicians collecting harbor seal biological samples.

Activity 1: Local hunters facilitate a local orientation to identify community procedures for sample collection participation.

Activity 2: Students analyze an available sample to become acquainted with what is taken and what to look for in a sample. Students collect various parts of the seal for analyzing, which include: skin, blubber, teeth, stomach, skull, liver, heart and kidney. Additionally, measurements and weight are taken for each animal.

Activity 3: Students at local sites participate in taking samples from harvested seals.

Activity 4: Students assist the hunter/technician in preparing the sample for shipment to the harbor seal management principal investigator.

Objective 11: Each community site conduct a local research/restoration project.

Activity 1: The site teachers and project coordinator work with participating students to identify a local research/restoration project.

Activity 2: During the winter months of November through January, students develop a plan for their local restoration project. This is completed with the appropriate assistance and coordination of community facilitators.

Activity 3: Site teachers work with project PIs where appropriate to develop protocol for student participation.

Activity 4: Students conduct local project activities according to protocol and timelines set out by site teachers.

Activity 5: Students provide data/samples to project PIs according to protocol.

Objective 12: Students maintain a Youth Area Watch web site.

Activity 1: Students become Internet proficient and learn to update their web site with current YAW information.[1]

Activity 2: Students analyze data collected from the research projects, both past and current.

Activity 3: Using the established reporting format, the data is posted on the web site.

Activity 4: Students update data on research activities as necessary.

Objective 13: Students at each site collect blue mussels for pristane/mussel analysis.

Activity 1: Students tag and identify mussel bed characteristics during fall and winter months at their local sites.

Activity 2: Students note predator/prey activity at the identified mussel bed sites monthly.

[1] While many students will be familiar with the Internet, some communities recently linked will need training. Additionally, previous Youth Area Watch participants may be proficient at updating the web site, yet new students will need assistance.

Activity 3: Students collect mussels according to principal investigator request during the spring months. Sites are selected by the principal investigator and noted in project reporting.

Activity 4: Student label and cold storage mussels for transport to the Auke Bay laboratory in Juneau.

Activity 5: Students send mussels directly to Auke Bay once an adequate collection has accumulated.

Activity 6: Student count mussels in the beds according to set protocol.

Activity 7: Students compile site data for transmission to the project coordinator.

Activity 8: Students travel to the Auke Bay laboratory to participate in the analysis of data.

Objective 14: Student conduct surf scoter monitoring and collect traditional ecological knowledge for identification of life cycle patterns.

Activity 1: Students capture scoters according to set protocol for bird monitoring.

Activity 2: Students assist the principal investigator in implanting satellite transmitters in scoters as appropriate.

Activity 3: Students monitor the scoters that have been implanted with the transmitter.

Activity 4: Students identify breeding, molting and wintering areas of the scoter within their area.

Activity 5: Students collect traditional ecological knowledge from community members on surf scoter breeding and migratory patterns, hunting and uses. This information is forwarded to the principal investigator, Dan Rosenburg.

Objective 15: Project coordinators facilitate project follow-up training for site teachers in the spring.

Activity 1: Project coordinators set a date convenient for site teachers to conduct a spring follow-up session.

Activity 2: Project coordinators invite principal investigators of participating projects to assist in the follow-up session.

Activity 3: Project coordinators facilitate a follow-up session for site teachers to share information and identify strategies for improving student activities.

C. Cooperating Agencies, Contracts, and Other Agency Assistance

The Chugach School District serves as the administrative agency for Youth Area Watch through their contract with the Department of Fish and Game. The school district has shown that it is an effective link to the students and communities impacted by the oil spill. As the administrative entity, the Chugach School District will maintain memoranda of agreement with the Valdez School District, Cordova School District and Kenai Peninsula Borough School District as the school districts that serve the identified communities.

The Chugach School District continues to work with the University of Alaska in an effort to provide credit for progressively responsible activities and research conducted by students participating in Youth Area Watch. The district views the University of Alaska system as an integral partner in a continuum of active ecosystem awareness and restoration. Through the Native Marine Sciences Program at the University of Alaska Fairbanks, students will have the opportunity to further their understanding of research and restoration activities, as well as explore personal goals that may lead to a career in this field.

The Chugach School District continues to work with the Chugachmiut and Chugach Regional Resources Commission to coordinate and exchange community information with regard to regional restoration activities. As the coordinating agency for community involvement, Chugach Regional Resources Commission works with the youth through the local facilitators so that students may participate in research and restoration activities.

Since the inception of the project, significant contributions have been made and are identified in the budget. Contractors have provided discounted services, as in the case of vessel hiring. Expensive equipment used in project activities are offered by coordinating agencies. Cooperating agencies provide technical assistance, student supervision and support for project activities. The Chugach School District relies heavily on the commitment and participation of cooperating school districts involved in the project. Site teachers dedicate their time to the goals of Youth Area Watch, serving as an in-kind contribution.

In keeping with its commitment to secure additional support for Youth Area Watch activities, Chugach School District has sought and received two significant grants that offset the cost of the project. A five-year ($498,750) U.S. Department of Labor grant allows the District to couple real life activities with education, focusing on how these experiences will be applied in adulthood; a particular objective of the grant is directed at science opportunities in response to Youth Area Watch. In addition, the District will continue to commit general funds to the project and will seek out alternative funding sources in an effort to transition away from Trustee Council support. The success of the

project activities motivates the Chugach School District to commit additional funding through diversified means so that the youth are equipped to continue their restoration and ecological management activities as an integral component of their education. For example, the school district has recently applied for a 21-Century, three-year grant from the Department of Education to support the innovative techniques used to educate students.

As Trustee Council responsibility for restoration activities decreases due to the decline of settlement funds, the project coordinators continue to pursue opportunities where Youth Area Watch project activities can transition. Toward this end, the school district maintains cooperative relationships with entities engaged in ecological management and restorative projects, independent of Trustee Council funding. Particularly with respect to local restoration projects where other agencies, organizations and private groups are involved, the Youth Area Watch project scope is expanding so that a smooth shift of focus can occur. By building and maintaining these cooperative working relationships resource exchanges can be enhanced to augment other district resources.

SCHEDULE

A. Measurable Project Tasks for FY 00 (October 1, 1999 - September 30, 2000)

July 1 - August 1, 1999:	Confirm research & data collection activities
August 15 - 31, 1999:	Site teacher orientation
September 1 - 18, 1999:	School site orientations
September 15 - 30, 1999:	Students selected for participation
September 24 - October 7, 1999:	Site teacher training on protocol
October 15 - 31, 1999 :	Student orientation and training
November 1 - 7, 1999:	Sites prepare weather stations
November 1 - July 30, 1999:	Students participate in research activities
November 1 - May 31, 1999:	Students maintain web site
March 1, 2000 :	Project Coordinator sends data to PIs
March 1 - 15, 2000:	Site teacher follow-up training
June 1, 2000:	Project Coordinator sends data to PIs
June 1, 2000:	Students complete project reports for FY 99

Ongoing Activities:

February 00 - August 00:	Student bi-monthly collection of mussels
October 99 - September 00:	Student mussel bed monitoring
October 99 - September 00:	Student weather station monitoring (daily)
October 99 - September 00:	Students collect harbor seal samples with local hunters
October 99 - September 00:	Students conduct local project activities
October 99 - September 00:	Students assist in documenting local TEK
October 99 - September 00:	PIs interact and exchange information with students

B. Project Milestones and Endpoints

October 17, 1999:	Students selected for participation
October 30, 1999:	Protocol training complete
November 1, 1999:	Students conduct project activities
March 1, 2000:	Data/samples to PIs
June 1, 2000:	Data/samples to PIs and reports complete
October 17, 2000:	Students selected for participation
October 30, 2000:	Protocol training complete
November 1, 2000:	Students conduct project activities
March 1, 2001:	Data/samples to PIs
June 1, 2001:	Data/samples to PIs and reports complete
October 17, 2001:	Students selected for participation
October 30, 2001:	Protocol training complete
November 1, 2001:	Students conduct project activities
March 1, 2002:	Data/samples to PIs
June 1, 2002:	Data/samples to PIs and reports complete
October 17, 2002:	Students selected for participation
October 30, 2002:	Protocol training complete
November 1, 2002:	Students conduct project activities
March 1, 2003:	Data/samples to PIs
June 1, 2003:	Data/samples to PIs and reports complete

C. Completion Date

Objectives identified in the project design will continue to serve as guidelines for community involvement within the civil settlement throughout the life of the restoration effort. It is expected that the Youth Area Watch project will be completed upon termination of the restoration process.

PUBLICATIONS AND REPORTS

Youth Area Watch was featured in "The Science Teacher," "Living on Earth" and "Alaska Magazine." Copies of these articles have been forwarded to the Restoration Office. In addition, the project has been featured on NPR.

In FY 00, project coordinators would like the assistance of the chief scientist and/or the peer review group to develop an article of importance to scientific juried journals.

PROFESSIONAL CONFERENCES

Throughout the year, Chugach School District administrative staff showcase Youth Area Watch. Most recently, the project was shown to a San Francisco-based foundation and a school district in Connecticut using digital video displays of student work with PI's from research projects. The principal investigator will continue this programmatic modeling in FY 00 as opportunities become available.

NORMAL AGENCY MANAGEMENT

This section is not applicable.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

Youth Area Watch relies on the participation of Trustee Council funded projects to maintain coordination with restoration efforts. Through the commitment of principal investigators, youth conduct research activities with and for participating projects. Students work independently, as well as beside researchers during the project year. Costs are shared between projects to allow for increased research vessel time and one-on-one interaction between students and the researchers.

Various contribute the necessary technical assistance and resources. Local community facilitators from Community Involvement (/052) work with students and serve as chaperones for project activities. School districts provide teacher time and facility space for activities.

A variety of funding sources and project contributions ensure the success of the project. The school district commits over $168,525 in FY 00 to the project. School districts contribute $56,700 in teacher time and $22,050 in facility resources. Communities and school districts contribute $12,600 in lodging. Equipment in-kind contributions total $7,718. Participating principal investigators from research projects contribute $7,140 worth of their time.

EXPLANATION OF CHANGES IN CONTINUING PROJECTS

Student orientation for Youth Area Watch will be conducted at the Seward SeaLife Center in FY 00. The hiring of a research vessel is no longer necessary now that this facility is available as a resource. Students witness research in this state-of-the-art facility and make use of the resources for purposes of Youth Area Watch. It is also expected that SeaLife Center staff will orient the students to the research and overall integration of their work into the monitoring of Prince William Sound.

Since the inception of the project, /195, Pristane Monitoring in Mussels has been a core research project for Youth Area Watch. Based on the tremendous success in working with

Pat Harris to collect blue mussels and monitors beds, students began visiting the Auke Bay Laboratory to work along side researchers in the analysis of data. This aspect of the project is integrated into the identified activities. Interaction between research staff and students at the Auke Bay Laboratory in Juneau is expected to continue in subsequent years.

While articles featuring Youth Area Watch were published in FY 99, it is still the hope that a scientific journal will accept an article on the project. The assistance of Trustee Council peer review members and/or the chief scientist is requested to help in achieving this goal. By drawing on the expertise of professionals from the scientific field, it is anticipated that a case can be developed to promote Youth Area Watch approaches of integrating youth in scientific research activities.

