Salmon carcasses and juvenile Chinook salmon production in the Kenai River Ecosystem
FY 97 Detailed Project Description

Project Number:	97239
Restoration Category:	Monitoring/Restoration
Proposer:	Alaska Department of Fish and Game
Lead Trustee Agency:	Alaska Department of Fish and Game
Cooperating Agencies:	U.S.F.W.S, N.B.S., Department of Interior
Duration:	Year 1 of 2
Cost FY 97:	$136,800
Cost FY 98:	$100,000
Cost FY 99:	$0
Geographic Area:	Kenai Peninsula
Injured Resource/Service:	This project is intended to evaluate the impacts of the large 1989 escapements on juvenile chinook salmon production rates by studying nutrient trophic dynamics in the Kenai River and selective tributaries.

ABSTRACT

This proposal provides for an investigation as to the role sockeye salmon carcasses play in primary and secondary production within the mainstem Kenai River. Using recently developed methodologies, we propose to expand our investigations into the potential symbiotic role sockeye salmon escapements have on nutrients and secondary productivity of the mainstem Kenai River. Investigations to date have involved only the direct effect of adult escapements and their progeny have had on the Kenai glacial lake ecosystems and their interaction with the zooplankton community and interactions among adjacent year classes of both sockeye salmon and the dominant zooplankton species. The development of a holistic ecosystem approach to restoration of this system requires examination of the role salmon carcasses play in freshwater life history of other important commercial species. Chinook salmon production may be positively influenced by nutrient additions to the relatively oligotrophic waters of the Kenai River. Although there are four anadromous salmon runs into the Kenai, sockeye salmon are the largest in terms of adult biomass. This study will focus on determining if measurable benefits to chinook salmon growth rates can be attributed to salmon carcasses in general, and more specifically, sockeye salmon effects. This aspect of the ecology of the Kenai River has had much interest by members of the public, members of the Board of Fisheries, and ADF&G staff. The method of restoration of this system will most likely be confined to regulation of harvest rates of the fisheries. An important feature of these studies is to ascertain if there are significant benefits to chinook salmon juveniles

with increased escapements. In addition, this program has the side benefit of providing insight as to historical significance of the dependence of the current chinook salmon fishery on the historically recent increase in sockeye salmon runs to the Kenai.

INTRODUCTION

Studies on the Kenai River since 1990 have addressed the large escapements of sockeye salmon into the Kenai River following commercial fisheries closures (Schmidt and Tarbox, 1993; 1995; 1996a; 1996b). These studies have focused on the population dynamics and trophic interactions of sockeye salmon juveniles rearing in the major glacial lake on the Kenai River. The limnological analyses (Schmidt and Tarbox 1996b) have established the biological mechanism for much of the observed variation in sockeye salmon run returns. In addition, investigations focused on the all trophic levels within the lake, including the influence of sockeye salmon carcasses on the productivity of these lakes. One of the techniques used in these investigations is the examination of carbon and nitrogen isotopes that are much more abundant in the marine food chain and concentrate in adult salmon carcasses (Kline et al. 1990; 1994). Smolt samples collected from the glacial lakes indicated relatively low levels of these isotopes in sockeye salmon smolts that have reared in these lakes. On a comparative basis, these lakes had very low isotope levels when compared with other systems, such as Lake Illiamna, Red Lake, or Karluk Lake. This is explainable by two factors. Adult sockeye salmon densities per unit area of these lakes is quite low when compared with the major clear water sockeye salmon systems (Personal Comm, B. Finney, U. of Alaska, Fairbanks). In addition, much of the spawning population of Skilak Lake, the dominant producer, is within the outlet. This most likely results in the nutrients being dispersed in the Kenai River below Skilak Lake. The development of a restoration strategy based on regulation of escapements into the Kenai River is incomplete without a broader based view as to the impact of these carcasses on the productivity of the mainstem Kenai River with particular focus on the chinook salmon population of the Kenai. This type of study was identified by a review team when examining the Kenai River salmon issues prior to the most recently completed Board of Fisheries meetings. This information will provide a quantitative assessment as to the broader ecological role sockeye salmon carcasses play in the Kenai River ecosystem and will provide a better perspective as to the impacts of large escapements on the overall production in the Kenai River and aide in the determining if there are tradeoffs in establishment of escapement.

NEED FOR THE PROJECT

Statement of Problem

The previous investigations into the role of large escapements of sockeye salmon on the Kenai River have resulted in an improved understanding of the density dependent responses of sockeye salmon and their ecological consequences to the large glacial lakes of the Kenai River. Public and agency questions have arisen concerning the breadth of these studies in that resident and other anadromous fish species within the Kenai River may have indirectly benefited from the larger sockeye salmon escapements. Although all species of fish within the Kenai River

undoubtedly have some interaction with sockeye salmon carcasses, the magnitude of this impact is highly speculative. This study proposes to focus on juvenile chinook salmon production in the Kenai River, and will determine if the abundance of salmon carcasses can be related to their productivity. These data will be used in the development of escapement goals in the Kenai system and will provide agencies with added information to assess if bottom up trophic level benefits to the Kenai River provide for a measurable offset to the losses of yield associated with overescapement of sockeye salmon. In addition, the maintenance of large sustainable runs of sockeye salmon to the Kenai through proper management of sockeye stocks, may be significantly related to the chinook salmon returns to the Kenai. This will provide the public with information as to the degree of dependence management of one of these stocks is on the successful propagation of the other, and will provide management agencies with insight as to the impact harvest management population restoration will have on other important economic salmon species.

B. Rationale/Link to Restoration

The proposed study will examine other roles sockeye salmon escapements have on in river ecological processes as opposed to the concentration on the lake ecosystems. In the development of restoration of sockeye salmon through escapement goal development, a broader ecosystem perspective on escapements that have the potential to affect populations of other species is desirable. Although many bird, mammal, and fish species may have an interaction with sockeye salmon carcasses, chinook salmon are highly dependent upon the mainstem rearing environment and have a major economic value to the economy of the Kenai Peninsula. The relatively recent development of stable isotope techniques have provided a method of quantifying the trophic transfer of carcass based nutrients in lakes and rivers (Kline et al. 1990; 1994; Rand et al. 1992; Bilby et al. 1996; Piorkowski 1995). In addition, the Alaska Department of Fish and Game has conducted studies on the distribution and migration of juvenile chinook salmon within the Kenai River. The current hypothesis on the factors limiting chinook salmon production in the Kenai River suggests that the smolt production is dependent upon juvenile chinook (rearing within the river) obtaining sufficient size to effectively migrate to suitable overwintering habitat within the system (Personal Comm. Terry Bendock, ADF&G, Soldotna). This study will examine the δ15N and d13C of juvenile chinook salmon rearing within different reaches and tributaries of the Kenai River which are affected by different relative abundance of adult salmon carcasses. By comparison of population growth rates prior to the introduction of salmon carcasses and after their introduction, coupled with the temporal and spatial comparisons of stable isotope ratios, we will draw inferences as to the relative importance salmon carcasses contribute to the growth of juvenile chinook salmon in these different reaches of the Kenai. With coho salmon on small stream in the Washington area, Bilby et al. (1996) found major effects of salmon carcass nutrients on growth rates. Although the morphology and volume of the Kenai River is substantially different, these investigations suggest that carcass effects on the food chain may be significant in these systems.

C. Location

These investigations will be confined to the Kenai River drainage and their tributaries. Benefactors of this project will be the citizens of the Kenai Peninsula and other members of the public throughout the railbelt area who utilize the fisheries resources of this system.

COMMUNITY INVOLVEMENT

Residents of the Kenai Peninsula Borough are an important part of the Trustee Council funded Kenai River restoration projects. Besides working on the projects in direct employment as ADF&G Fish and Wildlife biologist and technicians the people of the Peninsula are kept well informed about these projects. Major media outlets in Anchorage and Kenai cover the issues impacting the Kenai River, including the EVOS funded projects. In addition, local ADF&G project biologists have made presentations on restoration efforts to local governments, in local schools, and to community groups. Further, detailed discussions and program suggestions have resulted from the involvement of the Upper Cook Inlet Regional Planning Team. This team is composed of members from the Cook Inlet Regional Aquaculture Association and ADF&G. The team has held numerous meetings with diverse public participation to discuss the results to date of the EVOS Kenai River projects. The proposed project will be reviewed and subject to feedback on goals and objectives throughout the community.

PROJECT DESIGN

A. Objectives

This study proposal examines the following hypotheses:

1. The growth rate of juvenile chinook salmon will measurably change with the seasonal incremental increase in nutrients from salmon carcasses.

2. Juvenile chinook salmon tissue concentrations of stable isotopes reflect the relative abundance of salmon carcasses among the reaches of the Kenai River and the Kenai River tributaries in which they have reared.

3. Juvenile chinook salmon diets and the trophic status of their diet will provide information sufficient to define the proportion of their growth attributable to salmon carcass derived nutrients.

4. ADF&G escapement data and observations of the relative distribution of salmon spawners within the Kenai River ecosystem will approximate the relative contribution that escapements of the various anadromous species contribute to the productivity of juvenile chinook salmon.

To test these concepts, we will initiate a data collection effort with the following objectives:

A. Measure the population growth rate of juvenile chinook salmon by obtaining systematic samples on bi-weekly intervals through the growing season after July 1.

B. Obtain and process samples for marine derived nutrients (stable isotopes) of juvenile chinook salmon from five reaches of the Kenai River and its tributaries with variable adult salmon spawning densities before and after carcasses are assimilated into the system.

C. Obtain and process samples for stable isotope analysis of various trophic levels of the Kenai River food web prior to and after assimilation of carcasses, paralleling the juvenile chinook samples from Objective B. Food habits will be evaluated by examination of stomach contents.

D. Obtain from the 1997 and previous historical data bases of ADF&G the relative spawner distribution of the anadromous species present in the Kenai River.

These objectives are designed to provide the needed information for subsequent analysis of the relative importance salmon carcasses have in the trophic status of the mainstem Kenai River. The development of a restoration strategy involving escapement goal adjustment and improved harvest regulation that were funded previously by the Trustees has left some important information voids. Restoration of sockeye salmon populations through harvest management controls and by the establishment of escapement goals may be highly successful in maintaining strong runs to the Kenai River. However, the net effect of these activities on the potential productivity of other species is the subject of much speculation. In addition, large cyclic runs of sockeye salmon that establish as a result of escapements beyond the carrying capacity of the natal lakes may coincidentally adversely affect other species during the low ebb of their cycles; particularly if we see a density independent change in marine survival. For example, escapements of sockeye salmon during the 1970's in the Kenai River were far below the targeted escapement of the past decade. A successful run of sockeye salmon may be related to the successful production of other species. Alternatively, the volume of the Kenai River and its glacial nature, may render carcass nutrients as a minor component in the overall trophic structure of the river. This is consistent with the low $\delta 15N$ levels observed in sockeye smolts from Skilak Lake and the initial values from sediment core analysis (Personal Comm. B. Finney, U. of A. Fairbanks, AK.). These analyses should prove useful information on the ongoing discussions concerning biological escapement goals of the Kenai River and debates among the interdependence of sockeye and chinook salmon. We will also estimate the relative contribution of carcasses to the nutrient composition of other elements of the Kenai River food web. This will have implications as to the importance of carcasses on the productivity of other predators not investigated, such as resident fish, birds, and mammals.

B. Methods

The study design proposed here will be refined during the fall and winter of 1996, prior to initiating field investigations. The study design will be confined to the Kenai River drainage. Five reaches of the Kenai River will be selected during the summer and fall of 1997 to provide the following:

1. Two reaches of tributaries with minimal upstream spawning salmon but with sufficient rearing juvenile chinook to provide adequate samples for stable isotope and growth analysis without effecting the population.

2. Two reaches of the lower Kenai River mainstem, one immediately below the large sockeye salmon spawning aggregations near Skilak Lake outlet and one below the Soldotna Bridge but above tide water.

3. One reach between the Kenai and Skilak Lakes but above the confluence of the Russian River.

Chinook salmon juveniles will migrate extensively within a reach in response to initial emergence location, subsequent growth, and changes in habitat (Bendock 1989). Therefore, we will not attempt to relate fish characteristics to local micro-habitat, as much of their growth may be a function of previous locales. Samples will be collected from a minimum of five locations within the river reach. Location of samples will be retained in the analysis and will be used to provide an estimate of sample variance for a reach of river. Five fish per sampling location will be analyzed for $\delta 15N$ for a time period immediately before spawning and in the fall prior to major migratory movements of juvenile chinook to overwintering areas. All fish collected will be measured for AWL, and a representative sub-sample will be taken for stomach content analysis. Knowledge of the relative distribution of the various salmon carcasses will be used to infer the contribution of the different species to overall productivity of the various reaches.

At each station within each reach a sample of major trophic categories (following the classification of Bisson et al. (1996) and Piorkowski (1995) will be obtained for stable isotope analysis. The invertebrate species selected will be based on initial stomach analysis of diet. In addition, a sample of organic matter from epithetic organic matter from the stream bed will also be included. Invertebrates will also be collected and preserved for further analysis. . All samples will be processed for stable isotopes following the methods of Kline et al. 1994 by the University of Alaska, Fairbanks under the directive of Dr. Bruce Finney.

Each station will be sampled every 3 weeks from July 1 through October to determine nutrient status following the methods of Koenings et al. (1987) and Litchfield and Kyle (1991). In addition, juvenile Chinook salmon will be sampled for AWL at each site over the summer to establish population growth rates.

C. Cooperating Agencies, Contracts and Other Agency Assistance

Administrative support is provided by the Administrative Division, Habitat Division, Sport Fish Division and Commercial Fisheries Management and Development Division staff of the Alaska Department of Fish and Game. The project leaders and their assistants have not been funded by this project and are supported with general funds from the State of Alaska. As we anticipate major budget cuts in FY97 to the limnology program, we have provided for a limited funding of these positions to prepare a peer review publication. Most laboratory analyses are conducted by the limnology laboratory in Soldotna. These studies are integrated with ongoing studies by the Commercial Fisheries Management and Development Division on Kodiak Island and the Kenai Peninsula. These studies have different objectives, i.e. to manage, enhance, and rehabilitate common property salmon fisheries, but use the same techniques and data collection methods. Consequently, the EVOS investigations have been integrated into the normal operations of these Divisions for efficiency in completing the objectives of these studies and the general mission of these agencies. The stable isotope analysis will be conducted at the University of Alaska, Fairbanks, under the direction of Dr. Bruce Finney An RSA will be used as the contracting mechanism with ADF&G. This contract will include obtaining study design and project review assistance from Dr. Finney.

The proposed study provides for data collection and field sampling programs. As such no environmental effect of these programs occurs beyond that of traditional fisheries management data collection activities, and is within existing collecting permits or Federal special use permits issued to the Department of Fish and Game for scientific data collection activities. New programs on the Kenai National Wildlife Refuge are updated through permit amendments as needed. No other permits or other coordination activities are involved.

SCHEDULE

Measurable Project Tasks for FFY 97

1. Measure the population growth rate of juvenile chinook salmon by obtaining systematic samples on bi-weekly intervals through the growing season after July Completion date would be early winter of 1997.