Lastly, Lower Cook Inlet communities of Port Graham Nanwalek and Seldovia are fully integrated into the programmatic activities of Youth Area Watch.

PROPOSED PRINCIPAL INVESTIGATOR

Roger Sampson
Chugach School District
9312 Vanguard Drive, Suite 100
Anchorage, AK 99507
Office: (907) 522-7400
Fax: (907) 522-3399

PRINCIPAL INVESTIGATOR

Roger Sampson is the superintendent of the Chugach School District. He maintains administrative authority over all day-to-day functions of the district's activities. Mr. Sampson has extensive experience administering grants, adhering to project objectives and managing budgets. Mr. Sampson will be directly responsible for budget expenditures, negotiating contracts and working with the participating school districts to ensure effective project management.

OTHER KEY PERSONNEL

Project Coordinators: Jennifer Childress and Josh Hall. Both Ms. Childress and Mr. Hall are certified secondary teachers with Bachelor of Science degrees in physical science.

As noted previously, the project coordinator position has been split into two, part-time positions to most effectively meet the objectives of the project. Jennifer Childress and Josh Hall will share the following responsibilities:

1. working with principal investigators of research projects to ensure proper protocol.
2. coordinating student selection process.
3. coordinating all orientation and training sessions with site teachers and staff.
4. ensuring that site teachers and students have proper supplies.
5. completing site visits.
6. monitoring project activity of students.
7. providing support to site teachers.
8. coordinating principal investigator-student interaction through research.
9. transmitting data to principal investigators.
10. completing necessary project reports and/or materials for publication.
11. continuing to seek additional funding sources for project activities beyond the life of the Trustee Council.

LITERATURE CITED

Allen, W.H. "Biocultural Restoration of a Tropical Forest." Bioscience. 38(3): 156-161, 1988.

Block, Mindy. "Pine Barrens - Upland Associations." Notes, 1997.

Pinkerton, E. Cooperative Management of Local Fisheries: New Directions for Improved Management and Community Development. Vancouver: University of British Columbia Press, 1989.

Rogers-Martinez. "The Sinky One Intertribal Park Project." Restoration & Management Notes, 1992.

2000 EXXON VALDEZ TRU | **COUNCIL PROJECT BUDGET**

October 1, 1999 - September 30, 2000

Budget Category:	Authorized FY 1999	Proposed FY 2000						
Personnel	$54.0	$56.4						
Travel	$34.7	$30.0						
Contractual	$23.0	$5.0						
Commodities	$5.5	$4.0						
Equipment		$0.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	$117.2	$95.4			Estimated FY 2001	Estimated FY 2002		
Indirect	$23.4	$18.6						
Project Total	$140.6	$114.0			$100.0	$90.0		
Full-time Equivalents (FTE)	1.0	1.0						
	Dollar amounts are shown in thousands of dollars.							
Other Resources	$265.5	$264.3			$277.5	$291.3		

Comments:

Personnel - The two, part-time project coordinators share the duties of monitoring and facilitating the project activities at all sites.

Travel - Students travel by both charter (especially when conducting field work, such as mussel collection with the scientist). Student travel to Anchorage for the Science Review is a project contribution. Only transport expenses are requested through the budget. All per diem expenses are contributed to the project.

Contractual - The hiring of boats at a rate of $1,000 per day (5 days) will occur in conjunction with research on surf scoters and kittiwakes.

Commodities - Each major classroom site is allocated $500 for project supplies. Supplies from previous years will be used as well.

Indirect - School district administrative costs are calculated at 20%. This accounts for the direct oversight of fiscal reporting and associated support at the administrative offices in Anchorage. In addition, these costs offset the expenses that sites incure including telephone, fax, postage and other general support.

Other resources - Teacher time ($56,700); participating PIs ($7,140); Youth Area Watch PI ($11,025); Facility space ($22,050); equipment ($7,718); travel, facilities, lodging and additional adminstrative support ($159,705).

FY00

Prepared:

Project Number: 00210
Project Title: Youth Area Watch
Name: Chugach School District

FORM 4A
Non-Trustee
SUMMARY

2000 EXXON VALDEZ TRU : COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 2000

Personnel Costs:			Months	Monthly		Proposed
	Name	Position Description	Budgeted	Costs	Overtime	FY 2000
	Project Coordinator	The coordinator facilitates training for both site teachers and participating students; coordinates youth interaction with research PIs; schedules project travel; works with local sites to develop community restoration projects; works with local facilitators and site teachers to ensure the exchange of information; monitors the completion of project activities; solicits additional funding for project enhancement.	12.0	4.7		56.4
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
		Subtotal	12.0	4.7	0.0	
					Personnel Total	$56.4

Travel Costs:		Ticket	Round	Total	Daily	Proposed
	Description	Price	Trips	Days	Per Diem	FY 2000
	Charter and /or commerical trips for students to training/research.	0.5	53			26.5
	Project coordinator from Anchorage to Cordova.	0.3	2			0.6
	Project coordinator from Anchorage to Nanwalek.	0.2	2			0.4
	Project coordinator from Anchorage to Port Graham.	0.2	2			0.4
	Project coordinator from Anchorage to Seldovia.	0.2	2			0.4
	Project coordinator from Anchorage to Seward.	0.1	3			0.3
	Project coordinator from Anchorage to Tatitlek.	1.0	2			2.0
	Project coordinator from Anchorage to Valdez.	0.2	2			0.4
	Research PI travel to training sites.	0.5	4			2.0
						0.0
						0.0
						0.0
					Travel Total	$33.0

FY00

Prepared:

Project Number: 00210
Project Title: Youth Area Watch
Name: Chugach School District

FORM 4B
Personnel
& Travel
DETAIL

Contractual Costs:	Proposed FY 2000
Description	
The hiring of boats at a rate of $1,000 per day (5 days) will occur in conjunction with research on surf scoters and kittiwakes.	5.0
Contractual Total	$5.0

Commodities Costs:	Proposed FY 2000
Description	
Supplies for each classroom site are necessary. This will replace consumable commodities used during the project year. Commodities include chemicals, sampling containers (beakers, plastic bags), water resistent note pads and office supplies associated with the project. Each major classroom site (8) will require $500 for supplies, totaling $4,000.	4.0
Commodities Total	$4.0

FY00

Prepared:

Project Number: 00210
Project Title: Youth Area Watch
Name: Chugach School District

FORM 4B
Contractual & Commodities DETAIL

2000 EXXON VALDEZ TRU : COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 2000

New Equipment Purchases:	Number	Unit	Proposed
Description	of Units	Price	FY 2000
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
Those purchases associated with replacement equipment should be indicated by placement of an R.	**New Equipment Total**		$0.0

Existing Equipment Usage:	Number
Description	of Units
Weather stations have been purchased in previous years. They will continue to be used in FY 00.	5
Computers and peripherals are used at each site to synthesize and post information on the Youth Area Watch web site.	8
Video equipment is used to document activities for future review and use.	1
A GPS unit is used during various project activities.	1

FY00

Project Number: 00210
Project Title: Youth Area Watch
Name: Chugach School District

FORM 4B
Equipment
DETAIL

Prepared:

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

Project number:	00222
Restoration Category:	General Restoration
Proposer:	The Chenega Corporation
Lead Trustee Agency:	USFS
Cooperating Agencies:	None
Duration:	1st year, 3-year project
Cost FY 2000:	$78.4
Cost FY 2001:	TBD
Cost FY 2002:	TBD
Geographic Area:	Chenega Bay, Prince William Sound
Injured Resource:	Subsistence, water quality

ABSTRACT

Subsistence use of resources in the EVOS area declined following the spill in 1989. Unlike many of the other oil spill communities, subsistence harvest levels in Chenega Bay have not returned to pre-spill levels. This project seeks to help the recovery of subsistence users in Chenega Bay by rehabilitating the village solid waste dump and installing a fish pass in Stream 667. This creek flows through the community dump of Chenega Bay causing water quality problems and the stream is inaccessible to salmon because of a waterfall just above the upper intertidal zone. By diverting the stream away from the dump and the installation of a fish pass at the waterfall chum and coho salmon would have access to spawning and rearing habitats in the creek and would increase the number of salmon available for subsistence use.

INTRODUCTION

Subsistence activities for residents of Prince William Sound have been severely disrupted by the *Exxon Valdez* Oil Spill, and none more so than the subsistence activities for residents of Chenega Bay. While subsistence harvest levels in many of the communities have returned to pre-spill levels, harvest levels at Chenega Bay are still reduced (Seitz and Fall, 1995; EVOS 1998). Providing subsistence opportunities that are easily accessible to the residents of Chenega Bay would help subsistence users recover from the effects of the oil spill.

ADF&G stream number 667 is located in the village of Chenega Bay, and would provide easy access to subsistence activities. The common name for this creek appears to vary, therefore, this proposal will refer to the creek as Stream 667. This project seeks to increase salmon production in Stream 667 by installing a fish pass over a barrier fall located near the upper intertidal zone. This project began in FY96 with a feasibility study; field investigation found it feasible to install a fish pass, but identified a contamination problem in the stream as a result of the community dump and about 100 fuel drums stored adjacent to the stream. One of the tributaries of the stream flows through the dump. Prior to conducting the fish enhancement project it is recommended that the stream be diverted and potentially relocating and cleaning up the dump.

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

NEED FOR THE PROJECT

A. Statement of Problem

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

Additionally, the stream is contaminated by direct runoff from the community dump and fuel barrels stored adjacent to the stream. This contamination is having an impact not only on the stream but on Crab Bay into which it flows.

B. Rationale/Link to Restoration

The installation of a fish pass on Stream 667 will directly benefit the subsistence users of Chenega Bay by increasing the number of salmon that could be harvested from the creek. The fish pass will allow for chum and coho salmon to access the creek for spawning and rearing. Based on information from the oil spill channel typing data, Stream 667 has approximately 1400 meters of channel types that are considered suitable salmon habitat. Detailed information on the availability of spawning and rearing habitats will be collected during the 2000 design phase of the project.

Recent Trustee Council studies have shown that very low levels of hydrocarbons are toxic to pink salmon eggs. Diverting the stream, removing stored fuel barrels and potentially relocating the dump, would reduce contaminates flowing into Crab Bay and would have benefits for the entire near-shore ecosystem. The construction of the waste oil collection facility (97115) in 1997 at Chenega Bay will reduce the amount of contaminates entering the dump, but will have no effect on the contaminates already in the dump nor the fuel barrels stored adjacent to the stream.

C. Location

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

COMMUNITY INVOLVEMENT

This project was initiated at the request of The Chenega Corporation. Community involvement is planned as an integral part of all stages of this project. The 2000 assessment will involve the residents of Chenega Bay to gain local knowledge of existing escapement levels on the stream. Children from Chenega Bay and other communities will be involved in conducting the stream survey of the creek and we are looking for opportunities to include other residents during the preliminary design and assessment of the creek.

The Forest Service intends to use ANILCA Local Hire Authority to hire local residents for installation of the fish pass in 2001. After installation, it is anticipated that Chenega Bay residents will be responsible for maintaining and monitoring the fish pass with assistance from the Forest Service. Coordination with the Youth Area Watch Program (96210) was begun in 1996 to explore the possibilities of future involvement with this project. Potential opportunities include conducting escapement counts and monitoring the juvenile salmon populations.

PROJECT DESIGN

A. Objectives

1. Design a fish pass on Stream 667 in 2000 to increase salmon availability for subsistence harvest.

2. Install a fish pass on Stream 667 in 2001 to provide access to additional spawning and rearing habitats.

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

4. Document contamination from the dump.

5. Relocate stream flowing through the dump and remove stored fuel barrels.

6. Develop alternatives for cleanup and relocation of the dump.

7. Explore alternative sources of funding for cleanup and relocation of the dump.

B. Methods

Assessment (FY00): During 2000, residents of Chenega Bay will be interviewed for information on fish runs in Stream 667. This information will be helpful in understanding the historical use of the system. The interviews will be followed by an inventory of spawning and rearing habitat using a modified Hankin and Reeves (1988) procedure which provides quantitative measurements of habitat types. Stream reaches are divided into habitat types based on flow patterns and channel bed shape (pools, riffles, glides etc). Physical parameters of the habitat types would be measured or estimated and descriptions of substrates and available cover will be recorded. This information will also be used to update existing channel typing information for Stream 667.

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

In 2000 the stream will be relocated out of the dump and the fuel barrels will be removed. An assessment will be done to document the extent of contamination and alternatives for cleanup and dump relocation will be developed.

In 2000, a site survey will be conducted at the barrier falls and a preliminary design for a fish pass will be developed.

Fish pass installation: An updated proposal that includes details such as the size of the fish pass and the extent of the work required to install the fish pass will be provided to the Trustee Council after the 2000 field season is completed. This section outlines some of the steps that would be taken to install any type of fish pass.

Forest Service fisheries engineers will develop a formal blue-print design for the fish pass based on survey data and the preliminary design developed in FY00. Appropriate permits will be obtained (i.e. US Army Corps of Engineers - 404 permit, and the State of Alaska's Coastal Project Questionnaire). The actual installation of the fish pass will be done in the summer of 2001 when stream flows are low and salmon and their eggs are not present. To the extent possible, residents of Chenega Bay will be hired to install the fish pass.

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

C. Cooperating Agencies, Contracts, and Other Agency Assistance

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

SCHEDULE

A. Measurable Project Tasks for FY00

Oct.-Nov:	Inspect site, design for culvert installation, conduct NEPA for stream relocation, prepare contract for inspection of the dump and development of alternatives for cleanup and relocation of the dump
Dec. - Jan:	Apply for appropriate permits
Jan.:	Attend Annual Restoration Workshop
May - July:	Install culvert to relocate stream, remove stored fuel barrels, survey stream, document contamination from dump, locate new site for dump and survey

Aug. - Sept: Develop final design for fish pass, develop alternatives for dump cleanup and relocation

B. Project Milestones and Endpoints

Survey, design, and environmental compliance will be completed in 2000 and 2001 and all construction work on the project would be completed in 2000 and 2001. Monitoring of the success and maintenance of the structure will be conducted by people from Chenega Bay with assistance from the USFS.

After evaluation of the alternatives for cleanup and relocation of the dump, sources of funding will be explored. Potential sources are The Chenega Corporation, The State of Alaska and the Federal Government.

C. Completion Date

The project completion date will be at the end of FY02.

PUBLICATIONS AND REPORTS

Annual reports will be prepared during each year of the project and preliminary reports on the assessment and designs will be provided to the Trustee Council.

NORMAL AGENCY MANAGEMENT

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

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

Coordination with the Youth Area Watch Program (96210) was begun in 1996 to explore opportunities for future involvement with this project. Through the Chugach School District, children from Chenega Bay and other communities will be involved in conducting the stream survey of the creek in 2000, and the Youth Area Watch Program may be involved in escapement surveys.

PROPOSED PRINCIPAL INVESTIGATOR

The principal investigator of this project will be the Fisheries Biologist at the Glacier Ranger District of the Chugach National Forest.

PERSONNEL

Ken Holbrook (EVOS, Agency Liaison)
Chugach National Forest
3301 C Street, Suite 300
Anchorage, Alaska 99503

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

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

LITERATURE CITED

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

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

2000 EXXON VALDEZ TRI E COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 2000

Budget Category:	Authorized FY 1999	Proposed FY 2000
Personnel		$25.7
Travel		$0.3
Contractual		$43.4
Commodities		$2.1
Equipment		$0.0
Subtotal	$0.0	$71.5
General Administration		$6.9
Project Total	$0.0	$78.4
Full-time Equivalents (FTE)		0.5
Other Resources		$9.0

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

Dollar amounts are shown in thousands of dollars.

Comments: The property assessment is estimated at 40,000, but may be more or less. A site visit will proceed actual bid for the job.

FY00

Project Number: 00222
Project Title: Chenega Bay Dump Rehab. And Stream Enhancement
Agency: U. S. Forest Service

FORM 3A
TRUSTEE
AGENCY
SUMMARY

Prepared:4/6/99, KEH

2000 EXXON VALDEZ TRU E COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 2000

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 2000
R. Spangler	Fish biologist	GS-9	1.5	4.5		6.8
D. Gillikin	Fish tech	GS-9	0.5	4.5		2.3
Vacant	Bio Ttech	GS-7	1.0	2.8		2.8
Vacant	Bio tech	GS-5	0.5	2.3		1.2
C. Hubbard	Plant ecologist	GS-9	0.2	4.6		0.9
M. Gilliam	Archaeologist	GS-11	0.2	6.0		1.2
vacant	Engineer (fish)	GS-12	0.5	6.6		3.3
vacant	Engineer survey crew	GS-7	0.2	2.8		0.6
vacant	Engineer (environmental)	GS-12	1.0	6.6		6.6
						0.0
						0.0
						0.0
	Subtotal		5.6	40.7	0.0	
					Personnel Total	$25.7

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 2000
					0.0
Train tickets (truck)	0.1	1			0.1
train tickets (personal)	0.02	10			0.2
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$0.3

FY00

Prepared:

Project Number: 00222
Project Title: Chenega Bay Dump Rehab. And Stream Enhancement
Agency: U. S. Forest Service

FORM 3B
Personnel
& Travel
DETAIL

2000 EXXON VALDEZ TRI E COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 2000

Contractual Costs:	Proposed
Description	FY 2000
RT Anchorage to Chenega 2 trips @ 1.2	2.4
Contarct with environmental consultant for dump priliminary assessment (Property Assessment)	40.0
Equip rental (backhoe for culvert installation)	1.0
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$43.4

Commodities Costs:	Proposed
Description	FY 2000
food $18.00/day for 50 days	0.9
boat fuel	1.2
Commodities Total	$2.1

FY00

Prepared:

Project Number: 00222
Project Title: Chenega Bay Dump Rehab. And Stream Enhancement
Agency: U. S. Forest Service

FORM 3B
Contractual & Commodities DETAIL

2000 EXXON VALDEZ TRI E COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 2000

New Equipment Purchases:	Number	Unit	Proposed
Description	of Units	Price	FY 2000
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
Those purchases associated with replacement equipment should be indicated by placement of an R.		**New Equipment Total**	$0.0

Existing Equipment Usage:	Number	Inventory
Description	of Units	Agency
Stream survey equipment	1	5.5
Boat (350/day for 10 days)	10	3.5

FY00

Project Number: 00222
Project Title: Chenega Bay Dump Rehab. And Stream Enhancement
Agency: U. S. Forest Service

FORM 3B
Equipment
DETAIL

Prepared:

Project Title: Port Graham Pink Salmon Subsistence Project

Project Number:	00225
Restoration Category:	General Restoration
Proposer:	Port Graham Village Council
Lead Trustee Agency:	ADF&G
Cooperating Agencies:	Port Graham IRA Council
Alaska SeaLife Center	
Duration:	5th year, 5 year project
Cost FY 00	$75.0
Cost FY 01	$0.0
Geographic Area:	Port Graham, lower Cook Inlet
Injured Resource/Service:	Pink Salmon/Subsistence

ABSTRACT

This project will help supply pink salmon for subsistence use in the Port Graham area during the broodstock development phase of the Port Graham hatchery. Because local runs of coho and sockeye salmon, the more traditional salmon subsistence resource, are at low levels pink salmon are being heavily relied on for subsistence. This project will help ensure that pink salmon remain available for subsistence use until the more traditional species are rejuvenated. Two strategies are being employed; increased fisheries management surveillance to maximize use of adult pink salmon return and increasing marine survival of hatchery produced pink salmon.

Introduction

This project helps underwrite the hatchery production of pink salmon for subsistence use in Port Graham. Normally pink salmon are not heavily utilized for subsistence. However, the local sockeye run has been very depressed and is just now beginning to respond to rehabilitation efforts, and the coho subsistence harvest at about 15% of its historic level. This has resulted in a sharp increase in the number of pink salmon harvested for subsistence in recent years. Unfortunately, the pink run to Port Graham is also suffering. Escapement into the Port Graham River has barely met the minimum goal for six of the last seven years (the 1995 return was somewhat better).

A salmon hatchery is being developed in Port Graham. Its principal mission is to build the pink salmon run back up to levels that will allow commercial exploitation. When this objective is achieved the impact of the subsistence harvest on pinks will be negligible. At this point in time however, the subsistence harvest has a significant impact. The hatchery is in the broodstock development phase. The more eggs that are put in incubation the faster the hatchery will achieve its goals. The low pink returns to the Port Graham River coupled with the subsistence harvest on the hatchery returns is limiting the number of eggs that can be put in the hatchery and extending the time it will take for the hatchery to build the broodstock it needs to become self sufficient.

The EVOS clean-up effort had a negative impact on the Port Graham pink salmon as it did on the local coho and sockeye runs. Boom deployment during the early phases of the clean up trapped a large number of outmigrating pink salmon fry in the boom curtain on the ebbing tides causing high levels of mortality. It is possible that these losses are contributing to the poor even year returns that have been experienced recently.

This project is a small piece of the overall Port Graham pink salmon enhancement program. It comprises about a third of the overall Port Graham pink salmon enhancement budget. Port Graham pink salmon enhancement program complies with all state policies governing salmon enhancement activities including disease, genetics and harvest management. All required reviews and permits have been obtained for the hatchery program including this project. This project is designed to become self-sustaining beyond the development stage, which is currently estimated to occur in 2002.

NEED FOR PROJECT

A. Statement of Problem

The salmon runs to the Port Graham area are at low levels, partly as a result of the *Exxon Valdez* oil spill. As a consequence it has become more difficult for Port Graham villagers to meets their subsistence needs for salmon. Because of their four to five year life cycles, it will take a long time for the sockeye and coho runs to rebuild. A large number of the pink salmon that are being produced by the hatchery now being developed in Port Graham are being taken in the local subsistence fishery. Although the subsistence harvest of hatchery fish is helping to make up for the lack of wild fish, it is making it far more difficult for the hatchery to develop the

broodstock it needs to become self-sufficient. Unless the schedule for developing broodstock can be maintained, the hatchery will lose its positive benefit/cost ratio and may have to be closed.