2. Obtain and process samples for marine-derived nutrients (stable isotopes) of juvenile chinook salmon from five reaches of the Kenai River and its tributaries with variable adult salmon spawning densities before and after carcasses are assimilated into the system. Completion date for sample processing would be spring of 1998.

3. Obtain and process samples for stable isotope analysis of various trophic levels of the Kenai River food web prior to and after assimilation of carcasses, paralleling the juvenile chinook samples from objective B. Food habits will be evaluated by examination of stomach contents. Completion date for sample processing would be spring of 1998.

4. Obtain from the 1997 and previous historical data bases of ADF&G, the relative spawner distribution of the anadromous species present in the Kenai River. Completion date would be early winter of 1997.

B. Project Milestones and Endpoints

Finalize study design and initiate field work:	April 15, 1997
Complete draft final report	April 15, 1998
Submit peer manuscript and final report	June 15, 1998

PUBLICATIONS AND REPORTS

An annual status report detailing project results for the Kenai River carcass nutrient study will be prepared for peer review on April 15, 1997. This report will entail the final study design that will be implemented during the field season of 1997. A final separate report, detailing the results of these studies will be issued on April 15, 1998..

PROFESSIONAL CONFERENCES

During the initial year of this contract, no conferences pertinent to this aspect of the study are planned. We anticipate presentation of these findings at scientific meetings in the second year of the investigations.

NORMAL AGENCY MANAGEMENT

The Alaska Department of Fish and Game has ongoing sportfish and commercial fisheries research operations on the Kenai River. In addition, the CFMD Division has ongoing data collection activities from Hidden Lake relating to the limnology of this system. These data are integrated into statewide or regional data bases that are use to directly assess the impacts of the oil spill. In addition, the area research and management biologists for the Division of Commercial Fisheries Management and Development and numerous administrative and support staff are supported by general funds provided by the Alaska legislature. To date, most of the data analysis and reporting for the sockeye salmon over-escapement project has been provided for from contributions of the State of Alaska from these general funds. Total funding for these programs exceeds $1 million. The proposed investigation is not a normal part of ADF&G's activities.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

The investigations of Kenai River sockeye salmon have been integrated with long term research efforts by the Alaska Department of Fish and Game on these stocks. In addition, studies by the Limnology Laboratory and the fisheries development staff on Kodiak Island on these systems are

included in data analysis. Study design and methodology builds off of earlier efforts. Planning and permitting of research activities and future rehabilitation efforts are coordinated through the USFWS Refuge staff in Soldotna.

PROPOSED PRINCIPAL INVESTIGATOR

Dana Charles Schmidt
Alaska Department of Fish and Game
Commercial Fisheries Management and Development Division
34828 Kalifornsky Beach Rd, Suite B
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PERSONNEL

Dana Charles Schmidt
Alaska Department of Fish and Game
Commercial Fisheries Management and Development Division
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EMPLOYMENT:

October, 1991 to Present. Limnologist III, Principal Limnologist, FRED Division, Alaska Department of Fish and Game, Soldotna, AK. Responsibilities include establishing research objectives for the Statewide limnological investigations of the Commercial Fisheries Management and Development Division. This section provides direction for other components of the Division for determination of stocking rates for sockeye salmon in lakes and in the application of fertilization. This section also provides input to the commercial fisheries division for determination of the escapement goals for sockeye salmon. Supervise the limnology laboratory which completes water quality and plankton analysis for water samples taken from several hundred lakes statewide.

April, 1985 to October, 1991: Fishery Biologist IV, Regional Research Biologist, Westward Region, Alaska Department of Fish and Game. Responsible for establishing research objectives and priorities for the Westward Region Commercial Fisheries Division. This Division has management authority over extensive salmon and herring stocks on the Alaska Peninsula and Kodiak Island, in addition to management of the major shellfish stocks in the Gulf of Alaska and the Bering Sea. Annual ex-vessel value of these fisheries is several hundred million dollars, Research highlights included studies of crab larvae settling rates in the Gulf of Alaska and investigations on the effects of oil spill overescapement on the sockeye salmon production of major lakes on Kodiak Island.

May, 1982 to September, 1985 Acting F. B. IV, Susitna River Aquatic Studies Coordinator, Alaska Department of Fish and Game. The entire program under supervision included approximately 25 permanent and 50 seasonal employees. During this interim period, responsible for reorganizing the studies into a more efficient structure to meet the long term monitoring needs for determination of the effects of the Susitna project on the aquatic resources of the Susitna River. Supervised development of operational plans for 18 technical study programs on the Susitna River, assignment of priorities of tasks, and review of the technical merit of the programs proposed. Prior to January 1985. F. B. III, Resident and Juvenile Anadromous Project Leader, Su-Hydro Aquatic Studies Program, Alaska Department of Fish and Game. Supervised research programs on resident and juvenile anadromous fish in the Susitna River that may be impacted by development of the Su-Hydro Project. Technical studies included development of models of sport fishery exploitation on arctic grayling populations,

modeling instream flow responses of juvenile salmon habitat, development of baseline population parameters of resident fish and juvenile salmon and development of projections of supersaturated gas dissipation below the proposed dam sites.

January, 1981 to May, 1982: Fishery Biologist, Terrestrial Environmental Services, Anchorage, Alaska. Responsible for field and office review of the aquatic studies programs of the Alaska Power Authority for the Susitna Hydro-Electric Program. This responsibility included assisting the Alaska Department of Fish and Game in study plan development, providing preliminary assessment of impacts of the project on aquatic resources and presenting to the public progress of the aquatic studies programs.

May, 1980 to October 1980: Fishery Biologist, U.S. Fish and Wildlife Service, Soldotna, Alaska. Assisted on a radio-telemetry project and juvenile salmon habitat survey on the Kenai River, Six-mile Creek, and the Deshka River in the Cook Inlet area. Activities included tagging and radio tagging chinook and coho salmon, collection of juvenile salmon and measurements of associated habitat, and assisting in the analysis of scale patterns from Kenai River chinook salmon. Other activities included statistical analysis of data, report review, and preparation of a publication on the Kenai River chinook for Alaska magazine.

EDUCATION:

Ph.D. in Fisheries 1973
Major Field - Fisheries- Minor Field Pharmacology,
Oregon State University, Corvallis, Oregon
M. S. in Biology, 1970 Major Field - Aquatic Biology Minor Field - Sanitary Biology,
University of Utah, Salt Lake City, Utah
B. S. in Wildlife Biology, 1968, University of Montana, Missoula, Montana

Bruce P. Finney
Assistant Professor of Marine Science
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University of Alaska Fairbanks
Fairbanks, Alaska 99775
Born: 30 April 1957
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RELEVANT EXPERIENCE:

Stable isotopic studies of aquatic organic matter and carbonates. Chemical and mineralogical analysis of geological samples. Diatom analysis. Uranium-series isotope analysis and Quaternary dating techniques. Analysis of sedimentary organic carbon, calcium carbonate and biogenic silica. Field experience in box, gravity and

piston coring, hydrocasts and sediment trap deployment and recovery.
Description and curation of geological samples.
Computer-based statistical applications to geological data sets. Partitioning models of chemical composition using linear programming, factor analysis and chemical leaching studies. Time-series analysis and statistical testing.

EDUCATION: University of Minnesota, 1979, B. S. Geology (with honors)
Oregon State University, 1986, Ph.D. Geological Oceanography

Selected Publications:

Finney, B. P. and Johnson, T. C. (1991). Sedimentation in Lake Malawi (East Africa) during the past 10,000 years: a continuous paleoclimatic record from the southern tropics. Palaeogeography, Palaeoclimatology, Palaeoecology, 85: 351-366.

Finney, B. and Huh, C.A. (1989). History of metal pollution in the Southern California Bight: An update. Environ. Sci. Technol. 23: 294-303.

Finney, B., Lyle, M. and Heath, G.R. (1988). Sedimentation at MANOP Site H (Eastern equatorial Pacific) over the past 400,000 years: Climatically induced redox variations and their effects on transition metal cycling. Paleoceanography 3: 169-189.

Halfman, J. D., Johnson, T. C. and Finney, B. P. (1994). New AMS dates, stratigraphic correlations and decadal climatic cycles for the past 4 ka at Lake Turkana, Kenya. Palaeogeography, Palaeoclimatology, Palaeoecology, 111: 83-98.

Finney, B. P., Gardner, D. G. and Edwards, M. E. (1993). Late Quaternary climate change in Interior Alaska: Clues from reconstructing lake-level changes. EOS, 74: 332-333.

Finney, B. P. and McNeil, S. (1996). Sedimentary stable nitrogen isotopes in salmon systems: A tool for reconstructing long-term records of salmon abundance. Submitted to Canadian Journal of Fisheries and Aquatic Sciences.

Terry Bendock
Alaska Department of Fish and Game
Sport Fish Division
34828 Kalifornsky Beach Rd, Suite B
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EMPLOYMENT:

April 1985 to present: Research project supervisor for the Sport Fish Division of ADF&G in Soldotna, Alaska. Acted as senior biologist on several research projects, investigating juvenile salmon seasonal abundance and habitat preferences, hook and release mortality of chinook salmon in the Kenai River recreational fishery, and contributions of wild stocks of chinook salmon to mixed-stock marine harvests in the waters of Cook Inlet using coded-wire tag methods. As project leader, was responsible for all aspects of project development, implementation, analysis and reporting. Supervised other research project biologists investigating both resident and anadromous species in Kenai Peninsula waters including chinook and coho salmon, rainbow trout, lake trout and Dolly Varden. Assist with the development of research objectives, priorities, and protocols.

May 1980 to April 1985: North Slope area biologist for the Sport Fish Division of ADF&G in Fairbanks, Alaska. Responsible for conducting impact assessment studies on Alaska's North Slope with emphasis on drainages and stocks in the vicinity of the Trans-Alaska Pipeline Corridor and the Colville River drainage. Conducted lake and stream inventories, investigated seasonal movements, overwintering behaviors, food habits and age and growth characteristics of numerous resident species and anadromous Dolly Varden char.
Reviewed best management practices and permit applications for ADF&G's authority under Title 16 in all North Slope waters.

March 1978 to May 1980: Special project biologist for the Sport Fish Division of ADF&G in Fairbanks, Alaska. As an ADF&G research biologist, fulfilled a 2-year contract with the U.S. Fish and Wildlife Service to catalog and inventory all lakes and streams within the boundaries of the National Petroleum Reserve, Alaska, from the Colville River south to the continental divide.

May 1975 to March 1978: Special project biologist for the Sport Fish Division of ADF&G in Fairbanks, Alaska. As an ADF&G research biologist, fulfilled a 2-year OCS contract with NOAA. to investigate the composition and distributions of freshwater and anadromous fish along nearshore coastal waters in the Beaufort Sea.

June 1974 to May 1975: Biologist for the Sport Fish Division of ADF&G in Fairbanks, Alaska. Assigned to the Joint Fish and Wildlife Advisory Team during construction to the trans-Alaska pipeline. Responsible for permit compliance and on-site reviews of all stream crossings between Yukon River and Delta Junction, Alaska.

EDUCATION:

1973 Bachelor of Science, Biology, University of Alaska, Fairbanks.

APPLICABLE PUBLICATIONS / REPORTS:

Bendock, T., and A. Bingham. 1988a. Feasibility of estimating winter distribution and habitat preference for juvenile salmonids in the mainstem Kenai River, Alaska, 1986-1987. Alaska Department of Fish and Game, Fishery Data Series No. 38, Juneau, Alaska, USA. 33pp.

Bendock, T., and A. Bingham. 1988b. Feasibility of estimating winter distribution and habitat preference for juvenile salmonids in the mainstem Kenai River, Alaska, 1987-1988. Alaska Department of Fish and Game, Fishery Data Series No. 70, Juneau, Alaska, USA. 55pp.

Bendock, T. 1988. Summary and recommendations from Kenai juvenile studies. Alaska Department of Fish and Game, Soldotna, Alaska, USA. 28pp.

Bendock, T. 1989. Lakeward movements of juvenile chinook salmon and recommendations for habitat management in the Kenai River, Alaska, 1986-1988. Alaska Department of Fish and Game, Fishery Manuscript Series No. 7, Juneau, Alaska, USA. 40pp.

Bendock, T. 1993. It's wake-up time on the Kenai River. Alaska's Wildlife. Vol 25, No 3. May-June 1993.

Bendock, T. and K. Vaught. 1994. Feasibility of using sonar to estimate adult coho salmon returns to the Kenai River. Alaska Department of Fish and Game, Fisheries Data Series No. 94-50, Juneau, Alaska, USA. 26pp.

Bendock, T. 1995. Marking juvenile chinook salmon in the Kenai River and Deep Creek, Alaska, 1993-1994. Alaska Department of Fish and Game, Fisheries Data Series No. 95-17, Juneau, Alaska, USA. 21pp.

Stan R. Carlson
Alaska Department of Fish and Game
Commercial Fisheries Management and Development Division
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EMPLOYMENT:

January 1993 - present: Biometrician for the Alaska Department of Fish and Game, Limnology Section, Commercial Fisheries Management and Develop Division, Soldotna, Alaska. Supervised by Dr. Dana Schmidt. Conduct statistical data analyses to evaluate factors that affect dynamics of the biota in lake ecosystems. Design limnological experiments and determine methods to estimate zooplankton and salmon abundance. Develop and approve methods to estimate hatchery contributions to the fishery. Develop, review, and conduct statistical analyses for projects related to the impact of oil on commercial fishery species. Provide biometrical consulting to area and regional biologists and statewide limnologists.

November 1991 - January 1993: Mathematical Statistician for the National Marine Fisheries Service, Auke Bay Laboratory, Juneau, Alaska. Supervised by Mr. Steven Ignell. Conduct statistical studies on community attributes of pelagic fauna in the north Pacific Ocean. Provide biometrical consulting, technical editing, and collaborative input on projects such as salmon bycatch and climate change studies.

January 1989 - May 1991: Statistics Teacher, Experimental Statistics Department, New Mexico State University, Las Cruces. Supervised by Dr. Michael Ames. Instruct laboratory courses in statistics for undergraduate science majors.

May - August 1990: Research Specialist (statistician), Department of Entomology, Plant Pathology, and Weed Science, New Mexico State University. Dr. Ellis Huddleston, Supervisor. Provide statistical modeling, analysis, and design of experiments related to agricultural field studies and pest management programs.

May - December 1988: Field Biologist, Biology Department, New Mexico State University. Supervised by Mr. Roger Skaggs. Conduct field population surveys and habitat analyses of night birds in Lincoln National Forest, New Mexico. Collect field data, supervise field personnel, and maintain data records. Develop operational strategies and conduct follow-up statistical estimation procedures.

August 1985 - June 1988: Graduate Assistant, Biology Department, New Mexico State University. Supervised by Dr. Ralph Raitt and Dr. Walt Whitford. Teach undergraduate biology and zoology laboratory courses. Collect data and maintain field ecology experiments for ecological research programs. Develop and conduct original field research on desert insect ecology.

June 1983 - May 1985: Research Specialist, Gordon Environmental Studies Laboratory, University of Montana, Missoula. Supervised by Dr. Philip Tourangeau. Manage data, conduct quality assurance/control procedures, and perform statistical analyses for environmental science projects. Aid in the design and implementation of field research, primarily in the area of pollution biomonitoring.