A fire on January 13, 1998 in the building housing the hatchery destroyed the entire main hatchery facility including all the pink and sockeye eggs that were being incubated there. This was a major setback to the pink salmon broodstock development program and the local sockeye salmon rehabilitation effort. A newly started coho supplementation effort that was using an adjacent building to the hatchery for incubation and rearing is being curtailed so that this building can be converted to a pink and sockeye salmon incubation facility. The loss of the coho program and the setback in the pink and sockeye programs will result in less fish returning to the Port Graham and Nanwalek area. This will put additional subsistence harvest pressure on both wild and hatchery salmon that will be returning to the area over the next few years.

It is appropriate that the hatchery contribute pinks to the subsistence fishery. However, extraordinary methods will need to be employed for the hatchery to provide for the subsistence fishery as well as maintain its broodstock development schedule. These will include procedures to enhance the survival of juvenile pinks released from the hatchery, and coordinating with ADF&G to maximize the number of wild adult pink salmon returning to Port Graham that can be collected for broodstock.

B. Rationale/Link to Restoration

The importance of subsistence to the Native villages in the oil spill area has been recognized by the EVOS Trustee Council in its November 1994, *Exxon Valdez Oil Spill Restoration Plan*. This project will help preserve the subsistence lifestyle in Port Graham by providing additional salmon for subsistence needs. Harvest of these hatchery-produced salmon will take pressure off the local wild runs, helping them in their recovery effort. Using an enhanced resource to replace harvest of an injured resource is an accepted strategy under the Restoration Plan.

C. Location

The project will be conducted at Port Graham with the bulk of the benefits accruing to the Port Graham village.

COMMUNITY INVOLVEMENT

The Port Graham Village Council is submitting this proposal. The Port Graham hatchery is owned and operated by Port Graham Hatchery, Inc., an arm of the Port Graham Village Council. The Port Graham Village Council will manage this project under a contract with ADF&G.

PROJECT DESIGN

A. Objectives

Use the Port Graham hatchery to provide pink salmon for local subsistence use while maintaining the hatchery's pink salmon broodstock development schedule.

B. Methods

This will be the fifth year of a proposed five year project. Two basic strategies will continue to be employed to meet the objective. The first will be to supplement the ADF&G monitoring of the Port Graham pink salmon return and the second will be to enhance the juvenile to adult survival of the hatchery produced pink salmon through an extended rearing program. A brief discussion of each approach is given below.

The Port Graham River pink salmon run is the source of the hatchery broodstock. A program has been established to work closely with ADF&G in monitoring the pink salmon return to Port Graham each year in order to get as precise an estimate as possible on the wild and hatchery return. This program supplements the normal management stream and bay surveys of Port Graham that ADF&G conducts. It includes additional stream surveys and closely monitoring the subsistence fishery harvest. This program has established regular lines of communications between Port Graham and ADF&G. By coordinating effort and keeping close track of the pink salmon return, it has been possible to maximize the harvest of pink salmon while ensuring that the Port Graham River pink salmon escapement goal is met. This program will be continued in FY 00.

The second approach will apply techniques to increase the fry to adult (marine) survival of hatchery produced pink salmon. Normal hatchery practice involves holding pink salmon fry in saltwater pens after they emerge from the incubators. These fish are put on feed and held until the first mature zooplankton bloom that usually occurs in the later part of May in the Port Graham area. Normal holding time is 3 to 4 weeks. The marine survival with this technique has been poor, ranging between 1 and 2.5%.

Test lots of pink salmon fry reared at Port Graham to an average weight of 8 grams (the threshold size at which pinks leave the near shore area for the high seas) had survival rates of 7% to 10%. Although this was very encouraging there are major problems with holding pink salmon fry the four months it takes to rear them to 8 grams. First, rearing fish to that size is expensive. Second, there is a high risk that fish held that long may contact disease or otherwise be injured or killed. Of particular concern is the potential for the rearing fish to contact "warm water vibrio", a highly contagious bacterial infection that pink salmon fry are susceptible to if reared in salt water warmer than 10^{o} C. A group of pink salmon fry that were intended to be reared to an average weight of 8 grams under this project in FY 96 had to be released early because of an outbreak of warm water vibrio.

Studies undertaken at other pink salmon hatchery facilities in the state indicate that rearing salmon to a minimum of one gram also greatly enhances marine survival. Nearly eight times as many fry can be reared to 1 gram rather than 8 grams for the same cost. In addition, the reduced holding time required for producing 1 gram fish as opposed to 8 grams reduces the risk of loss from injury or disease. A group of pink salmon fry were successfully reared to the 1 gram

size and released as part of this project's FY 96 activities. An estimated 5% of this group survived to return as adults. A similar, perhaps larger, group of 1 gram fry will be produced in FY 00 to see if this marine survival rate can be repeated.

The Port Graham hatchery now has the capability to produce modest amounts of heated water, both fresh and salt. This provides the potential to accelerate development and growth of small groups of fish. In FY 00 a lot of 20,000 to 100,000 pink salmon will be incubated and reared on heated water with the objective of achieving a minimum average weight of 1 gram in time for release into the mature zooplankton bloom in late May. A search of the literature and conversations with other pink salmon hatcheries in Alaska, indicate that a test of this sort has never been conducted. However, it would seem that releasing large size pink salmon fingerling into the mature zooplankton bloom would greatly enhance marine survival.

All fish in both the 1gram fingerling lots reared in ambient temperature water and the 1 gram fingerling lot produced with heated water will be otolith marked with a separate mark for each lot. For comparison purposes a third lot of pink salmon will receive the normal treatment of incubating and rearing in ambient temperature water for release into the zooplankton bloom. This lot will not be marked.

SUPPLEMENTATION CRITERIA. This is a supplementation project. The following is a brief discussion of how the project fits under each of the supplementation criteria presented in the *Invitation to Submit Restoration Projects for Federal Fiscal Year 1996 and Draft Restoration Program: FY 96 and Beyond*, March 1995, pages 34-35.

Benefits of Supplementation. This project will provide additional pink salmon for harvest in the subsistence fishery in the Port Graham area. By shifting some of the subsistence harvest to hatchery salmon this project will help Port Graham wild salmon stocks recover from their present low levels.

Generic Risk. The Port Graham pink salmon hatchery program was reviewed by the ADF&G, CFMD Genetics Section who determined that the program (which includes this project) meets all criteria of the state Genetics Policy for Salmon Enhancement. The program (including this project) has been awarded a state Fish Transport Permit.

Mixed-stock Fishery. The potential for the Port Graham pink salmon hatchery program (including this project) creating or exacerbating a mixed stock fishery program is minimal. The harvest of Port Graham pink salmon are spatially and/or temporally separated from other Kachemak Bay pink salmon stocks as well as other salmon species. There is very little overlap. The same is true with the other salmon species that spawn in the Port Graham area.

Monitoring and Evaluation. A portion of the pink salmon reared to 8 grams will be coded wire tagged. The local fisheries and the hatchery egg take will be monitored for marked fish.

Economic Criteria. This project, especially long term rearing pink salmon fry to increase adult survival, will negatively impact the hatchery benefit/cost ratio. However, not doing this project would either cause a reduction in the overall subsistence harvest in Port Graham as well as put additional pressure on the wild stocks, and/or extend the hatchery broodstock development

phase to the point where operating the hatchery stops making economic sense.

Procedural Criteria. All evaluations (Regional Salmon Planning Team, Coastal Project Certification) of the Port Graham hatchery program (including this project) have been conducted and all necessary permits (hatchery permit, fish transport permit, COE, DNR, CZM) have been obtained. This project has not been evaluated under the NEPA process.

C. Cooperating Agencies, Contracts and Other Agency Assistance

The Port Graham IRA Council will operate this project under a contract with ADF&G. The funds for stream survey air charters will be retained by ADF&G to supplement the normal management surveys of Port Graham.

SCHEDULE

A. Measurable Project Tasks for FY 00

October, 1999	Incubators containing the lots intended for extended rearing and heated water rearing are identified and heat-treated to produce a separate otolith mark for each lot.
November, 1999	After eye-up eggs from the lot intended to reach 1 gram by late May are put on a heated water regimen.
May, 2000	Heated water rearing lot intended to produce fingerling with average weight of 1 gram are released into zooplankton bloom.
May, 2000	Fry receiving standard treatment (incubated and reared in ambient temperature water and held for release into zooplankton bloom) are released into zooplankton bloom.
late June, early July	Lots held for extended rearing in ambient temperature water are released after having reached an average weight of 1 gram.
July 7 to August 31	Monitor pink salmon return to Port Graham.
August 10 to August 25	Capture hatchery broodstock.
August 28 to September 10	Egg take.
April 2001	Final report.

B. Project Milestones and Endpoints

The project objective will be successfully met if broodstock development phase is completed on schedule at the end of FY 02.

C. Completion Date

This project will end when the broodstock development phase at the Port Graham hatchery is complete. This is expected to occur by the end of FY 02.

PUBLICATIONS AND REPORTS

Annual reports	Describes project activities for the year, analyzes successes and problems, makes recommendations for improvements due April 15 following fiscal year being reported on.
Final report	Synopsis of each tear's activities with analysis of project as a whole. Due April 15 following final year of project.

PROFESSIONAL CONFERENCES

No travel to professional conferences will be paid for out of this project. However, hatchery staff will be attending the Alaska Hatchery Manager's Workshop and the Native American Fish & Wildlife Society meeting and at which they will give a presentation of the work done under this project.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

If funded, this project will be integrated into the overall pink salmon enhancement program in Port Graham.

EXPLANATION OF CHANGES IN CONTINUING PROJECTS

The production of a lot of fingerling with an average weight of 8 grams has been eliminated because of the high potential for this lot to contract warm water vibrio. In its place heated water will be used to produce a lot of fingerling with an average weight of one gram from release during the mature zooplankton bloom in late May. This lot will test the efficacy of this strategy compared with rearing fry in ambient temperature water until they have achieved an average weight of 1 gram before releasing them.

PRINCIPAL INVESTIGATOR

Ephim Anahonak, Jr., Hatchery Manager
Port Graham Hatchery
P. O. Box 5543
Port Graham, AK 99603
phone (907) 284-2233
fax (907) 284-2238

Mr. Anahonak has been hatchery manager of the Port Graham hatchery for the past four years. He has had and will continue to have overall responsibility for the project.

OTHER KEY PERSONNEL

Paul McCollum, hatchery consultant. Mr. McCollum will advise the hatchery staff on the procedures and techniques needed to achieve project objectives.

David Daisy, fish culture consultant. Mr. Daisy will work with the hatchery staff and Mr. McCollum in project design, implementation and reporting.

1999 EXXON VALDEZ TRUS COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 1999

Budget Category:	Authorized FY 1999	Proposed FY 2000
Personnel	$0.0	$0.0
Travel	$0.0	$0.0
Contractual	$70.1	$70.1
Commodities	$0.0	$0.0
Equipment	$0.0	$0.0
Subtotal	$70.1	$70.1
General Administration	$4.9	$4.9
Project Total	$75.0	$75.0
Full-time Equivalents (FTE)		0.0
Other Resources		

LONG RANGE FUNDING REQUIREMENTS

Estimated FY 2001	Estimated FY 2002	Estimated FY 2003	Estimated FY2004
$0.0	$0.0	$0.0	$0.0

Dollar amounts are shown in thousands of dollars.