EDUCATION:

1991 Master of Science, Experimental Statistics, New Mexico State University.
1988 Master of Science, Biology (ecology), New Mexico State University.
1983 Bachelor of Arts, Environmental Biology, University of Montana

Gary Kyle
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Experience:

April 1977 - April 1988: Project Biologist and later Area Biologist for the Division of Fisheries Rehabilitation, Enhancement, and Development of the ADF&G in Soldotna Alaska. Conducted and evaluated various fisheries enhancement and evaluation projects in the Cook Inlet watershed including limnological investigations of sockeye salmon producing lakes, and evaluation of hatchery stocking programs. Also, during the period

I served as a project limnologist for the Limnology Section which involved the collection, analysis, and interpretation of limnological data from sockeye nursery lakes for assessment of rearing capacity and for modeling purposes.
April 1988 - present: Regional Limnologist for the Limnology Section for ADF&G in Soldotna, Alaska. Supervised by Dr. Dana Schmidt. As the Regional Limnologist for the Southcentral Region comprising of the Interior, PWS, Cook Inlet, and Alaska Peninsula; the primary purpose of this position is the supervision of staff in the coordination, assignment, prioritization, analysis, and review of subordinates work and interagency contract work related to lake fertilization and stocking projects, water quality monitoring projects, and fisheries and limnological research. In addition, the position is responsible for training subordinates, reporting and review of project results for publications and meetings, and administrating state and non-state (contract) budgets.

Education:

1975 Bachelor of Science, Life Science/Natural Resources, University of Wisconsin.

Publications:

A total of 41 technical reports, 10 journal manuscripts, 26 formal presentations, and 6 magazine articles dealing with adult sockeye production, lake fertilization, lake stocking, and in-lake assessments of juvenile sockeye production.

LITERATURE CITED

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

Budget Category:	Authorized FFY 1996	Proposed FFY 1997	LONG RANGE FUNDING REQUIREMENTS					
			Estimated FFY 1998	Estimated FFY 1999	Estimated FFY 2000	Estimated FFY 2001	Estimated FFY 2002	
Personnel		$74.3						
Travel		$2.8						
Contractual		$38.9						
Commodities		$6.9						
Equipment		$0.0						
Subtotal	$0.0	$122.9						
General Administration	$0.0	$13.9						
Project Total	$0.0	$136.8	$100.0	$0.0	$0.0	$0.0	$0.0	
Full-time Equivalents (FTE)		1.4						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments:

This project will provide for an initial year of field data collection of the different trophic levels of the Kenai River mainstem ecosystem and selected tributaries. These data will be used to complement existing work on the lake ecosystems, to understand the role of carcass nutrients in maintaining current levels of productivity in the Kenai River.

This FY97 budget submittal reflects a logical extension of the overescapement studies on the Kenai River. This program, however, is not dependent upon data or analysis collected in 97258, although the program was developed based on observations and analysis conducted under the overescapement program. The budget submitted reflects manpower contributions from two divisions of ADF&G, who will work cooperatively in completing this project. The stable isotope analysis and other technical assistance will be provided through Dr. Bruce Finney of the University of Alaska in Fairbanks through a non-competitive RSA. The project is planned for two years, with the first year reflecting detailed study design development and data collection. FFY98 will entail sample processing, data analysis and report writing.

1997

Prepared:

Project Number:97239
Project Title: Kenai salmon carcass nutrient investigation
Agency: ADF&G

FORM 3A
TRUSTEE
AGENCY
SUMMARY

4/16/96

1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1996 - September 30, 1997

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FFY 1997
PCN 115041-DS	Principal Investigator-DS-Limno III	21K	0.0	7		0.0
PCN 115038-GK	Reg. Limnologist III-GK	19K	0.0	7		0.0
PCN 117030-SC	Biom II -SC	19C	1.5	6		8.6
PCN 115086-JE	Limnologist I -JE	17K	1.0	6		5.8
PCN 113587-MS	Tech III-MS	11E	1.0	4		3.6
FB I-Limnology-4 positions	Lab staff-Sample analysis & field collection	14J	8.0	5		37.0
Tech III-Limnology-3 position	Lab staff-sample analysis	11E	3.0	4		10.8
FBI-Kenai SPFD-2 positions	FBI field data collection	14E	2.0	4		8.5
				4		0.0
				3		0.0
				5		0.0
				6		0.0
	Subtotal		16.5	59.1	0.0	
					Personnel Total	$74.3

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FFY 1997
Travel to and From Anchorage-workshop 1-T. Bendock	0.12	1	5	0.1500	0.9
Travel to and From Anchorage-workshop 2-D.Schmidt(see 97258)	0	0	0	0.1500	0.0
Travel to and From Anchorage workshop 2-J. Edmundson	0.12	1	2	0.1500	0.4
Travel to and From Anchorage workshop 2 B. Finney	0.2	2	7	0.1500	1.5
		0	0	0.1500	0.0
		0	0	0.1500	0.0
		0	0	0.1500	0.0
		0	0	0.1500	0.0
		0	0	0.1500	0.0
		0	0	0.1500	0.0
					0.0
					0.0
				Travel Total	$2.8

1997

Prepared:

Project Number: 97239
Project Title: Kenai salmon carcass nutrient investigation
Agency: ADF&G

FORM 3B
Personnel
& Travel
DETAIL

4/16/96

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

Contractual Costs:		Proposed
Description		FFY 1997
Rept	Long distance telephone and toll costs 10 months @ $100, copying and binding- 50 copies @ $10)	$1.1
Rept	Computer equipment repair (1 hard drives @ $500, one motherboard @ $1.0)	$1.5
Rept	Postage (10 months @ $50), photo processing (5 rolls @ $20), messenger service ($0.1)	$0.8
Field	Film processing and purchasing	$0.1
	Vehicle repair	$0.2
Field	Auto equip & parts	$0.2
RSA	Contract for stable isotope analysis- University of Alaska IMS $.1/sample x 350 samples	$35.0
When a non-trustee organization is used, the form 4A is required.	**Contractual Total**	$38.9

Commodities Costs:		Proposed
Description		FFY 1997
Rept	Office supplies-Paper ($.25), Xerox supplies and computer printer supplies ($.25)	$0.5
Rept	Laboratory glassware ($.5), chemical reagents ($1)	$1.5
	Field sampling gear, invertebrate nets (.25) backpack shocker repair, parts (.5)	$0.8
Rept	Photographic supplies - camera parts and film	$0.1
	Stationery ($.2) and duplicating supplies - xerox toner-supplies ($.4)	$0.6
Field	Raingear, hip boots and gloves for 4 people @ $250	$1.0
Field	Food (60 man days @ $15/day)	$0.9
Field	Flotation coats for 2 people @ $250	$0.5
Field		
Field	Fuel costs- all vehicles and vessels	$1.0
	Commodities Total	$6.9

1997

Project Number: 97239
Project Title: Kenai salmon carcass nutrient investigation
Agency: ADF&G

FORM 3B
Contractual & Commodities DETAIL

Prepared:

4/16/96

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

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FFY 1997
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			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
Optical Plankton Counter-with winch and towing body	1	ADF&G
boats, metal hull	2	ADF&G
boats, rubber	2	ADF&G
motor, outboard	5	ADF&G
acoustic sounder	1	ADF&G
oscilloscope	3	ADF&G
Innoculator, air inject	3	ADF&G
freezer	1	ADF&G
recorder, dat	3	ADF&G
computer	4	ADF&G
radio/location equip	3	ADF&G

1997

Project Number: 97239
Project Title: Kenai salmon carcass nutrient investigation
Agency: ADF&G

FORM 3B
Equipment
DETAIL

Prepared: 4/16/96

Clam Recruitment: Investigation of Settlement Limitation and Mechanisms Related to Successful Recruitment

Project Number: 97240

Restoration Category: Research

Proposer: Dr. Gail Irvine, National Biological Service, DOI

Lead Trustee Agency: Department of the Interior
Cooperating Agencies:

Alaska SeaLife Center: Yes

Duration: FY 97 start, 5 year project

Cost FY 97: $237,900

Cost FY 98: $250,000

Cost FY 99: $200,000

Cost FY 00: $200,000

Cost FY 01: $100,000

Geographic Area: Prince William Sound

Injured Resource/Service: Clams, subsistence

ABSTRACT

This project proposes, as a companion to the Nearshore Vertebrate Predator Project, to examine whether clams are settlement and/or recruitment limited and to determine what environmental and ecological factors promote successful recruitment. Clams are very highly preferred prey of sea otters and some sea ducks, and, their recovery from the *Exxon Valdez* oil spill is unknown. This project also has created linkages to the SEA project and should support restoration activities aimed at increasing local populations of clams for subsistence.

INTRODUCTION

The *Exxon Valdez* oil spill (EVOS) profoundly affected nearshore biological (including cultural) communities. These effects are defined by deaths, injuries, altered interactions, genetic and physiological abnormalities, alteration of subsistence patterns and continued concern among subsistence users regarding tainting of resources (EVOS Trustee Council [EVOSTC], 1993). The stranding of large volumes of oil in the intertidal resulted in myriad effects on the nearshore communities that cascaded through the food web via altered interactions and altered strengths of interactions (Highsmith et al., 1994). The Nearshore Vertebrate Predator (NVP) project has focused on the apparent lack of recovery of four apex vertebrate predators active in the nearshore (invertebrate feeders: sea otters, harlequin ducks; fish eaters: river otters, pigeon guillemots). Several hypotheses are being considered to explain the lack of recovery of these predators: 1) recruitment limitation of prey, 2) demographic effects, 3) initial and/or residual oiling of benthic habitats and benthic prey (e.g., clams, mussels), and 4) prey availability and competition for prey. The NVP and other EVOS projects have focused on what factors are constraining recovery of injured species, and this frequently involves examination of which mechanisms regulate populations. As the restoration process has developed, the emphasis has shifted away from single species studies to broader interactive or ecosystem studies that integrate environmental and ecological factors that may be influencing the recovery of injured species. In addition, increasing interest is being focused on nearshore areas.

This project, designed to be a companion project to current NVP studies, and a bridge to the Sound Ecosystem Assessment (SEA) project, focuses on the invertebrate prey of the NVP predators, especially clams. This project also will provide information useful in clam restoration activities. The primary questions focus on:

1) Are these populations settlement and/or recruitment limited?

2) What factors favor recruitment (i.e., what conditions create good years and bad)?

The NVP project is examining the dynamics of the interaction between sea otters and clams (their most preferred prey), and is indirectly assessing recruitment patterns of clams through analysis of the age/size structure of the populations (Fig.1). Preliminary sampling of subtidal clams has revealed low densities in the micro-habitats thus far examined. If this pattern continues, the age-structure of the population will be more difficult to determine. This proposal addresses the interaction of larval supply and recruitment directly, to ask if larval supply and/or recruitment are limiting clam populations in Prince William Sound.

Determining which factors favor recruitment will be examined in concert with SEA investigators. This project is conceptually linked to the SEA project, in that both seek to understand how oceanographic conditions are related to the development and success of biological communities, whether pelagic or benthic. Planned cooperation with SEA researchers will allow extension of measurements (temperature, salinity, nutrients,

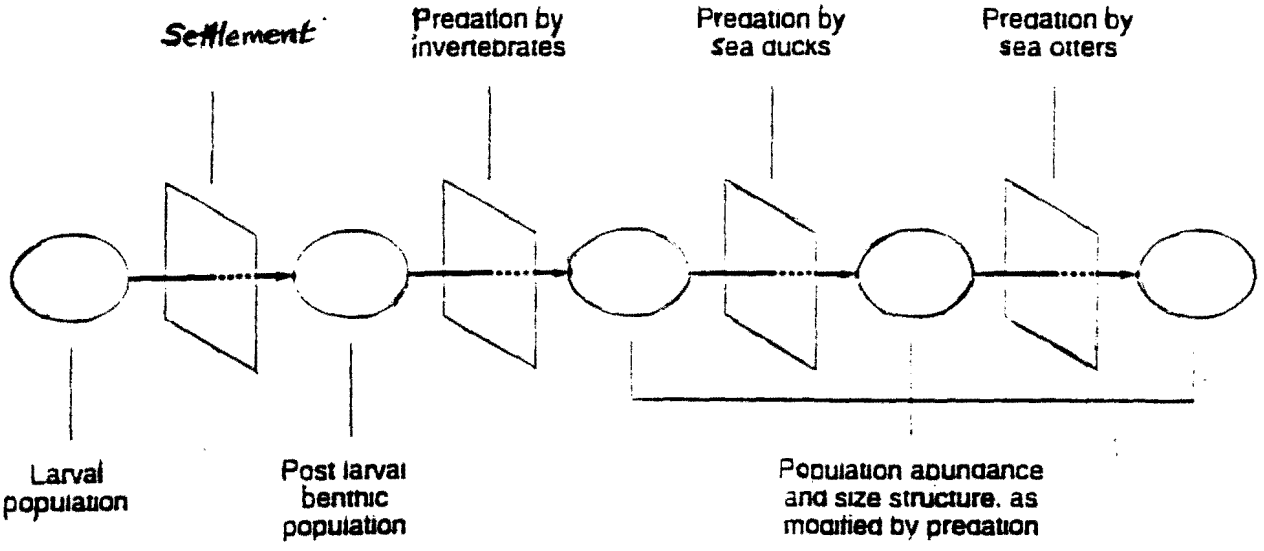


Fig.1 Theoretical "filters" that influence invertebrate prey size structure.

(Nearshore Vertebrate Predator Project diagram)

chlorophyll, etc.) into nearshore areas adjacent to at least one Prince William Sound Aquaculture Corporation (PWSAC) hatchery. Cooperative analysis of data is also planned, including modelling nearshore coupling of phytoplankton and zooplankton. Central elements of this proposal include analysis of larval patterns across Prince William Sound through analysis of a subset of nearshore plankton samples taken by the hatcheries, coupled with plankton samples collected via an alternative method (passive settlement traps) year round, and plankton samples taken at NVP sites.

A contrasting situation occurs at Glacier Bay National Park: dense beds of clams and no sea otters. Relationships between adult clam densities and larval abundances will be examined there (without EVOS funds) and compared with the case for western Prince William Sound.

NEED FOR THE PROJECT

A. Statement of the Problem

This project is designed to address the lack of recovery of nearshore ecosystems by addressing issues complementary to the Nearshore Vertebrate Predator Project and SEA. Although the various invertebrate prey of the NVP predators are being examined, greater focus is on clams. Within Prince William Sound, clams in the family Veneridae (*Saxidomus giganteus, Protothaca staminea*) are the most highly preferred prey of sea otters (Calkins, 1978; VanBlaricom 1987, 1988; Garshelis et al., 1986; Doroff and Bodkin, 1994) and also figure prominantly in the diets of white-winged scoters (Sanger and Jones, 1982; Vermeer and Bourne, 1982) and to a lesser extent the diets of surf-scoters and black scoters (Esler, pers comm; Fig. 2). As outlined above, the focal question is whether recruitment is limiting clam populations, and, through the NVP, whether low abundances of clams are limiting the recovery of sea otter.

Clams are listed in the *Exxon Valdez* Trustee Council publication (EVOSTC, 1996; Table 1) as an injured resource whose recovery is unknown. In that same publication, on page 34, the injury is stated: "Littleneck clams and, to a lessser extent, butter clams were killed or suffered slower growth rates as a result of the oil spill and clean-up activities." Houghton et al. (1993a, b) found fewer littleneck clams (*Protothaca staminea*) at oiled and high-pressure hot water washed sites than at control and oiled sites; Jewett et al. (1994) found fewer butter clams (*Saxidomus giganteus*) at oiled sites. Trowbridge et al. (1996) in intertidal transect studies of clams, found that growth rates of littleneck clams decreased as the level of aromatic hydrocarbons increased.

B. Rationale/Link to Restoration

This study would directly address one of the mechanisms given high research priority in the workshop conducted by the EVOSTC in April 1994 (EVOSTC, 1994), namely, that recruitment limitation could be constraining recovery of both intertidal and subtidal organisms.

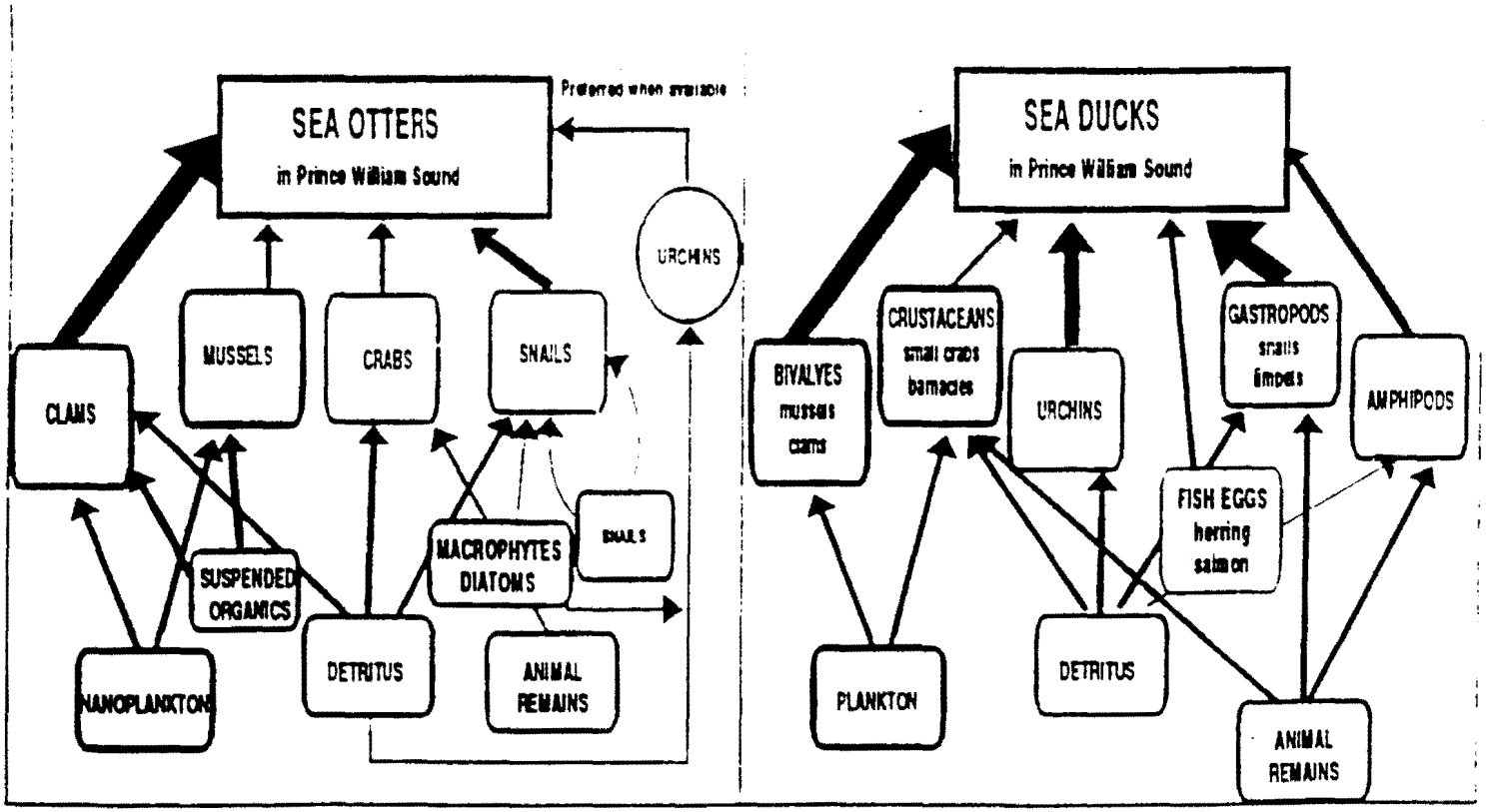


Figure 2: Prey Relations of Two Nearshore Vertebrate Predator groups, Sea Otters and Sea Ducks

Through coordination with the SEA project, another high research priority, the effect of climate/oceanography will be addressed (see Project Design: Objectives and Methods).

The NVP project is interpreting recruitment processes indirectly through the age/size structure of various of the invertebrate prey of the selected vertebrate consumers. The invertebrates chosen for focus include both intertidal and subtidal clams, mussels, and sea urchins. Preliminary investigations of the subtidal clams have indicated that these clams seem to be rare. If these preliminary low abundances of subtidal clams are borne out by further sampling, then additional concerns are raised regarding the dynamics of the populations. One concern directly focused on by this proposal is whether larval suppply and recruitment limit clam populations. Secondarily, if otters begin recovering in the more heavily oiled areas, will the clam populations become even further depressed, so that the low numbers of adults increase the likelihood of larval and recruitment limitation?

Direct restoration of intertidal clam populations near villages for the enhancement or replacement of subsistence resources is the object of Shellfish Restoration Project (96131). Littleneck clams (*Protothaca staminea*) are being bred, raised through the larval stages to small juveniles at the Qutekak shellfish hatchery in Seward, with plans for transplantation to appropriate habitat near villages. Increased understanding of what conditions lead to successful recruitment of clams would aid the success of this restoration effort.

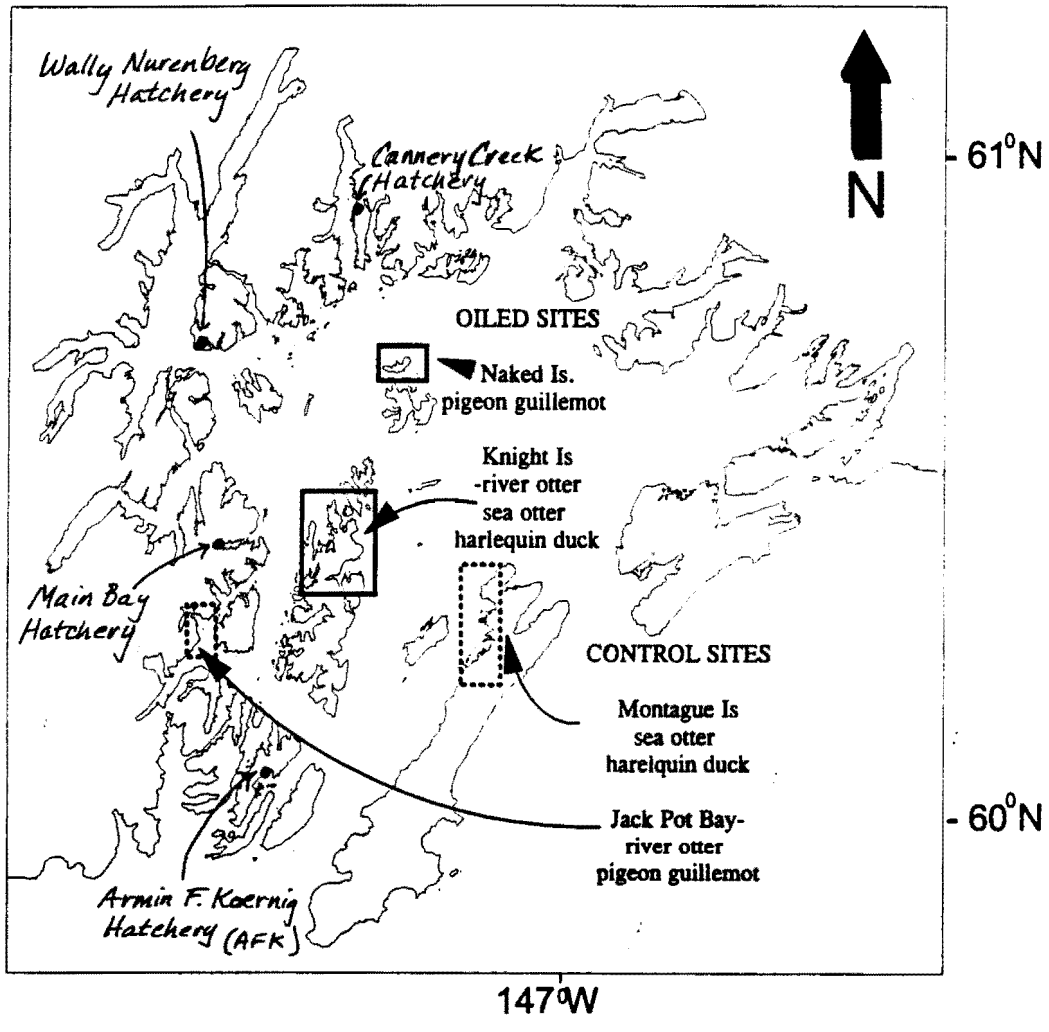
C. Location

Study sites (Fig. 3) will be coincident with the NVP, and include both random and selected sites in Northern Knight Island (Herring Bay and Bay of Isles) and Montague Island. Additional sites will occur adjacent to the Prince William Sound Aquaculture Association Hatcheries (Cannery Creek, Wally Nurenberg, Main Bay, and A. F. Koernig). Because of the broad array of the sites, the project's benefits are likely to be realized across Prince William Sound. Communities that may be affected by the project include Tatitlek, Port Graham, Nanwalek, Chenega Bay, and Ouzinkie (all the focus of the Clam Restoration Project).

COMMUNITY INVOLVEMENT

Community involvement will occur through planned interactions with various of the villages where shellfish restoration efforts are planned, and with the Quetekak Shellfish Hatchery in Seward. Discussion with several of these Local Community Involvement Facilitators occurred at the recent work session for the development of protocols for indigenous and local knowledge research in the EVOS Restoration process. Further discussion and coordination is needed to identify the best linkages between this project, the Shellfish Restoration Project and the NVP. We plan on visiting the hatchery as one of our first steps. Their raising of *Protothaca* and other bivalve species will assist us in our identifications of larvae.

Figure 3. Location of "oiled" and "control" study sites for NVP



PROJECT DESIGN

A. Objectives

General objectives of this study are stated as follows:

1. Measure and compare larval abundances of clams and other NVP invertebrate prey at NVP sites and at PWSAC hatcheries.

2. Compare larval abundances and temporal patterns of abundances of clam larvae with recruitment at NVP sites.

3. Compare abundances of larval clams with adult densities of clams at NVP sites in PWS and in a companion study (non-EVOS funded) at Glacier Bay National Park.

4. Examine coupling of physical oceanographic parameters with phytoplankton and zooplankton blooms and abundances of benthic invertebrate larvae (in conjunction with Drs. Peter McRoy, Dave Eslinger and Ted Cooney).

B. Methods

This project is addressing the following hypotheses:

H1: Clam populations are being limited by larval supply and/or recruitment.

H2: The abundance of clam larvae is related to the abundance of adults (i.e., the low clam densities in PWS are correlated with lower larval abundances than in the more densely populated clam beds of Glacier Bay National Park and Preserve).

H3: The abundance patterns of larvae in the water column are correlated with oceanographic conditions and/or phytoplankton blooms.

A) Nearshore primary production patterns are determined by oceanographic conditions (stratification, nutrients, etc.; cooperative SEA element)

B) Larval success is tied to effective coupling of phytoplankton blooms and larval development (cooperation by SEA)

C) The type of primary production pattern influences the success of larval invertebrates.

1) When phytoplankton blooms are short in duration, but of high intensity, carbon is transferred primarily to the benthos, resulting in high growth rates of the invertebrates, but more limited

success of larval forms (only those tightly coupled to the bloom are successful).

2) When phytoplankton blooms set up more gradually, with resetting by wind events, so that the bloom is of lesser magnitude but longer duration, larval success is increased for species with longer development times and/or periodic production of larvae.

The methods used to test each of these hypotheses are given below, as well as details of the proposed study sites, data sets and statistical procedures.

H1: Clam populations are being limited by larval supply and/or recruitment.

Determining whether clams are being limited by larval supply or recruitment depends on determining not only the relationship between larval densities and settlement densities, but densities at later stages. Mechanisms can then be inferred based on the pattern of the relative abundances, although experimental manipulations would be preferred (Table 1). Knowledge of the dynamics of the clam populations is important, e.g. age structure, predation rates, competitive interactions, interactions of the clams with particular habitat characteristics, larval supply through time, settlement rates, post-settlement mortality rates, and recruitment rates (see reviews by Connell, 1985; Olafsson et al., 1994). The proposed project is designed to interface closely with the NVP project, where a number of the afore-mentioned factors are being addressed.

Age structure of the populations is being assessed from current NVP sampling, and the initial intention was that analysis of the age structure would indicate when, and with what pattern past recruitment events occurred. The scarcity of clams in the preliminary sampling provided the impetus to seek a more direct method of assessing whether these populations are settlement or recruitment limited. Thus, this project adds a direct component to the NVP, the measurement of larval supply rates to the study areas, and across the Sound.

We also propose to analyze the age/size structure for a collection of dead clam shells collected by Glenn VanBlaricom in areas that had been uplifted by the 1964 earthquake. Approximately 200 0.25m^2 quadrats were sampled. Data were gathered between 1978 and 1984 at Gibbon Anchorage on Green Island; some data were also collected near Cordova during the same time period. Although this is not pre-otter (Lensink, 1962), it is probably before the peak abundance of otters, which may have occurred in the middle or late 1970s (Estes et al., 1981; A. Johnson, pers comm; as cited by VanBlaricom, 1988). These clams will provide a pre-spill reference for aspects of clam population structure. Although patchy in their distribution, these clams, when encountered, had densities well in excess of 10 clams/m^2, compared to the preliminary densities from 1995 of approximately 2.7-3.2/m^2. Almost every quadrat contained members of the genera *Saxidomus*, *Protothaca*, and *Macoma*. Occasional individuals of *Mya, Tresus,* and *Hiatella* occurred. The 1995 suction-dredge samples also found some of these same genera (*Saxidomus, Protothaca, Macoma,* and *Mya*), but in much reduced abundances.

Table 1. Interpretations of Process based on Observed Densities

	Larval Availability	Settlement Density	Recruitment Density		Adult Density
			New recruits	Juveniles	
1.	Low	Low	Low	Low	Low
2.	Low	Low	Low	Low	High
3.	High	High	Low	Low	Low
4.	High	High	High	Low	Low/High
5.	High	High	High	High	Low

1. Larval supply likely limiting, even though predation may also be acting to keep accumulation of adults low.

2. Slow accumulation of adults into the population; age structure may reveal periodic high recruitment. Larval supply/recruitment probably limiting the adult population. Adults with apparently little predation pressure.