Comments:

FY 00

Project Number: 00225
Project Title: Port Graham Pink Salmon Subsistence Project
Agency: AK Dept. of Fish & Game

FORM 3A
TRUSTEE
AGENCY
SUMMARY

Prepared: 1 of 8

4/15/99

1999 EXXON VALDEZ TRUS COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 1999

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 2000
	Subtotal		0.0	0.0	0.0	
					Personnel Total	$0.0

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

FY 00

Prepared:

Project Number: 00225
Project Title: Port Graham Pink Salmon Subsistence Project
Agency: AK Dept. of Fish & Game

FORM 3B
Personnel
& Travel
DETAIL

1999 EXXON VALDEZ TRU! COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 1999

Contractual Costs:	Proposed
Description	FY 2000
4A Linkage: Contract with non-trustee agency	70.1
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$70.1

Commodities Costs:	Proposed
Description	FY 2000
Commodities Total	$0.0

FY 00

Project Number: 00225
Project Title: Port Graham Pink Salmon Subsistence Project
Agency: AK Dept. of Fish & Game

FORM 3B
Contractual & Commodities DETAIL

Prepared:

4/15/99

New Equipment Purchases:	Number	Unit	Proposed
Description	of Units	Price	FY 2000
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
Those purchases associated with replacement equipment should be indicated by placement of an R.	**New Equipment Total**		$0.0

Existing Equipment Usage:	Number	Inventory
Description	of Units	Agency

FY 00

Project Number: 00225
Project Title: Port Graham Pink Salmon Subsistence Project
Agency: AK Dept. of Fish & Game

FORM 3B
Equipment
DETAIL

Prepared: 4/15/99

1999 EXXON VALDEZ TRUS COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 1999

Budget Category:	Authorized FY 1998	Proposed FY 1999
Personnel	$33.0	$33.0
Travel	$0.0	$0.0
Contractual	$13.1	$13.1
Commodities	$14.0	$14.0
Equipment	$0.0	$0.0
Subtotal	$60.1	$60.1
Indirect	$10.0	$10.0
Project Total	$70.1	$70.1
Full-time Equivalents (FTE)		12.0
Other Resources		

LONG RANGE FUNDING REQUIREMENTS

Estimated FY 2001	Estimated FY 2002	Estimated FY 2003	Estimated FY 2004
$0.0	$0.0	$0.0	$0.0

Dollar amounts are shown in thousands of dollars.

Comments:

FY 00

Prepared: 5 of 8

Project Number: 00225
Project Title: Port Graham Pink Salmon Subsistence Project
Name: Chugach Regional Resources Commission

FORM 4A
Non-Trustee
SUMMARY

4/15/99

1999 EXXON VALDEZ TRUS COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 1999

Personnel Costs:			Months	Monthly		Proposed
	Name	Position Description	Budgeted	Costs	Overtime	FY 2000
[redacted]		Fish Culturist	6.0	$2,750		16.5
		Fish Culturist	6.0	$2,750		16.5
		Subtotal	12.0	5500.0	0.0	[redacted]
					Personnel Total	$33.0

Travel Costs:		Ticket	Round	Total	Daily	Proposed
	Description	Price	Trips	Days	Per Diem	FY 2000
[redacted]						
					Travel Total	$0.0

FY 00

Project Number: 00225
Project Title: Port Graham Pink Salmon Subsistence Project
Name: Chugach Regional Resources Commission

FORM 4B
Personnel
& Travel
DETAIL

Prepared: 4/15/99

1999 EXXON VALDEZ TRUS COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 1999

Contractual Costs:	Proposed
Description	FY 2000
Freight	1.0
Maintenance & Repair	0.8
Seine boats for broodstock collection 8 days @ $500/day	4.0
Air charter for stream surveys - to ADF&G	2.3
Technical consultants	5.0
Contractual Total	$13.1

Commodities Costs:	Proposed
Description	FY 2000
Fish Food	10.1
Skiff fuel/oil	0.3
Plumbing supplies	0.2
Building supplies	0.3
40 x 40 rearing pen nets	3.1
Commodities Total	$14.0

FY 00

Project Number: 00225
Project Title: Port Graham Pink Salmon Subsistence Project
Name: Chugach Regional Resources Commission

FORM 4B
Contractual & Commodities DETAIL

Prepared:

4/15/99

COMMUNITY-BASED HARBOR SEAL MANAGEMENT AND BIOLOGICAL SAMPLING

Project Number:	00245
Restoration Category:	General Restoration
Proposer:	Alaska Native Harbor Seal Commission
Lead Trustee Agency:	Alaska Department of Fish and Game
Cooperating Agencies:	
Alaska SeaLife Center:	
Duration:	2nd year; four year project
Cost FY 96:	
Cost FY 97:	
Cost FY 98:	
Cost FY 99:	$70,700
Cost FY 00:	$56,500
Cost FY 01:	$40,000
Cost FY 02	$25,000
Geographic Area:	Prince William Sound, Cook Inlet, Kodiak, Alaska Peninsula
Injured Resource/Service:	Harbor seals; subsistence

ABSTRACT

This project continues, at a reduced level, work supported through previous harbor seal restoration projects (\244 and 99245). A biological sample collection program, implemented in FY96 and expanded in FY97, in Prince William Sound, lower Cook Inlet, and Kodiak Island will continue. A training initiative will take place in a Chignik area community (Alaska Peninsula). Village-based technicians are selected by the Alaska Native Harbor Seal Commission (ANHSC) and trained by the Alaska Department of Fish and Game to collect samples. The samples are transported to Anchorage or Kodiak for further sampling and distribution to participating scientists for analysis. The ANHSC will produce and distribute a newsletter with summaries of the biological sampling program.

INTRODUCTION

The goal of this project (which continues the work of #\244) is to support collaboration between subsistence hunters of harbor seals, scientists, and resource management agencies to assess the factors which are affecting the recovery of the harbor seal population of the oil spill area and to identify ways to reduce these impacts. In FY 94 (Project 94244) and FY 95 (95244), the Trustee Council provided funding for the Alaska Department of Fish and Game, Division of Subsistence, to compile available data, collect additional information, and to organize workshops and community meetings with scientists and subsistence users. Participants in the workshops concluded that the lack of a formal organization which represents subsistence users of harbor seals is a major impediment to communication between scientists and hunters and to the inclusion of subsistence hunters as full partners in harbor seal research and restoration. To fill this gap, Alaska Native participants in the harbor seal restoration workshop of March 2, 1995 voted to form an Alaska Native Harbor Seal Commission. In FY 96, Project 96244 assisted the ANHSC by providing it with funds to organize two workshops held in conjunction with commission meetings and to produce and distribute two newsletters and other communications. Additional workshops took place under Project 97244, Project 98244, and Project 99245.

A second consensus point reached at the workshops was that subsistence hunters are in an excellent position to assist in scientific studies through providing biological samples from subsistence-taken animals. A goal of Project 96244 was to test the practicality and effectiveness of a community-based harbor seal biological sampling program, designed and administered cooperatively between the University of Alaska, the Alaska Native Harbor Seal Commission, and the Department of Fish and Game. In FY 97, this program was expanded to collect samples from the Kodiak Island area and add Valdez to the sample communities in Prince William Sound. This program continued in FY 98 and FY 99. As of March 1999, samples from 148 animals had been distributed for analysis. Table 1 reports how the samples have been distributed. Table 2 shows the geographic origin of the samples from the oil spill region, as of March 1999.

Finally, this project will support other restoration projects proposed for FY 00 and beyond, such as Harbor Seals: Monitoring and Field Research (\064), , Harbor Seals: Health and Diet (\341), Harbor Seal Metabolism/Stable Isotopes (\371), Harbor Seal Diet: Lipid Metabolism and Health (\441),the Community Involvement and Traditional Knowledge Project (\052), and the Youth Area Watch (\210). The project will also contribute to the Trustee Council's recovery objectives for subsistence by facilitating involvement of subsistence users in the restoration process.

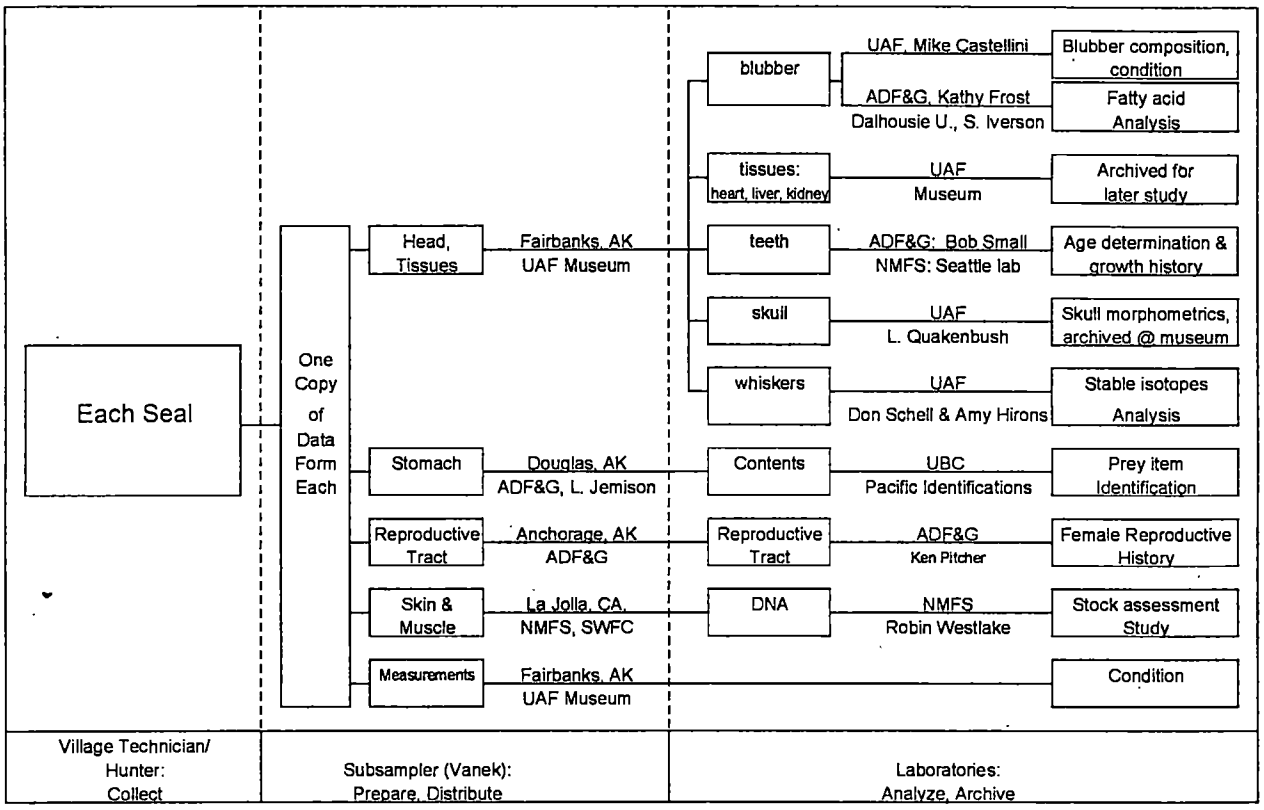
Table 1. Distribution of Subsistence Harbor Seal Samples Collected under EVOS Restoration Projects 244 and 245 (as of 3/18/99)

Tissue	# Samples	Contact	Disposition, status, and analysis
Stomachs	142	L. Jemison, ADF&G	Sent to UBC for prey identification
Teeth	128	R. Small, ADF&G	Extracted at UAF Museum; age & growth history to be determined by NMFS in 1998
Whiskers	148	D. Schell, UAF	Used in stable isotopes analyses (EVOS # 97170)
Brain and collagen[1]	128	A. Hirons, UAF	Used in stable isotopes analyses (EVOS # 97170)
Blubber	129	B. Fadely, et al., UAF & M. Castellini, UAF	Blubber composition studies completed and continuing (EVOS Proj. 95117)
		K. Frost, ADF&G	Sent to Dalhousie University for fatty acid analysis (EVOS Proj. 95064)
Skin/muscle	148	R. Westlake, NMFS	Sent to NMFS La Jolla for genetic analysis
Reproductive tracts	31	K. Pitcher, ADF&G & H. Harmon, UAF	Stored for future reproductive analysis
Skulls	128	G. Jarrell, UAF	UAF Museum staff is cleaning skulls for archive and morphometric examination
Archived tissue heart liver kidney blubber skeletal muscle	131	A. Runck, UAF	Tissues subsampled and archived in -70C freezer at UAF Museum; available for future contaminant analyses.