3. Adult population being limited by early post-settlement mortality.

4. Adult populations could be limited by competition, predation resulting in low adult density. High adult densities could be achieved by gradual accumulation through time.

5. Adults being limited by predation, competition, or disturbance.

Note: Certainly many other possible combinations exist; these were considered to be reasonably likely cases.

Predation rates on clams are being approached in the NVP project in two ways: 1) through observations of sea otter foraging, and 2) through analysis of predatory activities of invertebrate predatory sea stars (termed copredators in the NVP project). Competition is viewed as being presently unimportant, given the low densities of the clams thus far encountered. The relationship with different habitat types will be assessed through the systematic sampling design laid out for the NVP sites (see NVP 97 Detailed Project Description [DPD]). Basically, the shallow-water habitat of the selected study areas has been delineated into habitat types by side-scan sonar conducted in 1995. This has allowed for stratification of sampling by habitat type.

The sites being studied by the NVP include a series of oiled and control sites. For the clam and otter studies, oiled sites include Herring Bay and Bay of Isles on the northern part of Knight Island, and control sites along the northwestern coast of Montague Island. A series of sites that have been selected systematically, with a randomized element, have been chosen for sampling by all of the various NVP invertebrate prey study units (details are presented in the 1997 DPD for the NVP project). Some subunits will also add sites of particular interest for intensive study. This study will use the same set of "universal" study sites as the subtidal clam component of the NVP.

A critical companion study being conducted by the University of Washington NVP investigators is a study of recruitment of clams. This is being accomplished by analysis of core samples, sieved after collection through a 0.5 mm screen. Small bivalves are being identified and enumerated. Additionally, some settling tray experiments are being conducted by these same investigators to examine the influence of post-settlement mortality.

This proposal adds the assessment of larval supply into the same study areas through the deployment of plankton tubes (Yund et al., 1991), which passively collect plankton as they drop through the water column. These tubes will be set out near the substrate, since we are interested in larvae that are close to settling. The great advantage of the plankton tubes is that they allow an integration of the larval supply over a period of time, versus the brief snapshots that are gained by net plankton tows. Settlement into the tubes will be affected by the amount of water moving over the opening, thus some measure of water flow is important. An approximate measure of the total water flow is gained by measuring the erosion of dental stone blocks attached to each sampling unit; differences between and among tubes can then be compared. These plankton tubes have been tested for hydrodynamic considerations in flow tanks, and have been used in ecological studies of larval supply and recruitment rates in several locations (Yund et al, 1991; Wittman and Arnold, 1989; Bertness et al, 1992). Somewhat similar traps (although almost buried into the substrate) were used in a study of clam recruitment into various habitat types in North Carolina (Wilson, 1990).

One potentially challenging area is the ability to identify species or species groups of various larval invertebrates, including clams. In Wilson's study of clam settlement in North Carolina, he was able to identify down to the level of the family (for Venerids; C. H. Peterson, pers. comm., 1996). Both *Protothaca* and *Saxidomus* are Venerids. The successful rearing of

Prothaca by the Qutekak shellfish hatchery in Seward should allow us to discriminate *Protothaca*, given sufficient variables in the development of the various bivalve species. The hatchery has plans to rear other bivalves as well: *Clinocardium* and perhaps *Saxidomus*. We will coordinate with them to facilitate study cooperation, and will propose to rear *Saxidomus* this coming year at the hatchery, if they are not yet ready to do so. If that is not possible, due to space considerations, we would propose to use the IMS facilities at Seward. We propose to use the Seward Sea Life Center, after its completion, for further larval studies.

At the present, we do not know how much variation we are likely to encounter in larval abundances, therefore it is difficult to plan the a statistical design based on knowledge of variation. Some preliminary data will be gathered in 1996 that should allow more precise study design.

A first step in planning experiments and sampling is knowledge of the of spawning behavior and larval periodicity of the target species. Preliminary analysis of some hatchery plankton samples and test plankton tube samples planned for the summer of 1996 should provide information about when clam larvae are in the plankton. Information from Strathmann (1987) indicates that *Protothaca* breed possibly from April to July, although there are reports from various sites in the northwestern United States and British Columbia, Canada, of spawning through late September, and in another locale, in January. Larval development from spawning to settlement at the Qutekak Shellfish hatchery is reported to be one month. Ken Coyle (pers. comm, 1996), at the University of Alaska, recalls numerous bivalve larvae in plankton samples in June-July in southeast Alaska. *Saxidomus* reportedly breed from spring through summer, veliger larvae develop after two weeks, and feed in the plankton for four weeks more before settlement (Strathmann, 1987). We have no local information for *Saxidomus*.

Sampling of larval abundances related to the question of settlement or recruitment limitation of clam populations is planned to occur at NVP sites, using, as mentioned above, the sites selected by the NVP project. A random design will be used to determine where specific plankton traps will be deployed. At present, without further information about the variability of larvae, we plan to place 8-10 plankton tubes per site. These samples will provide a measure of within-site variability of the larval assemblages through time, and oiled sites can be compared statistically with control sites using ANOVA and time series analyses. Setting up a similar array of plankton samplers at the AFK and WHN hatcheries in 1997 will allow comparative sampling between the NVP and hatchery sites, and linkage of SEA and NVP data.

Sampling at NVP sites is anticipated for April, June, July, August, and September. Plankton traps will be deployed in April, resampled in June, July, August, and pulled in September. Cruises initiated by this proposal are planned for April and September; other sampling will piggyback on NVP cruises. Plankton samples will be filtered through both through a 250 micrometer mesh screen (to match plankton sampling by net tows at the hatcheries) and a 45 micrometer mesh screen, to enable capture of small larvae. Samples will be fixed in 10% buffered formalin, and changed, at the earliest time possible, to 70% isopropyl alcohol, to reduce deterioration of larval shells. Samples will be analyzed by the University of Alaska

(Ted Cooney's lab) and NBS.

H2: The abundance of clam larvae is related to the abundance of adults.

The logic behind this hypothesis, is that a low abundance of adult clams may result in a low supply of larvae, and that larval supply might be limiting recruitment into the population. Given that organisms with planktotrophic larvae (small larvae that feed in the plankton during their often lengthy stays there) often produce huge numbers of larvae, low adult numbers might not be considered a likely limitation on subsequent recruitment. Given also, that larvae spend a considerable amount of time in the plankton, it might be difficult to ascertain that the larvae settling in an area are related to the resident adults. Local water movement patterns coupled with larval behavior (e.g., vertical migration) can affect the retention of larval forms in an area. If we were to assume that the larvae found in PWS came from the Sound, or from not too distant east of the Sound (larvae carried by the prevailing Alaska Coastal Current), then larval abundances relative to adult abundances could be compared between western PWS and an environment with a greater abundance of clams (Glacier Bay NP). In a parallel study (funded with non-EVOS monies), larval abundance and settlement will be examined in Glacier Bay, where a number of dense clam beds occur (J. Bodkin, pers comm, 1995).

The information needed to support investigation of this relationship in PWS would be gathered already in support of H1studies.

H3: The abundance patterns of larvae in the water column are correlated with oceanographic conditions and /or phytoplankton blooms.

Patterns of larval abundance and recruitment have been tied to mesoscale patterns in oceanographic conditions, such as upwelling events off the California coast (Roughgarden et al., 1988). The investigation of the importance of such mesoscale physical processes (e.g., currents, winds, frontal systems) forms the basis for the SEA project, with the success of juvenile herring and pink salmon hypothesized to be linked to whether PWS is operating as a "lake" or a "river". Such definitions of Sound status are related to the predominant physical forcing functions operating. The physical conditions, in turn, are determining the development of the planktonic assemblages and the relationships of those predators of large zooplankton and larval/juvenile fishes (SEA Draft Proposal, 1993).

Because such mesoscale physical forcing functions may figure importantly in the transport and success of benthic invertebrate larvae (meroplankton), we propose to examine the broad patterns in such larval abundances as related to various environmental variables such as sea temperature, salinity, phytoplankton blooms, and blooms of predominant zooplankton (e.g., copepods). This study would extend the examination of biological processes into the nearshore, and would effectively link into the SEA study by: sharing and coordinating physical oceanographic measurements, providing support to extend some measurements into

the nearshore and to extend measurements past the time (June) that they are currently taken, and analyzing complementary plankton samples taken by the Prince William Sound Aquaculture Association hatcheries. Ted Cooney has been analyzing the offshore plankton samples taken twice weekly (March through June) by the hatchery staff. We propose preservation and analysis of the nearshore samples, which the hatcheries use soley for settling volume. The focus of the analysis would be identification and enumeration of invertebrate larvae in the samples, with emphasis on the bivalves. A more complete integration with the SEA project would involve analysis of the copepods and other zooplankters as well. We propose this more complete analysis of the plankton samples for the AFK hatchery in 1997, since SEA will be taking both detailed physical and biological measurements there then.

Plankton tubes are an alternative sampling method, and in 1997, we propose also the test their effectiveness at the AFK hatchery. Since the hatcheries usually collect the plankton tows only from March through June (but note plan above to extend plankton tows at the AFK hatchery in 1997 through August), the deployment of plankton tubes in the nearshore areas of the hatcheries allows us to extend the sampling of larval forms year-round. The plankton traps integrate larval abundance through time and they can be deployed and left in place for periods of up to about 2 months (S. Gaines, pers comm). The resolution of the patterns will be enhanced by decreasing the amount of time that the tubes are deployed. Results of the plankton tube collections will be compared with the plankton net tow collections. The NVP sites can only by visited periodically, so plankton tube collections are a better means of determining the abundances of larval invertebrates through time at those sites. Therefore, we need to be able to use common methods at the NVP sites and at least some of the hatcheries in order to be able to compare and extend the results over a broader reach of the Sound. Thus, we propose a similar sampling pattern of deployment of plankton tubes at the AFK hatchery as at NVP sites, in order to be able to compare results, and especially, to be able to tie NVP data into the results of physical and biological oceanographic measurements being taken by SEA investigators (with some additional support by this proposal).

H3.A. Nearshore primary production patterns are determined by oceanographic conditions (stratification, nutrients, etc.).

This work will be done in cooperation with SEA investigators, notably Dr. Peter McRoy. Dr. McRoy and his students will be conducting intensive work at the AFK hatchery in 1997, measuring oceanographic parameters such as salinity and temperature measurements at particular depths, chlorophyll, carbon, nitrogen, dissolved oxygen, nutrients, phytoplankton abundances and composition, and taking zooplankton tows. We will provide support for continuation of this sampling through July and August, and for some additonal measurements in the nearshore.

H3.B. Larval success is tied to effective coupling of phytoplankton blooms and larval development.

This hypothesis will also be examined through cooperation with SEA researchers (especially Dr. Dave Eslinger). Dr. Eslinger has been modeling the coupling of phytoplankton and

zooplankton (primarily the large copepod zooplankters) for the SEA project. He is interested in examining the coupling of phytoplankton and zooplankton in the nearshore, and the larval invertebrates can be included as a subset of this analysis. It is for the development of this more complete picture that we are proposing a concentration of meshed activities at the AFK hatchery in 1997 and the complete analysis of the plankton tows taken there.

H3.C. The type of primary production pattern influences the success of larval invertebrates.

1. **When phytoplankton blooms are short in duration, but of high intensity, carbon is transferred primarily to the benthos, resulting in high growth of the benthic invertebrates, but more limited success of larval forms (only those with short development times and whose presence is tightly coupled to the bloom are successful).**

2. **When phytoplankton blooms set up more gradually, with resetting by wind events, so that the bloom is of lesser magnitude but longer duration, larval success is increased for species with longer development times and/or periodic production of larvae.**

These hypotheses will be examined by comparing larval abundances, their coupling with phytoplankton blooms and successful settlement/recruitment.

Under H3.C.1, carbon gets transferred to the benthos because the bloom is established quickly and intensely, may get shut off by nutrient limitation (although grazing may also be a factort), and much of the planktonic biomass cannot be efficiently used, therefore considerable production gets shunted to the benthic environments (T. Cooney, pers. comm.). There is some evidence that the spawning of several bivalve species has been triggered or correlated with dense algal suspensions, although temperature has also been implicated as a spawning trigger. Both *Protothaca staminea* and *Saxidomus giganteus* have been noted to spawn in response to dense algal suspensions (Robinson and Breese, 1982, as cited by Strathmann, 1987). The mussel, *Mytilus californianus*, has also shown a spawning response to dense algal suspensions (Robinson and Breese, 1982; Smith and Strehlow, 1983; both cited by Strathmann, 1987). Thorson (1946) presents information for several bivalve species, *Mya truncata* and *Saxicava arctica,* in East Greenlandic fjords where temperature had no relation to spawning, however spawning occurred on a large scale simultaneously with a sudden, heavy increase in phytoplankton. In order for the triggering of spawning by phytoplankton blooms to be effective for reproductive success, larval development times have to be short enough for the larvae to be able to take advantage of the bloom. Bivalve larvae can develop very quickly; Thorson (1946) gives examples of several species that produce free-swimming veligers within a few hours to several days following fertilization of the gametes. Thus, it is quite likely that some bivalve species, including clams, might show a tight coupling of spawning and rapidly increasing larval abundances with an intense phytoplankton bloom. Further selection for tight coupling to intense phytoplankton blooms might derive from the potential "rain" of

unconsumed carbon to the substrate, which could enrich the environment for newly settling larvae. Food-limitation has been suggested as a potentially limiting factor for new recruits or juveniles in soft-bottom habitats (see review by Olafsson et al., 1994).

The relative success of species with different patterns of larval development and timing with respect to the patterning of the phytoplankton bloom, will be examined within the context of NVP invertebrate prey (e.g., clams, mussels, echinoderms, crabs).

The relationship between growth rates of benthic invertebrates and the patterning of the phytoplankton bloom (predicted effect: greater growth in years with an intense phytoplankton bloom), can be examined retrospectively by comparing periods of greater growth as recorded in the shells of bivalves and tests of echinoids, with historical knowledge of patterns of phytoplankton productivity, and information gathered in the last two years by SEA.

C. Cooperating Agencies, Contracts, and Other Agency Assistance

Contracts will be required for vessel charters (to deploy plankton tubes at NVP sites early in the season, March/May-- and for the last sample collection in September). Other contracts, including Research Work Orders, are planned for analysis of plankton samples (Ted Cooney's lab at the University of Alaska, Fairbanks). An additional research work order (with Dr. Peter McRoy) is anticipated to support extension of phytoplankton and oceanographic sampling past the date that SEA and the hatcheries currently sample, and with extension of some sampling into the nearshore. Further cooperation with SEA investigators (e.g., Dr. Dave Eslinger) for analysis of coupling between phytoplankton and zooplankton is planned, and for some analysis of correlation with broad Sound-wide patterns in oceanographic conditions or primary production as determined from satellite imagery.