[1] Collagen from ligaments or tendons; also using muscle, blubber, skin, heart, liver, and kidney

Table 2. Summary of Harbor Seal Biosamples Collected (3/99)

Community	Number of Seals Sampled	
	Full Set of Samples	Partial Set of Samples
Chenega Bay	4	3
Nuciiq	2	0
Cordova	31	3
Tatitlek	41	29
Valdez	14	0
Seward	0	0
Nanwalek	5	1
Port Graham	0	0
Seldovia	2	3
Afognak Island	1	1
Akhiok	5	0
Old Harbor	1	1
Port Lions	1	0
GRAND TOTAL	107	41



EVOS Project 245: Sample Distribution and Chain of Responsibility (As of 3/99)

NEED FOR THE PROJECT

A. Statement of Problem

The harbor seal populations of Prince William Sound and the northern Gulf of Alaska were in decline before the oil spill for unknown reasons. The spill injured these populations, adding to the decline, and they are not recovering. Harbor seals are a primary subsistence resource in the Alaska Native communities of the oil spill region. Subsistence harvests of harbor seals have declined in many of communities since the spill because of the reduced population size and voluntary efforts on the part of hunters to limit their harvests to aid in recovery. In order to assess these efforts and to identify measures which subsistence users could take to further assist in harbor seal restoration, the Trustee Council funded projects in FY 94 and FY 95 to compile existing data, collect additional information, organize meetings of scientists and subsistence users, and develop recommendations for hunters. Two workshops took place. Among other things, participants at the workshops recognized that without a formal organization representing subsistence hunters of harbor seals, it was unlikely that a consensus on recommendations could be developed or that a dialogue between hunters and scientists could be maintained. Workshop participants stressed that strong involvement of hunters in research activities and management decisions was an essential ingredient in any plan for harbor seal recovery. Several other restoration projects are examining the potential causes of the harbor seal population decline and

lack of recovery, including mortality caused by humans. The need exists to continue to follow through on the workshop recommendations to support these harbor seal restoration efforts.

B. Rationale/Link to Restoration

The recovery objective for harbor seals states that recovery will have occurred when harbor seal population trends are stable or increasing. Based on findings from two workshops which involved scientists and subsistence users of harbor seals (conducted under Projects 94244 and 95244), meeting this recovery objective is enhanced by continuing dialogue between scientists and subsistence users, involving subsistence hunters in research efforts, involving traditional knowledge in scientific studies, and collaborating in the development of recommendations for subsistence hunters about how they can assist in harbor seal recovery. This project implements the recommendations of the workshops by continuing a biological sampling program, supporting the activities of the Alaska Native Harbor Seal Commission, and partially funding a workshop in which data and hypotheses are collaboratively reviewed.

The FY 96, FY 97, FY 98, and FY 99 Restoration Work Plans included research projects to monitor seal population trends and conduct research to discover why harbor seals are not recovering. These are likely to continue in FY 00 under project 00245 Assessing parameters that affect marine mammal abundance and health requires access to and examination of animals or tissues. Marine mammals are inherently difficult to study and the collection and examination of tissues is further complicated by legal limitations imposed by federal protective measures and permitting procedures. Sacrificing animals for research purposes is either undesirable or illegal, and beachcast carcasses are often too decomposed to be of value. A potentially invaluable source of fresh specimens exists in Alaska, where coastal Alaska Natives still legally use marine mammals for subsistence or handicraft purposes. This project has developed a successful community-based bio-sampling program. This program has succeeded because:

1. Local people support the program and its goals, are involved in the sample collection, understand the significance of the data being collected, are willing to store and ship samples from villages to a central receiver, and are trained and willing to record data and collect samples as instructed.

2. Samples are easily collected, stored and shipped; they are subsequently sub-sampled by ADF&G staff; are analyzed in due time; and results are returned to villages.

Furthermore, over the last several years, the Trustee Council has attempted to involve spill-area communities more fully in the restoration process. The biosampling effort is a prime example of this involvement and collaboration.

C. Location

The biological sampling portion of the project includes the Prince William Sound communities of Cordova, Chenega Bay, Valdez, and Tatitlek; the lower Cook Inlet communities of Seldovia, Port Graham, and Nanwalek; and two Kodiak Island communities, Akhiok and Old Harbor (Table 2). For FY 00, it is proposed to add a Chignik area community to those with trained biosamplers. This is the only area within the range of harbor seals where no such training has taken place.

COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE

Community and subsistence user involvement in the restoration process and in harbor seal recovery is a central purpose of this project. The primary continuing goal is to support the involvement of the Alaska Native Harbor Seal Commission in the biosampling program. As part of the continuing biological sampling effort, the ANHSC will select technicians (most of whom will be subsistence harbor seal hunters) in participating communities. New technicians will be trained by ADF&G staff to collect biological samples. Subsistence hunters will supply the samples and will be trained through the use of an instructional video (produced in FY 96), and through hands-on instruction as needed. Also, participants in the Youth Area Watch Project (\210) will be included in project activities, including community technician training sessions and the workshop. The ANHSC will also produce a newsletter with summaries of the biosampling efforts. Although project funds are no longer available to help support a workshop, it is anticipated that the biosampling program and results will be reviewed at ANHSC meetings.

PROJECT DESIGN

A. Objectives

The primary premise upon which this project is based is that restoration of harbor seal populations is facilitated by involving subsistence users in research and management activities. Key to the success of this effort is support for the activities of the Alaska Native Harbor Seal Commission. Specific objectives include to:

1. Continue a community-based program to collect biological samples and other information from harbor seals in Prince William Sound and the northern Gulf of Alaska involving hunters from Cordova, Tatitlek, Chenega Bay, Valdez, Seldovia, Port Graham, Nanwalek, Akhiok, and Old Harbor. Train bio-samplers in one Chignik area community. Specific sub-objectives include:

    a. Train local technicians and hunters in biological sample collection procedures
    b. Maximize sampling for efficiency and coordination with other harbor seal projects
    c. Evaluate the program's effectiveness and develop a more long-term funding plan.

2. Collect biological samples and other information from harbor seals harvested by subsistence hunters in 10 communities: Tatitlek, Chenega Bay, Valdez, Cordova, Seldovia, Port Graham, and Nanwalek, Akhiok, Old Harbor, and a Chignik area community. Provide these samples to researchers for analysis.

    a. Collect information about the number, sex, approximate age and place and date of harvest for harbor seals taken in each village
    b. Collect biological samples to be analyzed in cooperation with other harbor seal projects, including blubber, whiskers, skin, female reproductive tracts, and stomachs (see Table 1 and Figure 1).
    c. Store samples in a community freezer and periodically ship samples to Anchorage or Kodiak for further processing and distribution for analysis
    d. Develop and maintain a procedure for tracking disposition of samples and results of analyses

3. In collaboration with the Alaska Native Harbor Seal Commission, communicate information about results of harbor seal studies to hunters and scientists on a regular basis through a newsletter and the development of a database.

a. Produce an informational newsletter describing results of harbor seals studies, ongoing harbor seal research, and community involvement
b. Maintain a database of biosamples and results
c. Discuss biosampling program and results at periodic meetings of the ANHSC (these meeting are funded through other programs)

4. Collaboratively produce recommendations for subsistence users of harbor seals which derive from study findings and the discussions at community meetings and workshops

a. These recommendations will be based on traditional knowledge, contemporary observations, and scientific findings
b. Recommendations will be developed at meetings of the ANHSC.

5. Evaluate the program's effectiveness and explore options for a long-term funding plan for the biological sampling program

6. Coordinate with the Youth Area Watch Program (Project /210) to involve participants in that program in biological sampling and workshops and to support a year-long curriculum based on information gathered through the biosampling program.

B. Methods

Objectives 1, 2, & 6: Biological Sampling Program

For Objectives 1 and 2, the Biological Sampling Program, the following procedures will be used:

1. Training. As part of Project 96244 (and revised as part of 97244 and 98244), a marine mammal biologist, Kate Wynne of the University of Alaska, and Vicki Vanek, a veterinarian with the Division of Subsistence (ADF&G) compiled protocols, synthesized these into useable formats, developed data forms, labels, and sampling kits, and incorporated instructions for their use into a training program. In FY 99 under 99245, Vanek assumed full responsibility to apply these materials and revise them as appropriate.

Instruction. Sampling requires instruction or training of community-based sampling technicians, who ideally are also subsistence seal hunters. Any new village-based technicians will attend a full-day sampling training session in Kodiak or Anchorage. Vanek will: provide a detailed explanation of project goals, and significance and use of data to be collected; distribute sampling kits; explain and demonstrate sampling techniques and use of equipment; and distribute written and graphic instructional materials to take to villages. An alternative is for Vanek to travel to the community to train a replacement. Vanek and Riedel will travel to a Chignik area community to introduce the project and train one or more biosamplers.

Other hunters will be informed of program objectives and specified sampling requirements through communication with village technicians and other project personnel and through written, graphic, and video instructional materials.

2. Training materials.

Manual: This was produced in FY 96 (Project 96244). It includes step-by-step diagrams and a visual guide. It is waterproof and is included in the sampling kit. Labor is involved in laying out, laminating, and binding each new manual for newly-trained local assistants.

Examples: If a seal is available, at the training session participants work on an actual animal, filling in data forms and labels. Otherwise, the training relies on slides, the training video, and artificial props.

Video. In FY 96 (Project 96244), a training video was produced by ADF&G, incorporating footage shot at the two training sessions. It has been distributed to the technicians trained at these sessions. The video includes: project rationale and objectives; footage of current research and population declines; significance and use of data to be collected; demonstrations of how to fill in data forms and labels; demonstrations how to use sampling kit and supplies; demonstrations of where and how to remove tissues from animals; and demonstrations of how to sub-sample, bag, and label tissues.