SCHEDULE

A. Measurable Project Tasks for FY97 (October 1, 1996- September 30, 1997)

Oct. 1-Sept. 30:	Plankton tube sampling at the hatcheries
Oct - Dec:	Coordination with SEA, NVP, and Shellfish Restoration Project; coordination expected to continue throughout the year
December:	Attend NVP project meeting
Jan 22-25:	Attend Annual Restoration Workshop
January:	Attend SEA and NVP project review meetings
Jan-Feb:	Arrange logistics (boat contracts, equipment, contracts)
March/May:	Deploy plankton tubes at NVP sites
April:	Submission of 1997 Progress Report (of activities since Oct.)
June:	Resample NVP sites (coordinated with other NVP investigators)
July:	" " " " " " " "
August:	" " " " " " " "
September:	Resample NVP sites

June - Sep: Analysis of plankton samples (tube and net)

B. Project Milestones and Endpoints

Objective 1: Field studies planned for 1997 and 1998.
Objective 2: Field studies planned for 1997 and 1998.
Objective 3: Field work planned 1998.
Objective 4: Analysis planned for each year of the study (1997 through 2000; comparative analysis for 2001).

C. Completion Date

Coordinated field seasons with SEA and NVP are planned for 1997 and 1998; further coordinated field work will persist with SEA through 2000 to extend potential coupling of larval abundances and oceanographic processes. Closeout and final report preparation are planned for 2001.

PUBLICATIONS AND REPORTS

No publications are scheduled on this project, as it is not yet funded. The annual reports will be generated on the schedule listed above. Papers are in preparation for previous EVOSTC-funded research on oiled mussels (one paper is imminently expected out), and oil persistence on national park coastlines. The latter paper is expected to be submitted to Marine Pollution Bulletin by Nov. 1996.

PROFESSIONAL CONFERENCES

Results from previously-funded EVOSTC-funded research are expected to be presented in FY97. Data from this project will be presented at the annual EVOS meeting in January in Anchorage. Preliminary results or a methods paper may be presented in FY97, but no specific presentations are yet planned.

NORMAL AGENCY MANAGEMENT

This proposal was developed, in part, to link SEA and NVP projects, while addressing basic questions regarding the influence of ecological and environmental factors in regulating populations and in the recovery of species affected by the EVOS. The NBS has no management function or responsibilities but provides information for the management of Department of the Interior trust species and lands as its primary mission. Knowledge gained about the importance of various processes and specifics of interrelationships can be transferred to the appropriate management agencies for further use.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

This project will entail a high degree of coordination among several projects: NVP, SEA, and Shellfish Restoration. Hypotheses are bridging from one project to another, there are plans for joint or parallel research, support of hatchery activities, shared research platforms, and data analysis.

PROPOSED PRINCIPAL INVESTIGATOR

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PERSONNEL

Dr. Gail Irvine is a marine ecologist who has conducted research on various coastal ecosystems since 1970. Her research experience has been concentrated in the fields of community and population biology, with special interests in plant-animal interactions, complex interactions and life-history. After the EVOS, Gail started working with the National Park Service (NPS), and has been a project manager and principal investigator on two EVOSTC-funded projects, Oiled Mussel Beds along the Gulf of Alaska, and the Persistence and Degradation of Oil Stranded along National Park Coastlines. While at the NPS, she had responsibility for initiating development of long-term coastal research and monitoring programs for national parks in Alaska. Her position transferred into the National Biological Service two years ago.

Dr. Glenn R. VanBlaricom has conducted research on coastal ecosystems since 1970, and has been involved in research on sea otters and their ecosystems for 17 years. Dr. VanBlaricom studied relationships of sea otters and intertidal mussels in Prince William Sound from 1978 through 1986 and published papers on population size structure and individual growth rate of mussels, and effects of foraging by sea otters. Dr. VanBlaricom worked on sea otter rescue and rehabilitation in the immediate aftermath of EVOS, primarily in the Kenai region, and has published one paper on rehabilitation strategies. Currently Dr. VanBlaricom is Assistant Unit Leader (Wildlife), Washington Cooperative Fish and Wildlife Research Unit, and is Associate Professor of Fisheries in the School of Fisheries, University of Washington. He has 24 peer-reviewed scientific publications.

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

Budget Category:	Authorized FFY 1996	Proposed FFY 1997						
Personnel		$80.7						
Travel		$21.0						
Contractual		$100.9						
Commodities		$16.1						
Equipment		$0.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	$0.0	$218.7	Estimated FFY 1998	Estimated FFY 1999	Estimated FFY 2000	Estimated FFY 2001	Estimated FFY 2002	
General Administration		$19.2						
Project Total	$0.0	$237.9						
Full-time Equivalents (FTE)		2.0						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments:

1997

Prepared: 1 of 4

Project Number: 97240
Project Title: Clam Recruitment: Investigation of Settlement Limitation and Mechanisms Related to Successful Recruitment
Agency: National Biological Service

FORM 3A
TRUSTEE
AGENCY
SUMMARY

4/15/96

1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1996 - September 30, 1997

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FFY 1997
G Irvine	Marine Ecologist	GS-12	3.0	6.2		18.6
Vacant	Biologist	GS-9	6.0	3.6		21.6
Vacant	Biological Technician	GS-7	12.0	2.9		34.8
UW Student	Graduate Student		3.0	1.9		5.7
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		24.0	14.6	0.0	
					Personnel Total	$80.7

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FFY 1997
Charters to hatcheries					0.0
AFK (8 @ $550)	0.6	8			4.8
other hatcheries	0.4	5			2.0
Meetings - SEA					0.0
Cordova	0.2	1	4	0.2	1.0
Fairbanks (includes sample analysis and coordination)	0.2	4	12	0.1	2.0
Seward - coordinate with shellfish hatchery	0.2	8	30	0.2	7.6
Conference - Ecological Society of America - New Mexico	1.1	1	5	0.1	1.6
($860 travel, $200 registration)					0.0
Seattle to Anchorage (graduate student)	0.8	1	6	0.2	2.0
					0.0
					0.0
				Travel Total	$21.0

1997

Prepared: 2 of 4

Project Number:
Project Title: Clam Recruitment: Investigation of Settlement Limitation and Mechanisms Related to Successful Recruitment
Agency: National Biological Service

FORM 3B
Personnel
& Travel
DETAIL

4/15/96

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

Contractual Costs:	Proposed
Description	FFY 1997
Boat Charter (20 days @ $1800/day)	36.0
Statistical consultation	2.0
Primary production, extension of sampling to nearshore	25.0
Analysis of plankton samples	25.0
Data analysis - coupling zooplankton and phytoplankton	6.0
Coordination with shellfish restoration	5.0
Sample shipment	1.0
CTD calibration and shipping	0.9
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$100.9

Commodities Costs:	Proposed
Description	FFY 1997
Plankton traps	4.5
Gear to deploy (lines, rebar, buoys, etc.)	4.0
Misc. supplies (formalin, alcohol, film, developing, lab supplies, sample bottles)	5.0
Plankton nets and nitex	0.6
Plankton water samplers	1.0
Fuel, small boat supplies	1.0
Commodities Total	$16.1

1997

Project Number:
Project Title: Clam Recruitment: Investigation of Settlement Limitation and Mechanisms Related to Successful Recruitment
Agency: National Biological Service

FORM 3B
Contractual & Commodities DETAIL

Prepared: 4/15/96

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

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

Existing Equipment Usage: Description	Number of Units	Inventory Agency
Camera	1	DOI-NBS
Survival suit	1	DOI-NBS
Whaler or Zodiac for work at hatchery (NEED TO BORROW FROM EVOS INVENTORY)	1	
Outboard motors (NEED TO BORROW FROM EVOS INVENTORY)	2	

1997

Project Number:
Project Title: Clam Recruitment: Investigation of Settlement Limitation and Mechanisms Related to Successful Recruitment
Agency: National Biological Service

FORM 3B
Equipment
DETAIL

Characteristics of the Cutthroat Trout Resources of Prince William Sound, Alaska

Project Number:	~~97USGS 22~~ 97242
Restoration Category:	Monitoring
Proposer:	Joe Dorava and Bob Black United States Geological Survey
Lead Trustee Agency:	U.S. Geological Survey
Cooperating Agencies:	Alaska Department of Fish and Game,University of Alaska Environment and Natural Resources Institute
Alaska SeaLife Center:	No activity planned
Duration:	Three years planned
Cost FY97:	248,000
Cost FY98:	150,000
Cost FY99:	150,000
Geographic Area:	Cutthroat Trout supporting streams of Prince William Sound
Injured Resource/Service:	Subsistence and sport fishing

ABSTRACT

The characteristics of the cutthroat trout population and the available habitat in Prince William Sound will be investigated by the U.S. Geological Survey following the protocols of the National Water Quality Assessment (NAWQA) program. Twenty sites around the Sound will be investigated during the first year of this project as a supplement to a water resources monitoring program proposed as part one of a two part NAWQA style study. Additional characterization of seasonal variations in cutthroat trout populations and habitat will be investigated at five index sites during the second and third years of this project.

INTRODUCTION

Little is currently known about the cutthroat trout (Oncorhynchus clarki) resources of Prince William Sound. Previous studies funded by the Trustee Council indicated that there is a difference in growth rates between cutthroat trout in oiled and un-oiled areas of the Sound (Exxon Valdez Oil Spill Trustee Council, 1996). However, without additional supporting evidence identifying the abundance, distribution, and limiting factors reasonable conclusions about the damage to these fish or their recovery cannot be made.

The cutthroat trout in the Prince William Sound area have been described as geographically separated into local populations estimated at fewer than 1,000 fish (Exxon Valdez Oil Spill Trustee Council, 1996).Trout are particularly sensitive to changes in chemical and physical variables (Moyle and Cech 1988, Hunter 1991) and the small numbers in Prince William Sound could make them extremely vulnerable to environmental changes (Begon et al. 1986, Wootton, 1990).

A program to assess the current abundance, distribution, and limiting factors of cutthroat trout in the streams of Prince William Sound, the uses of these fish by local residents and sport fishermen, and the quality and quantity of the available stream habitats in Prince William Sound would improve the Trustee Council's ability to determine the level of damage to these resources, their recovery status, and potential restoration enhancement opportunities.

NEED FOR THE PROJECT

A. Statement of Problem

Cutthroat trout populations in the Prince William Sound area are presently estimated to be very low. Trout are known to be sensitive to environmental changes, therefore, reductions in the numbers of fish and degradation of their habitat may have occurred in conjunction with the Exxon Valdez Oil Spill (EVOS). Subsequent reductions in the subsistence and sport fishing opportunities for cutthroat trout could be effecting Native communities and the present and future local economy.

B. Rationale/Link to Restoration

Cutthroat Trout are not an important commercial fishing resource, they do not represent a significant attraction to sport fishermen in Prince William Sound, and they likely are not a substantial source of subsistence food for local residents. However, the damage to Cutthroat Trout from the EVOS may be significant because of their small population and sensitivity to environmental change. A small geographically separated population of Cutthroat Trout could be threatened by changes to their habitat or alterations to the ecosystem that might shift predator/prey relations.

C. Location

This assessment will include areas of Prince William Sound which are north of the Copper River and east of Kodiak Island.

COMMUNITY INVOLVEMENT

Significant community involvement will result from investigations of the historical and current uses of Cutthroat Trout by local residents.

PROJECT DESIGN

A. Objectives

(1) Estimate the abundance and distribution of cutthroat trout in the Prince William Sound area.

(2) Characterize the quantity and quality of available cutthroat trout habitat in the Prince William Sound area utilizing both field and photo interpretation.

(3) Assess limiting biotic and abiotc factors for cutthroat trout in the streams within the Prince William Sound area through statistical models.

(4) Estimate the level of current and historical use of cutthroat trout by local residents.

(5) Identify changes or trends in the pattern of local use of cutthroat trout that may indicate recent alterations to the habitat of the trout.

B. Methods

The abundance and distribution of cutthroat trout will be determined in 20 low elevation stream sites within the Prince William Sound area. The 20 stream sites will represent both a range of physical habitat conditions as well as a range of oil impacted areas. Every effort will be made to overlap these sites with previous, existing or future stream studies to increase the effectiveness and efficiency of data collection and interpretation (See the proposed Part 1, USGS Water Resources Water Quality and Monitoring study). The length of each study site will be determined by stream geomorphology and minimum-maximum length criteria. Ideally, each sampling site will include at least two each of two different types of geomorphic channel units such as pools and riffles. If this is not possible the length of the study reach will be based on 20 times the distance of the stream channel width (Meador et al. 1993).

Snorkeling or electrofishing techniques will be used to determine trout densities within each study reach. The choice of techniques will be determined by water depths. Snorkeling counts are often preferred over electrofishing (Northcote and Wilkie 1963, Gardiner 1984, Hankin and Reeves 1988), but stream conditions often prevent this type of population estimate. If electroshocking estimates are used a multiple pass removal summation technique as described by Carle and Strub (1978) and catch per unit effort techniques (Wootton 1990) will be used to determine population densities. Block nets will be used at the upstream and downstream ends of each study section during the electroshocking. The length (mm) and weight(g) of each fish captured will be recorded. Cutthroat trout densities will be determined once during the late summer or early fall and again in the late spring.

The quality and quantity of cutthroat trout habitat will be based on two techniques: field measurements and photo/GIS interpretation. Habitat quality will be assessed at each of the 20 sampling sites following the methods developed by Meador et al. (1993) and Hankin and Reeves (1988). The following physical variables will be measured within each study site: 1) habitat types, 2) habitat lengths, 3) water surface width, 4) active channel width, 5) maximum depth, 6) mean depth, 7) mean velocity, 8) maximum velocity, 9) minimum velocity, 10) percent in-stream cover, 11) percent overhead cover, 12) substrate type, 13) stream gradient, and 14) bank erosion. Habitat types will be determined based on criteria given in Bisson et al. (1982), Helm (1985) and Hawkins et al. (1990). Length and width measurements will be made to the nearest 0.1 meter. Depth, velocity, and substrate measurements will be recorded using a point-transect method. Velocity measurements will be taken with a hand held velocity meter at 0.6 of the total depth at every depth measurement point. Stream substrate will be characterized using the Wolman (1954) pebble count technique. In-stream cover will include undercut banks, woody debris and vegetation within the stream. Areal estimates for each type of in-stream cover will be made by measuring the length and width of each cover type. The location of each cover type will also be measured. Overhead cover will include overhanging woody debris and vegetation less than one meter from the water surface. Overhead cover will be measured and recorded in a similar manner as in-stream cover. Bank erosion will be recorded by location and areal extent. Habitat and geomorphology measurements will be coordinated with proposed sampling projects (See the proposed Part 1, USGS Water Resources Water Quality and Monitoring study). Key water-quality parameters such as pH, conductivity, temperature and dissolved oxygen concentrations will also be collected at each site. The quantity of cutthroat trout habitat will be preliminarily determined by evaluating aerial photos and GIS coverages. The field data will be used to calibrate the photo and GIS interpretations. Habitats will be characterized at the watershed scale using the methods outlined by Paustian et al. (1992)

Limiting biotic and abiotic factors will be assessed using regression and discriminant analysis techniques (Fausch et al. 1988, Johnson and Wichern 1988, Scheiner and Gurevitch 1993, Sokal and Rohlf 1995). Input variables will include the physical variables identified above. Previous studies designed to address trout responses to physical variables have historically produced

successful results (Binns and Eiserman 1979, Marshall 1985,Fausch et al. 1988). The limiting factors analysis will also incorporate biological and water chemistry data from concurrent studies (See the proposed Part A, USGS Water Resources Water Quality and Monitoring study).

To evaluate the level of current and historical use of cutthroat trout by local residents and identify changes or trends in the pattern of local cutthroat trout use an interview and/or survey technique will be employed. A review of existing literature and databases will be employed to identify important areas of the Sound where cutthroat trout are harvested for subsistence and sport fishing and any changes in the harvest patterns that may indicate a recent alteration to the cutthroat trout numbers or habitat. A review of existing information will determine the necessity and approach of any follow-up interviews of surveys. Surveys and/or interviews will follow the methods outlined in Nielsen and Johnson (1983)

C. Cooperating Agencies, Contracts, and Other Agency Assistance

Alaska Department of Fish and Game, University of Alaska Environment and Natural Resources Institute

SCHEDULE

A. Measurable Project Tasks for FY97 (October 1, 1996 - September 30, 1997)

Select 20 study sites for investigation (October 1996-April 1997)
Survey and interview local residents about cutthroat trout usage (October 1996-August 1997)
Sample cutthroat trout from 20 sites (April-May, August-September 1997)
Characterize habitat quality and quantity in Prince William Sound area streams (April-May, August-September 1997)
Select 5 Index sites for additional seasonal monitoring

B. Project Milestones and Endpoints

Attend EVOS Workshop January 1997

C. Completion Date

September 30, 1999

PUBLICATIONS AND REPORTS

A summary report describing the abundance, distribution and uses of cutthroat trout in Prince William Sound streams and characterizing the available habitat will be written by April 15, 1998.

Another report describing seasonal variations in cutthroat trout habitat at the index sites will be written by September 30, 1999

PROFESSIONAL CONFERENCES

Attend annual meeting of the American Fisheries Society Alaska Chapter November 1996

NORMAL AGENCY MANAGEMENT

This project is typical of what is becoming a major component of the U.S. Geological Survey's investigations. The National Water-Quality Assessment program is evaluating aquatic habitat throughout the nation and new studies not directly associated with this National program are also concentrating on aquatic habitat issues. The decline in anadromous fish populations across the western United States has increased concern for aquatic habitat in many areas. The study of Cutthroat Trout populations and habitat in Prince William Sound; however, is not planned to be done as part of the National program and can not be done without additional funding. There are numerous examples of recent investigations by the USGS which are similar to the one proposed here and all the technical capabilities of the National program could be utilized to meet the objectives outlined in this proposal.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

The project described in this proposal will be coordinated with other Cutthroat Trout studies and with other related EVOS projects. Field studies will be closely coordinated with other USGS work in Prince William Sound and with other agencies as appropriate.

EXPLANATION OF CHANGES IN CONTINUING PROJECTS

This will be a new project

PROPOSED PRINCIPAL INVESTIGATOR

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PERSONNEL

Bob Black	Biologist
Joseph M. Dorava	Hydrologist
Mark Munn	Biologist
Jim Hall	Hydrologic/GIS Technician
Jackie McIntire	GIS/Hydrologic Technician

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

Budget Category:	Authorized FFY 1996	Proposed FFY 1997	LONG RANGE FUNDING REQUIREMENTS					
Personnel		$25.2						
Travel		$9.1						
Contractual		$77.0						
Commodities		$0.5						
Equipment		$0.0						
Subtotal	$0.0	$111.8	Estimated FFY 1998	Estimated FFY 1999	Estimated FFY 2000	Estimated FFY 2001	Estimated FFY 2002	
		$136.2						
Project Total	$0.0	$248.0	$150.0	$150.0	$0.0	$0.0	$0.0	
Full-time Equivalents (FTE)		6.0						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments: Indirect Costs:

Data-Base Management $3.0 -On-line data availability

Reports $6.1 1)Publish data in annual USGS report, 2)Publish journal article on inflow quality/quantity in Prince William Sound

Computer System Input $14.9

Common Services $84.8

Headquarters Charge $27.4

Helicopter services are to visit streams in both eastern and western Prince William Sound above water resources project uses
Aerial photography is to update airphotos of study sites
University contracts are for interns
No NEPA costs are projected for this proposal.

1997

Prepared:3/96

Project Number:
Project Title: Water Resources of Prince William Sound
Name: Joesph M. Dorava, U.S. Geological Survey

1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1996 - September 30, 1997

Personnel Costs:			Months	Monthly		Proposed
Name	Position Description		Budgeted	Costs	Overtime	FFY 1997
J. Dorava	Hydrologist		2.5	5.1		12.8
J. Hall	Hydrology Technician		2.5	2.4	0.5	6.5
						0.0
J. McIntire	GIS Technician		1.0	2.4		2.4
						0.0
						0.0
Pay raise (Promotion, Step increases 1.5%)						0.3
Annual leave, sick leave, holidays (Salaries x 0.15)						3.2
						0.0
						0.0
						0.0
		Subtotal	6.0	9.9	0.5	
					Personnel Total	$25.2

Travel Costs:		Ticket	Round	Total	Daily	Proposed
Description		Price	Trips	Days	Per Diem	FFY 1997
Per diem		0.0	10	20	0.1	2.0
Airline fare roundtrip to Cordova--purpose of trip for stream sampling		0.2	2	2	0.0	0.4
and gathering historical data from native community		0.0	0	0	0.0	0.0
Airline fare roundtrip to Valdez--purpose of trip for stream sampling		0.2	2	2	0.0	0.4
and gathering historical data from native community		0.0	0	0	0.0	0
Airline fare roundtrip from Tacoma		0.7	4	4	0.0	2.8
				0	0.0	0
Cost of Rental Vehicles		0.0	12	12	0.1	0.0
Vehicles--government						3.5
						0
						0.0
						0.0
						0.0
						0.0
					Travel Total	$9.1

1997

Project Number:
Project Title: Water Resources of Prince William Sound
Name: Joesph M. Dorava, U.S. Geological Survey

FORM 4B
Personnel
& Travel
DETAIL

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

Contractual Costs:	Proposed
Description	FFY 1997
Helicopter or charter airplane	20.0
Aerial photography	3.0
University contracts	3.0
Tacoma District	50.0
	0.0
	0.0
Film processing	1.0
Contractual Total	$77.0

Commodities Costs:	Proposed
Description	FFY 1997
Film	0.5
Commodities Total	$0.5

1997

Prepared:3/96

Project Number:
Project Title: Water Resources of Prince William Sound
Name: Joesph M. Dorava, U.S. Geological Survey

FORM 4B
Contractual & Commodities DETAIL

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

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FFY 1997
	0	0.0	0.0
	0	0.0	0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
Those purchases associated with replacement equipment should be indicated by placement of an R.		**New Equipment Total**	$0.0

Existing Equipment Usage: Description	Number of Units	

1997

Prepared:3/96

Project Number:
Project Title: Water Resources of Prince William Sound
Name: Joesph M. Dorava, U.S. Geological Survey

FORM 4B
Equipment
DETAIL

Water Resources of Prince William Sound

Project Number:	~~97USGS-1/2~~ 97243
Restoration Category:	Monitoring
Proposer:	Joseph M. Dorava, Hydrologist, U.S. Geological Survey
Lead Trustee Agency:	U.S. Geological Survey, Water Resources Division
Cooperating Agencies:	SEA Team , Native Corporations and Villages, Alaska Department of Natural Resources, United States Fish and Wildlife Service, United States Forest Service, Alaska Department of Fish & Game
Alaska Sea-Life Center:	NA
Duration:	4-years planned
Cost FY97:	786,300
Cost FY98:	440,000
Cost FY99:	370,000
Cost FY00:	370,000
Geographic Area:	Prince William Sound from the Copper River to Montague Island
Injured Resource/Service:	Sea and shore birds; marine and terrestrial mammals; fisheries; commercial, sport, and subsistence fishing

ABSTRACT

Information on the quantity and quality of rivers discharging to Prince William Sound provided by this project will assist the Trustee Council's damage assessment goals and biological recovery objectives. This study will provide a baseline of existing water resource conditions using a integrated hydrology, water chemistry and biological health indicators approach. This information will also permit analysis of long-term trends of both water quantity and quality in order to monitor recovery of streams that may have been affected by the Exxon Valdez Oil Spill. Along with assessing present conditions and establishing a baseline for monitoring trends, this study will provide information needed for damage assessment and restorations.

INTRODUCTION

Prince William Sound is located in southcentral Alaska and ranges from the southern tip of Montague Island north/northeast to the Copper River Delta. Much of the freshwater which enters the Sound originates from two sources. One source is the runoff from many small basins, generally less than 5 square miles. The other source is meltwater from glaciers which comprise about 38 percent of the land mass connected to the Sound.

The freshwater resource of Prince William Sound is poorly defined and yet this resource has a dramatic affect on the Sound's ecosystem. Annual and interannual variation in freshwater discharge affects the Sound's freshwater, estuarine, and oceanic regions. These regions are important spawning, rearing, and feeding areas for wildlife.

Much of the Sound's wildlife and wildlife habitat was affected by the 1989 Exxon Valdez Oil Spill. In ensuing years, efforts to assess the damaged resources, evaluate their recovery, and initiate their restoration have focused on the near and off shore environment. Few studies have focused on the freshwater environment. Consequently, damage assessment and recovery of natural resources cannot be fully assessed. Fundamental to the evaluation of the Sound's freshwater environment is an understanding of interaction between the physical, chemical, and biological components of the system.

Prince William Sound has a complex hydrologic setting. The rapid topographic rise surrounding the Sound strongly effects precipitation and results in three distinct climatic zones: maritime, transitional, and continental (Jones and Fahl, 1994, Hartman and Johnson, 1984). These environments differ in the extent and pattern of runoff. Many short, small streams flow into Prince William Sound and are not well represented in Alaska's historical stream-gaging network. Basic data concerning discharge and water quality is lacking. Glaciers surrounding the Sound will have a strong influence on streams receiving glacial melt. For example, it has been shown that glaciers exert a disproportionately larger influence on the hydrology. Anderson (1970) estimated that 47 percent of the Tanana River Basin runoff comes from the glacierized 9 percent of the basin area that is above 5,000 feet altitude. Timing of the peak discharge, daily discharge, temperature, turbidity, and sediment transport differ between streams receiving glacial melt-water and those dominated by snow and rainfall runoff. Distinct biotic communities have developed in glacial fed streams (Milner and Petts, 1994) and recovery of these communities likely will be related to the glacial processes.

Freshwater input is a key component in the circulation patterns of the extensive saltwater and freshwater mixing area throughout the Sound (Tom Royer, Institute of Marine Science, University of Alaska, Fairbanks, oral commun, 1996). Current models assume stream flow data available from Cannery Creek is representative of the entire Sound and that a uniform climate exists throughout the Sound. These assumptions are necessary because of the lack of freshwater discharge data. Discharge data from throughout the Sound would allow validation of the oceanic current circulation models and enhance the ability to define the microclimatic regions (Haper Simmons, Fairbanks, written communications, 1996).

In stream restoration projects, efforts have also been frustrated by the lack of freshwater discharge information. Many salmon habitat enhancement structures constructed on Hanning Creek were destroyed by floods in 1995 (Hodges and Schmid, 1996). Stream discharge data would be useful in designing in-stream restoration structures capable of withstanding floods by providing information to characterize local flood frequency.

This project emphasizes a multidisciplinary approach using physical, chemical and biological data to assess water quality in rivers discharging to Prince William Sound. Together these data will provide an integrated approach to assess hydrologic and water quality trends, and to investigate natural (land use, hydrology, etc.) and anthropogenic (oil contamination) factors that influence water quality and the biologic community. Including a biological component in a water quality program provides several advantages: (1) increased sensitivity to a wide variety of natural and anthropogenic environmental influences; (2) greater ability to measure biological effects directly without the need to extrapolate from chemical or physical studies; and (3) greater integration of exposure over multiple temporal and spatial scales.

Knowledge of the Prince William Sound freshwater environment is important in fully understanding the effects of the Exxon Valdez oil spill. This project will contribute to this knowledge by 1) providing data on the quantity, distribution, and quality of freshwater inflow to Prince William Sound, and 2) by identifying the significant sources of freshwater inflow into Prince William Sound due to rainfall, snowmelt, glacier melt, and groundwater discharge.

NEED FOR THE PROJECT

A. Statement of Problem

Information on the quantity and quality of freshwater inflow into Prince William Sound is limited to a few hydrologic studies near populated communities such as Cordova, Valdez, and Seward. The long-term hydrologic records currently available do not accurately represent typical Prince William Sound streams or the complexity of the hydrologic system. In order to fully evaluate the damage and recovery of the natural resources, accurate data describing the physical and chemical nature of the freshwater discharge and the effect of the physical and chemical environment on the biological community is required.

B. Rationale/Link to Restoration

Establishing restoration goals and tracking long-term changes in stream ecosystems is possible only if present and reference environmental conditions are known. Hydrologic data for the Prince William Sound will aid in this effort.

Hydrologic information is needed because streamflow affects fish survival rates. Flood information is necessary because extreme flow events may destroy spawning and rearing areas.

Extreme low-flows may cause fish eggs to freeze and die. Thus, the recovery rates for the various fish species throughout the Sound may be linked to natural variability in stream water quality rather than changes in stream water quality resulting from oiling. Interannual variations in properties such as surface-water temperature, dissolved oxygen, nutrient concentration, and/or suspended sediment, may contribute to the interannual variability in fish recruitment. Alternatively, oiling may have impacted key water quality properties related to fish survival. For instance, increased carbon in the gravel of oiled streams may increase the biochemical oxygen demand within the gravel, resulting in decreased intragravel dissolved oxygen concentrations. The reduced intragravel dissolved oxygen concentration may adversely affect both egg and fry development. Data collected over several years will allow annual comparisons to be made.

The biological component of this project will provide the data for the following: (1) baseline information for assessing trends in the biological integrity of the rivers; (2) identification of reference conditions with healthy biological communities that can be used to monitor the recovery of contaminated habitats; and (3) permit an integration of the quantity and quality of the streams with biological conditions. Understanding the present benthic communities is important since algae are the instream primary producers and benthic invertebrates are fed upon by fish.

The hydrologic data provide could be used by other EVOS projects. Adequate data accurately characterizing local discharge characteristics is required to design structures capable of withstanding flood events, forecasting the recovery of affected species that utilize freshwater environments, and oceanic circulation modeling. Data from this work could be used by both current studies to help interpret interannual variability in recruitment and by future studies evaluating impacts in resident species.

C. Location

All streams in the Prince William Sound area from the Copper River Delta to Montague Island will be considered in an area-wide evaluation of water quality and flow characteristics. Specific study sites will be determined after an evaluation of basin characteristics of area streams. The sites will be selected to provide statistically representative information for streams in the area. Initially, emphasis will be placed on streams of interest to other EVOS studies, and to those streams of interest to the local Native communities.

COMMUNITY INVOLVEMENT

Historical information will be obtained from Native villages concerning streamflow patterns and seasonal climatic conditions. In addition, stream gaging stations will be operated near villages where basin characteristics are representative of streams in the area, where the village has a need for the information, or where other EVOS studies need information for that village area.