3. Sample collection

Technicians. There is a village-based technician in each participating community, whose responsibilities are to take samples from seals taken by themselves or participating hunters, record data as requested, assure access to freezer and sampling supplies, notify Vanek or Riedel when supplies are low or freezer is nearly full, and load and ship coolers with samples to Anchorage, Cordova, or Kodiak.

Key hunters. Ideally at least two hunters per village provide subsistence taken seals from which the technicians take samples, and record data as requested.

Sample size and distribution: It is difficult to predict the number of samples that may be collected in this program annually or by community, but we have assumed an average of 8 animals per community while designing the sampling strategy and estimating project costs.

Tissues to be collected. A minimal sample can be collected by technicians in each village with relative ease and subsequently sub-sampled in Anchorage or Kodiak to provide the suite of tissue samples required. We have trained technicians and hunters to record information about harvest location and animals' sex, evidence of tags or markers, and standard measures of length and girth and blubber thickness. Technicians are trained to collect the whole head; stomach (after tying off both ends), samples of liver, heart, blubber, and kidney; and female reproductive tract. Although collecting the reproductive tracts and claws is highly desirable, it is realistic to assume they will be collected opportunistically only from those hunters willing to dedicate extra effort required to collect them.

Sampling procedure.

Step 1. In the community: village technician receives sample from the hunter, or works with an animal they have taken themselves. The data form is filled out by hunters in the field and in the community by the technicians, or by youth from the Youth Area Watch project. The data form is placed inside the specimen bag with samples for village-based storage. Technicians have a kit that includes supplies adequate for sampling of 8 animals. Among the items in each kit are 1) ziploc sampling bags for collection of the head, stomach, and tissues, 2) large garbage bags in which to place the sample bags collected from each animal, and 3) data forms and specimen labels. The head, stomach, and tissues will each be individually bagged in a two gallon ziploc bag. All these sample bags are placed in one large garbage bag along with the specimen label from the bottom of the data form. The specimen bag and the data form are placed in a freezer without sub-sampling, the technician contacts Vicki Vanek or Monica Riedel when a full shipment has accumulated, and then sends the samples to Kodiak or Anchorage.

Step 2. Vicki Vanek receives samples in Anchorage and stores them at ADF&G or receives them in Kodiak and stores them at the Fisheries Technology Center. Periodic sub-sampling efforts occur as depicted in Figure. 1. Subsamples from each seal are repackaged into individual bags and labeled, specifying organ and origin; tied securely, refrozen, and shipped to the appropriate laboratory (see Fig. 1).

4. Data collection.

Data are recorded on forms which allow for standardization of data with other harvest-sampling programs. Presently, these forms have been supplied in paper copies only. An objective for Project 99245 is the development of an electronic version of this form, as recommended during the EVOS scientific review committee's review of project \244. Sample label and freezer log forms have been developed to assure adequate sample tracking. Each animal receives a unique number that is tied to the UAF Museum Archive numbering system. The number is assigned before any subsampling occurs so all parts are linked to the appropriate animal and can be easily tracked.

5. Sample analysis.

Figure 1 provides a summary of the research programs involved in the tissue analysis. It is expected that participating scientists will acknowledge in any reports and publications the role of the ANHSC in facilitating the biological sampling program. In Project 99245, an agreement form is being developed which participating researchers will sign to agree to return the results of their analysis for inclusion in databases and to acknowledge the assistance of the ANHSC.

6. Data management and reporting

Biological data collected from this program are managed and maintained in a data base using Microsoft Excel software that is easily translated or integrated with software used by other agencies and organizations. This database is centrally maintained by ADF&G and a summary of the samples collected and analyzed will be included in the project's annual and final reports to the Trustee Council, with copies to pertinent agencies, such as NMFS. Additionally, ADF&G (Vanek) will collate the results of the sample analysis into a readily understandable newsletter, that will be provided to all the project participants.

In Project 99245, steps are being taken to enhance this database, as recommended by the EVOS scientific review committee. These include:

a. Development of an electronic data form (see above). This will facilitate communication of information and incorporation of sample data into databases.
b. Enhance UAF Museum database for back-up tracking, to include information on the biosampled seals, such as the names of researchers who received samples and identification of the sample with this program
c. Development of an electronic form that summarizes all information from samples from a particular animal
d. Development of a biannual biosample status report. Presently (mid-FY99) there is no automatic system in place for researchers to return the results of their analyses or to update other participants on their activities and progress. This will be an electronic form to be submitted every six months by each researcher who receives biosamples from this project.
e. Assisting the Youth Area Watch Program in developing a curriculum that incorporates biosample collection and study results. This will initially include developing a limited set of classroom lessons that illustrate the application of length, weight, sex, location, timing, and stomach content data.

Summary: Proposed responsibilities of each cooperating group for Objectives 1 and 2:

Vicki Vanek of the Alaska Department of Fish and Game, Division of Subsistence will:

1. Compile protocols, develop data forms and sampling kits, and incorporate instructions for their use into a training program (this was completed in Project 96244; appropriate revisions will take place in Project 00245); make appropriate revisions to the instruction manual.
2. Help answer biosamplers' questions
3. Train new community assistants in a Chignik community and any replacements if necessary, in other communities in training workshops.
4. Receive samples from village-based technicians, process samples, and ship samples to participating researchers for analysis
5. Maintain the database of biological data
6. Collate the results of the sample analysis into a readily understandable newsletter.
7. Write a brief summary of the project for inclusion in the interim and final reports for the Trustee Council
8. Participate in the Alaska Native Harbor Seal Commission workshop
9. Provide technical support for Youth Area Watch school curriculum
10. Develop and maintain electronic exchange of information with researchers, including providing data forms to researchers and researchers' subsample status and results (from biannual reports) for annual reports and reports prepared by the ANHSC.

The Alaska Native Harbor Seal Commission will:

1. Identify and subcontract with 10 community technicians
2. Purchase sampling kits and distribute kits and other supplies to village-based technicians
3. Set up air freight accounts for shipping samples

4. Receive samples from Prince William Sound biosamplers, in Cordova and prepare for shipping to Anchorage for subsampling and distribution.
5. Communicate study findings through a newsletter and at its periodic meetings

Objectives 3, 4, and 5: Communications, Recommendations, and Evaluation

Communication of study findings, development of recommendations for hunters, project evaluation, and development of a long-term funding plan, are part of a collaborative effort met in part through a contract with the ANHSC, which will do the following:

1. Communicate with communities involved in the biological sampling project to review data and any recommendations developed by the ANHSC. These communications may be through phone discussions or take place during community visits connected with biosampling training or other ANHSC business
2. Write a newsletter which provides overviews of findings from harbor seal research and ANHSC activities.
3. Participate in the Trustee Council restoration workshop and contribute to Trustee Council's annual and final reports

The Division of Subsistence will provide technical assistance to the Commission as needed. The goals of these objectives are also addressed through the development and maintenance of databases, as discussed above.

Annual and final reports: the Division of Subsistence will prepare annual and final reports for the project overall, with contributions from the collaborating groups.

C. Cooperating Agencies, Contracts, and Other Agency Assistance

A. In prior study years, a contract was developed with the Alaska Native Harbor Seal Commission to undertake portions of the project. This contract will be amended to include the objectives for Project 00245. Tasks for the ANHSC under this contract will include:

1. Purchase sampling kits and distribute kits and other supplies to village-based technicians
2. Set up air freight accounts for shipping samples
3. Identify and subcontract with local community technicians
4. Organize and participate in community meetings in selected communities involved in the biological sampling program
5. Prepare brief (letter format) quarterly reports on its activities as related to this project.
6. Attend the Trustee Council Restoration Workshop and contribute to Trustee Council's annual and final reports

Through subcontracts with the ANHSC, community technicians in 10 communities (Cordova, Tatitlek, Chenega Bay, Valdez, Seldovia, Port Graham, Nanwalek, Akhiok, Old Harbor, and a Chignik community) will do the following:

1. Attend one day training session (if newly hired in FY 00)
2. Collect samples (stomach contents, female reproductive organs, liver, heart, kidney, claws, head)

3. Record data on harvest locations, sex, evidence of tags or markers, length, and girth
4. Label and freeze samples, notify Vicki Vanek or the ANHSC when freezers are full, and load and ship coolers with samples to Kodiak or Anchorage

Contract A: Budget

Personnel	Executive Director for 12.0 months @ 1/3 time	$16,000
Travel	Executive Director travel	2,800
Operational costs: phone & mailing		3,600
Insurance		1,200
Sampling and freezer supplies, freezer electricity, shipping		2,400
Subcontract, village-based technicians		3,800
15% indirect program cost		4,500
Total		$34,300

Note: in kind contributions for the operations of the ANHSC include technical assistance from the Chugach Regional Resources Commission (Anchorage), the Alaska Sea Otter Commission (Fairbanks), and the Indigenous Peoples' Council on Marine Mammals (Anchorage).

Subcontract: Village-based Technicians

Training honorarium: $100/day for two new technicians for one day each:	$200
Compensation for taking biological samples of seals	3,600
Total	3,800

Note: it is anticipated that samples will be taken from an average of 8 seals per community, for a total of 80 seals, and that it will take about 3 hours per seal to take samples, store samples, and ship samples. At a rate of $15/hour, this gives: $15 x 3 hours x 8 seals x 10 communities = $3,600.

SCHEDULE

A. Measurable Project Tasks for FY 00

Start-up to October 15, 1999:	Update contract with the Alaska Native Harbor Seal Commission; hire technicians
October/November:	Hold training sessions for biological sampling for new community technicians
December to September 2000:	Biological sample collection
March/April 2000:	Produce and distribute newsletter (Alaska Native Harbor Seal Commission)
April 15, 2000	Annual report
September 2000:	Evaluate fourth year of program

B. Project Milestones and Endpoints (includes \244)

1. Development of sampling program: October/November 1995
2. Production and distribution of Instructional video: March 1996
3. Workshops to train local hunters and technicians in collection procedures: October/November 1995
4. Workshop in conjunction with meeting of Alaska Native Harbor Seal Commission: March 1996
5. Produce and distribute first proceedings report: April 1996
6. Maximize coordination with other programs: ongoing
7. Ship samples to appropriate laboratories for subsequent analysis: ongoing
8. Advise villages and scientists of analytical results when available: ongoing
9. Conduct interviews with hunters to collect traditional knowledge: ongoing
10. Second workshop in conjunction with Commission meeting: September 1996
11. Produce and distribute second proceedings report: September 1996
12. Train new village technicians and new Youth Area Watch participants: November 1996
13. Hold workshop in conjunction with ANHSC meeting: March 1997
14. Demonstrate updated Traditional Knowledge Database: March 1997
15. Produce and distribute proceeding for 1997 workshop: April 1997
16. Annual report: April 15, 1997
17. Complete map database and report: June 1997
18. Evaluate the program's effectiveness and develop a more long-term funding plan: September 1997 and September 1998
19. Train new Youth Area Watch participants -- October 1997
20. Hold workshop in conjunction with ANHSC meeting: March 1998
21. Produce and distribute proceedings for 1998 workshop: April 1998
22. Develop electronic forms for researcher exchange of information and system to transmit forms, assist UAF Museum to add tracking information to computer programs as a backup to main database; assist in Youth Area Watch curriculum development
23. Final report, \244: September 30, 1998
24. Train new community technicians and new Youth Area Watch participants: October/November 1998
25. Hold workshop in conjunction with ANHSC meeting: March 1999
26. Produce and distribute proceeding for 1999 workshop: April 1999

27. Annual report, 4/15/00
28. Annual report: 4/15/01
29. Annual report: 4/15/02
30. Final report: 9/30/03

C. Completion Date

This project should continue as long as the Marine Mammal Ecosystem Research package is underway. Presently, fieldwork and data analysis for several marine mammal restoration projects are continuing into FY 00, including \064 (Harbor Seals: Monitoring and Field Research), \341 (Harbor Seals: Health and Diet), \371 (Harbor Seal Metabolism/Stable isotopes), and \441 (Harbor Seal Diet: Lipid Metabolism and Health).

PUBLICATIONS AND REPORTS

Annual report	April 15, 2000
Annual report	April 15, 2001
Annual report	April 15, 2002
Final report	September 30, 2003

PROFESSIONAL CONFERENCES

No attendance planned for FY 00.

NORMAL AGENCY MANAGEMENT

The Division of Subsistence of the Alaska Department of Fish and Game has no statutory or regulatory responsibilities for marine mammal management. Without this project, marine mammal biologists who are working on harbor seal recovery will lose a key source of biological information on this species. Trustee Council support of the activities of the Alaska Native Harbor Seal Commission has improved management of the injured harbor seal resource by facilitating communications between scientists and subsistence users and providing traditional knowledge to factor in to harbor seal studies. The ANHSC has received a congressional appropriation through the National Marine Fisheries Service to support certain administrative and operational costs, such as office space and travel to certain meetings and conferences. It is seeking funding from NMFS in accordance with provisions of the Marine Mammal Protection Act to support its long-term activities.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

The project provides biological samples from subsistence-taken harbor seals to address potential health and nutritional problems that may be impeding harbor seal recovery, including restoration project numbers \064, \341, \371, and \441. The project provides information to researchers working on harbor seal restoration projects and facilitates their work with Alaska Native hunters.. Participants in the Youth Area Watch project (\210) participate in community technician training sessions and attend workshops.

Several programs exist to sample tissues from harbor seals from the spill area (see Table 2 and Fig. 1). As noted above, every effort is made to coordinate with these programs to minimize the burden and confusion of hunters and communities, maximize logistical efficiency, collect comparable or standardized data whenever possible, and limit the likelihood of duplication of efforts. The National Marine Fisheries Service assists with coordinating the harbor seal sampling and testing programs.

Additional funding for the operations of the Alaska Native Harbor Seal Commission received from the National Marine Fisheries Service and the U.S. Congress, and additional funding is being sought. Such funding supports more extensive activities for the Commission across the entire range of the harbor seal in Alaska. As of April 1997, a congressional appropriation to support basic commission functions (office, accounting, travel to conferences) was being administered through NMFS. The ANHSC received a Title VIII ANILCA grant to assist in the development of co-management plans.

EXPLANATION OF CHANGES IN CONTINUING PROJECTS

No additions to project objectives or methods of the detailed project description submitted and approved for Project 99245 are being proposed. Previously, the ANHSC organized a workshop in conjunction with one of its meeting and prepared a proceedings report. This task has been eliminated in FY00 in light of reduced funding. It is anticipated that review of project progress will still take place at ANHSC meetings. In FY00, Vicki Vanek will assume responsibilities as co-principal investigator (along with Monica Riedel), replacing James Fall.

ENVIRONMENTAL COMPLIANCE

This project is, a continuation of Project 99245 which ware classified as categorically excluded under NEPA guidelines. While this project will collect biological samples from subsistence-taken harbor seals, the sampling effort will not result in any additional takings of seals.

PROPOSED PRINCIPAL INVESTIGATORS

Vicki Vanek
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PERSONNEL

Monica Riedel, an Alaska Native resident of Cordova, is the executive director of the Alaska Native Harbor Seal Commission. Ms Riedel is responsible for the ANHSC activities under this project, including identifying and subcontracting with local village technicians, developing subcontracts, and developing the newsletter.

Vicki Vanek is a Wildlife Biologist with the Division of Subsistence in Kodiak. She holds a Doctor of Veterinary Medicine degree, and has worked on previous Division projects in collecting marine mammal samples and training hunters as well as on the biological sampling tasks of 96244, 97244, and 98244. Dr. Vanek is responsible for overall project performance for the Division. She will assist hunters and community technicians in biosampling, and will train newly hired technicians. Dr. Vanek will also process biosamples. She will also prepare a newsletter which reports results of the biosampling efforts and will also coordinate preparation of annual and final reports.. Three months of funding is being requested for her work on this project.

2000 EXXON VALDEZ TRU: COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 2000

Budget Category:	Authorized FY 1999	Proposed FY 2000
Personnel	$15.3	$12.6
Travel	$3.6	$3.7
Contractual	$45.3	$35.1
Commodities	$1.0	$0.8
Equipment	$0.0	$0.0
Subtotal	$65.2	$52.2
General Administration	$5.5	$4.3
Project Total	$70.7	$56.5
Full-time Equivalents (FTE)		0.3
Other Resources		

LONG RANGE FUNDING REQUIREMENTS

Estimated FY 2001	Estimated FY 2002
$40.0	$25.0

Dollar amounts are shown in thousands of dollars.

Comments:

FY00

Prepared: 4/15/99

Project Number: 00245
Project Title: Community-based Harbor Seal Management and Biological Sampling
Agency: Alaska Department of Fish and Game

FORM 3A
TRUSTEE
AGENCY
SUMMARY

2000 EXXON VALDEZ TRU COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 2000

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 2000
Vicki Vanek	Wildlife Biologist I	14B	3.0	4.2		12.6
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		3.0	4.2	0.0	
					Personnel Total	$12.6

Travel Costs:		Ticket	Round	Total	Daily	Proposed
Description		Price	Trips	Days	Per Diem	FY 2000
Kodiak - Anchorage		0.2	4	12	0.1	2.0
Anchorage - Seldovia - Port Graham - Nanwalek		0.3	1	3	0.1	0.6
Anchorage - Chignik		0.7	1	4	0.1	1.1
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
					Travel Total	$3.7

FY00

Prepared: 4/15/99

Project Number: 00245
Project Title: Community-Based Harbor Seal Management and Biological Sampling
Agency: Alaska Department of Fish and Game

FORM 3B
Personnel
& Travel
DETAIL

2000 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1999 - September 30, 2000

Contractual Costs:	Proposed FY 2000
Description	
4A Linkage	34.3
Air freight for shipping samples from Anchorage and Kodiak to participating sites	0.8
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$35.1

Commodities Costs:	Proposed FY 2000
Description	
Supplies for shipping and for subsampling	0.8
Commodities Total	$0.8

FY00

Prepared: 4/15/99

Project Number: 00245
Project Title: Community-based Harbor Seal Management and Biological Sampling
Agency: Alaska Department of Fish and Game

FORM 3B
Contractual & Commodities DETAIL

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FY 2000
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
Those purchases associated with replacement equipment should be indicated by placement of an R.		**New Equipment Total**	$0.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency

FY00

Project Number: 00245
Project Title: Community-based Harbor Seal Management and Biological Sampling
Agency: Alaska Department of Fish and Game

FORM 3B
Equipment
DETAIL

Prepared: 4/15/99

2000 EXXON VALDEZ TRU_ _ _ COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 2000

Budget Category:	Authorized FY 1999	Proposed FY 2000						
Personnel	$24.0	$16.0						
Travel	$2.2	$2.8						
Contractual	$11.0	$9.9						
Commodities	$1.3	$1.1						
Equipment		$0.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	$38.5	$29.8			Estimated FY 2001	Estimated FY 2002		
Indirect	$5.8	$4.5						
Project Total	$44.3	$34.3			$25.0	$15.0		
Full-time Equivalents (FTE)		0.3						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments:

Indirect = 15% of program costs

FY00

Prepared: April 15, 1999

Project Number: 00245
Project Title: Community-based Harbor Seal Management and Biological Sampling
Name: Alaska Native Harbor Seal Commission

FORM 4A
Non-Trustee
SUMMARY

2000 EXXON VALDEZ TRU COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 2000

Personnel Costs:			Months	Monthly		Proposed
Name	Position Description		Budgeted	Costs	Overtime	FY 2000
Monica Riedel	Executive Director Note: works 1/3 time year round on this project		4.0	4.0		16.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		4.0	4.0	0.0	
					Personnel Total	$16.0

Travel Costs:		Ticket	Round	Total	Daily	Proposed
Description		Price	Trips	Days	Per Diem	FY 2000
Exec. Dir., Cordova to Anchorage for restoration workshop and ANHSC workshop		0.2	2	5	0.1	0.9
						0.0
Exec. Dir. Cordova to Chignik, biosampling training and meeting		0.9	1	4	0.1	1.3
Exec. Dir., Cordova to Port Graham, community meeting		0.4	1	2	0.1	0.6
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
					Travel Total	$2.8

FY00

Prepared: 4/15/99

Project Number: 00245
Project Title: Community-based Harbor Seal Management and Biological Sampling
Name: Alaska Native Harbor Seal Commission

FORM 4B
Personnel
& Travel
DETAIL

2000 EXXON VALDEZ TRU COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 2000

Contractual Costs:	Proposed
Description	FY 2000
Phone: 12 months @ 200/month	2.4
Postage: 12 months @ 100/month	1.2
Insurance	1.2
Subcontracts with community biosamplers	3.8
Training honorarium: two @ $100/each = $200	
Sample processing: 10 communities, 8 seals/community, $45/seal = 3,600	
Shipping biological samples	0.8
Electricity for village freezers	0.5
Contractual Total	$9.9

Commodities Costs:	Proposed
Description	FY 2000
Purchase replacement materials for sampling kits (knives, gloves, plastic bags) (6 kits)	0.1
Purchase new sampling kits (2 kits @ $120/kit)	0.2
Supplies for shipping samples	0.8
Commodities Total	$1.1

FY00

Prepared: 4/15/99

Project Number: 00245
Project Title: Community-based Harbor Seal Management and Biological Sampling
Name: Alaska Native Harbor Seal Commission

FORM 4B
Contractual & Commodities
DETAIL

2000 EXXON VALDEZ TRU_ _ _ COUNCIL PROJECT BUDGET

October 1, 1999 - September 30, 2000

New Equipment Purchases:	Number	Unit	Proposed
Description	of Units	Price	FY 2000
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
Those purchases associated with replacement equipment should be indicated by placement of an R.		**New Equipment Total**	$0.0

Existing Equipment Usage:	Number	
Description	of Units	

FY00

Prepared: 4/15/99

Project Number: 00245
Project Title: Community-based Harbor Seal Management and Biological Sampling
Name: Alaska Native Harbor Seal Commission

FORM 4B
Equipment
DETAIL