PROJECT DESIGN

A. Objectives

The project objective is to assess the quantity and quality of freshwater discharging to Prince William Sound for the purpose of establishing baseline conditions for assessment and long-term monitoring.

Specific objectives include:

(1) estimate the quantity and distribution of freshwater discharging to Prince William Sound and identify the percentage of streamflow generated from rainfall, snowmelt, glacier melt, or groundwater.

(2) characterize the quality of the freshwater environment and any spatial patterns in water quality along Prince William Sound.

(3) characterize the present benthic algae and invertebrate communities and integrate their community structure with both water quantity and quality.

This information will provide an assessment of present conditions, identify reference conditions, and establish baseline information for long-term monitoring of recovery and natural changes in stream communities.

B. Methods

Site Selection for General Sampling

Approximately 20 streams in Prince William Sound will be selected for a general water-quality and water quantity characterization. They will be selected by using Geographical Information Systems (GIS) techniques, cluster analysis, mapped information on precipitation, available aerial photography, and available baseline sediment and water column chemistry data. The 20 sites will be selected to ensure spatial distribution and a wide range in basin characteristics. Basin characteristics important in selecting the sites would include, but not be limited to, drainage area, channel slope, mean annual precipitation, mean annual snowfall, percentage of watershed area covered by glaciers, and the differing characteristics between the eastern and western areas of the Sound.

General Sampling Program - Water Quality

Water-quality data will be collected from these 20 sites. Key water-quality properties such as pH, specific conductance, temperature, dissolved oxygen concentration will be determined in the field, and nutrients, petroleum hydrocarbon, and trace metal concentration in the water and sediments will be determined in the laboratory. The biological component of the program will include assessing both benthic invertebrate and algae communities at the 20 sites. Because there is a strong seasonal difference in these streams, samples will be collected twice during the year, once in April during base flow and again in August/September during runoff. In order to assess biological communities adequately, replicate samples will be collected from riffle habitats in the lower reach of the rivers. Benthic invertebrate and algae samples will be collected using methods adapted from the USGS National Water Quality Assessment (NAWQA) Program (Cuffney et al. 1993; Porter et al. 1993). Replicate samples of both benthic invertebrate and algae will be collected in order to assess within site variability of benthic communities and how this relates to variability among the different streams. Three replicate benthic invertebrate samples will be collected from each reach in each stream using a modified Surber sampler. This sampler has an rectangular kick-net frame to which a Nitex net with a 425 micron mesh opening is attached. Sampling involves removing all rocks inside the frame and removing invertebrates in the net, then using a rod to stir the substrate to dislodge invertebrates. The sample is then placed into a plastic container and preserved in 95 percent ethanol. Benthic invertebrate samples will be processed in a laboratory following established procedures (EPA 1989). Invertebrates will be identified to the lowest practical taxonomic level.

Three replicate benthic algae samples will be collected from the same riffle habitat as the invertebrates using methods adapted from Porter et al. (1993). Benthic algae will be collected by scraping the surface of individual rocks; however, because benthic algae communities can vary greatly within a riffle, the algae from three cobble-sized rocks will be composited for each replicate sample. Algae samples will be preserved in 5 percent formalin solution, sealed, and labeled. The surface area of the three rocks will be determined by the aluminum foil method (Porter et al. 1993). Algae will also be identified to the lowest practical taxonomic level.

The physical habitat of streams plays an important role in determining the biological communities that reside in the river. Therefore, a rapid habitat assessment will be done for each stream using methods adapted from Meador et al. (1993) and Hankin and Reeves (1988). Habitat assessment will include measuring water depth and velocity at the location of each invertebrate and algae sample, along with a more detailed assessment of the reach. Instream habitat assessment of the reach will include percent geomorphic unit (riffle, run, pool), stream width, discharge, average water velocity, average water depth, gradient, and substrate, which includes size and embeddedness of bed material. Other significant habitat features that will be assessed include riparian cover and stream bank height and shape. Stream channels will be classified using methods outlined in U.S. Forest Service (1992). If possible, aerial photographs will be obtained at each site in order to assess stream vegetation and percent cover to track long-term changes; ground photo documentation of the riparian canopy and stream reach will also be included.

General Sampling Program - Surface Water

Discharge measurements will be made at the twenty sites on a monthly basis, beginning in April 1997, and ending in March 1998. In addition, crest stage gages will be placed at each site to record the peak discharge. The flow information from these 20 sites should provide a good snapshot of the range of flows which occur throughout Prince William Sound. Using methods outlined by Savard (1985), the discharges will be correlated with long-term gaging stations located near the Sound such as Spruce Creek near Seaward, Hobo Creek near Whittier, San Juan River near Seaward, and Solomon Gulch near Valdez. If good correlations are found between the monthly discharge measurements and the flows from the long-term gaging stations, equations for average monthly discharge can then be developed for each site.

Site Selection for Detailed Sampling - Water Quality and Surface Water

Based on the basin characteristics, and the water quality and surface water data collected from the general sampling program, five of the 20 sites will be selected for detailed analysis. At these sites, instrumentation will be installed to collect discharge, precipitation, and air temperature on a continuous basis. Instruments at these sites will be equipped with satellite telemetry. By having real time data, collection and analysis can be accomplished in a timely manner and be made available over the Internet. In addition, significant hydrologic events such as floods can be closely monitored and subsequent visits to the sites can then be made if needed.

The continuous flow record at the five index sites will provide considerable information on the flow patterns of streams in Prince William Sound. Characteristics such as low-flow and high-flow periods will be better understood as well as any groundwater contribution. In addition, the continuous streamflow information would be correlated with the continuous streamflow information at the long-term gaging stations using methods outlined by Helsel and Hirsch (1991). If acceptable correlations can be established between these stations, long-term runoff characteristics can then be synthesized at these index stations.

At the five index sites, water quality samples collected under the general sampling program will be collected on a quarterly basis. By collecting samples more frequently at these sites, seasonal water quality characteristics will be defined. The additional data will provide a suitable data base for statistical analysis to determine any water quality trends.

Glacier Monitoring and Analysis Program

Six glaciers would be chosen for monitoring. Three of the glaciers would be tidewater glaciers and three glaciers would be inland glaciers with a single runoff channel. All six glaciers would be instrumented to record precipitation and air temperature. A number of stakes would be placed throughout each glacier to measure accumulation of snow and ablation of snow and ice. At the three tidewater glaciers, time-lapse cameras would be placed near the terminus of the glacier to record and determine the amount of calving into the Sound. At the three inland glaciers, gaging stations would be installed to measure runoff. Most of the instrumentation would be equipped will satellite telemetry.

By integrating the point measurements made at the monitoring stakes over the entire glacier, the amount of icemelt and snowmelt for each glacier can be determined. Knowing these variables as well as the amount of precipitation which occurs as rain, and the total runoff which is measured at the gaging stations, the components of runoff due to icemelt, snowmelt, and rain can be determined. The amount of runoff from the tidewater glaciers will be determined essentially the same way except that the amount of ice which calves at the terminus will also be included in the amount of runoff. Since it is not possible to measure runoff directly from a tidewater glacier as it is with the inland glaciers, the measurements made on the inland glaciers will be used as a guide in estimating the components of runoff.

After determining the amount of runoff from the six glaciers, several different methods will used to determine the runoff from other glaciers. The first method would be a simple assumption that the glaciers that are not monitored exhibit the same characteristics as the glaciers that are monitored. Once a glacier's area altitude distribution is computed, its runoff characteristics would be determined. The second method involves using a techniques developed by Mayo (19xx). This technique determines the amount of runoff from a glacier based on its equilibrium line altitude (ELA). The technique would be tested on the monitored glaciers to determine its accuracy and whether or not modifications are needed before it is applied to the unmonitored glaciers. The third technique would involve comparison of the runoff characteristics of the six glaciers to the characteristics of Wolverine Glacier. Wolverine Glacier is part of the USGS glacier monitoring program and is located near Seaward. Data have been collected at Wolverine Glacier for over 30 years. If the six glaciers have the same characteristics as Wolverine Glacier not only could the characteristics of the unmonitored glaciers be determined, but long-term runoff characteristics of the glaciers in Prince William Sound could then be synthesized.

As a final check on the runoff characteristics of glaciers, an independent determination of ice storage changes would be done using photogrammetric techniques. Aerial photographic analysis will 1) serve as a check on the error accumulation in the mass balance determination and define mass balance adjustment factors, 2) update the glacier area altitude distribution for balance determination, 3) update the terminus position, glacier length, and total ice area, and 4) document changes in ice thickness. The aerial mapping and analysis would be done in the third year of the study.

C. Cooperating Agencies, Contracts, and Other Agency Assistance

SEA Team
Native Corporations and Villages
Alaska Department of Natural Resources
United States Fish and Wildlife Service
United States Forest Service
Alaska Department of Fish & Game

SCHEDULE

A. Measurable Project Tasks for FY97 (October 1, 1996 - September 30, 2000)

October 1996:	Evaluate GIS, map, and airphoto land coverage data for Prince William Sound
October 1996 to May 1997:	Discuss water resources needs with other EVOS projects
October 1996 to September 1997:	Define historical uses of freshwater resources
November to December 1996:	Evaluate long-term stream gaging station data for Prince William Sound area
January 22-25, 1997:	Attend the Annual Restoration Workshop in Anchorage
April, September 1997:	Collect water quality data from 20 selected streams
April 15, 1998:	Submit annual report (FY97 findings)

B. Project Milestones and Endpoints

September 1997: Select location for 5 telemetered stream gaging stations.
April 1998: Complete report on general sampling program
October 1998: Install continuous gaging stations and index sites
October 1998 (approximately): Begin making Prince William Sound hydrologic data available on the Internet.

C. Completion Date

October 1, 2007

PUBLICATIONS AND REPORTS

Annual project report to EVOS Trustee Council submitted by April 15, 1998

Annual publication of streamflow data in USGS "Water Resources for Alaska"

Summary of Prince William Sound streamflow characteristics and estimation techniques after collection of first year's water quality data and evaluation of GIS and mapped based data.

Summary of runoff characteristics from glaciers in Prince William Sound

Summary of water quality characteristics from streams and rivers in Prince William Sound

PROFESSIONAL CONFERENCES

North American Benthologic Society meeting, June 1998: present data from the macroinvertebrate samples and describe their relation to the quality of Prince William Sound water resourses

NORMAL AGENCY MANAGEMENT

The USGS Water Resources Division collects and disseminates information on hydrology throughout the United States. The USGS hydrologic program has been in operation in Alaska since 1906 and currently operates 78 stream gaging stations. Operation of some stream gages in the Prince William Sound area will continue without additional funding from the Trustee Council. However, the concentration of new data collection in Prince William Sound proposed here would not be possible without additional funding and would not be part of the normal mission of the agency, because that data collection would overemphasize a single area. Similar projects identifying water resources of large areas have been completed by the USGS. These studies include a recent state wide evaluation of the stream gaging network (Brabets, 1996), an assessment of surface water quantity and quality in the lower Kenai Peninsula (Savard and Scully, 1984), and a description of water resources of the Cook Inlet Basin (Freethey and Scully, 1980). The examples contain information and assessments similar to those proposed here for the Prince William Sound area. The short-and long-term recovery and restoration goals and objectives of the EVOS Trustee Council, however, can be met with this program of water- resources data collection.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

The USGS Water Resources Data Collection program will be integrated across all projects using hydrologic data. This program will also cooperate with other EVOS-sponsored projects to provide the most efficient means for investigating hydrologic and environmental factors common to all projects. Data will be shared widely via the Internet, and field investigations will be planned and coordinated with the needs of other projects and local Native communities.

PROPOSED PRINCIPAL INVESTIGATOR

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PERSONNEL

Tim Brabets	Hydrologist/Geomorphologist
Bronwen Wang	Hydrologist/Aquatic Chemist
Mark Munn	Aquatic Ecologist
Robert Black	Aquatic Ecologist
Jim Hall	Hydrologic/GIS Technician
Jackie McIntire	Hydrologic/GIS Technician
Larry Myers	Hydrologic Technician

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

Budget Category:	Authorized FFY 1996	Proposed FFY 1997						
Personnel		$107.9						
Travel		$24.5						
Contractual		$217.7						
Commodities		$4.2						
Equipment		$5.9	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	$0.0	$360.2	Estimated FFY 1998	Estimated FFY 1999	Estimated FFY 2000	Estimated FFY 2001	Estimated FFY 2002	
		$426.1						
Project Total	$0.0	$786.3	$440.0	$370.0	$370.0			
Full-time Equivalents (FTE)		19.4						
			Dollar amounts are shown in thousands of dollars.					
Other Resources								

Comments: Indirect Costs:

Data-Base Management $9.3 On-line data availability
Reports $18.8 1)Publish data in annual USGS report, 2)Publish journal article on inflow quality/quantity in Prince William Sound
Computer System Input $46.4
Common Services $263.2
District Lab Overhead $1.7
Headquarters Charge $86.7

Helicopter services are to: 1)recon stream gage sites, 2)collect water quality data in both eastern and western Prince William Sound, and 3)recon glaciers.
Laboratory services are for: 1)water quality analysis, 2)sediment chemistry analysis, and 3)sediment size characteristics.
Aerial photography is to update glacier position and to photo stream gage sites.
University contracts are for macroinvertebrate identification.
No NEPA costs are projected for this proposal

1997

Prepared:3/96

Project Number:
Project Title: Water Resources of Prince William Sound
Name: Joesph M. Dorava, U.S. Geological Survey

1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1996 - September 30, 1997

Personnel Costs:			Months	Monthly		Proposed
Name	Position Description		Budgeted	Costs	Overtime	FFY 1997
J. Dorava	Hydrologist		8.5	5.1		43.4
J. Hall	Hydrology Technician		1.1	2.5	1.3	4.1
M. Munn	Biologist		1.0	5.5		5.5
J. McIntire	GIS Technician		3.0	3.6		10.8
T. Brabets	Hydrologist		5.8	5.6		32.5
						0.0
Pay raise (Promotion, Step increases 1.5%)						1.1
Annual leave, sick leave, holidays (Salaries x 0.15)						10.5
						0.0
						0.0
						0.0
	Subtotal		19.4	22.3	1.3	
					Personnel Total	$107.9

Travel Costs:		Ticket	Round	Total	Daily	Proposed
	Description	Price	Trips	Days	Per Diem	FFY 1997
	Per diem	0.0	85	85	0.1	8.5
	Airline fare roundtrip to Cordova--purpose of trip for stream sampling	0.2	2	2	0.0	0.4
	and gathering historical data from native community	0.0	0	0	0.0	0.0
	Airline fare roundtrip to Valdez--purpose of trip for stream sampling	0.2	2	2	0.0	0.4
	and gathering historical data from native community	0.0	0	0	0.0	0
	Airline fare roundtrip from Tacoma	0.7	4	4	0.0	2.8
	Airline fare roundtrip from Fairbanks	0.2	2	2	0.0	0.4
	Cost of Rental Vehicles	0.0	12	12	0.1	1.2
	Vehicles--government					10.8
						0
						0.0
						0.0
						0.0
						0.0
					Travel Total	$24.5

1997

Project Number:
Project Title: Water Resources of Prince William Sound
Name: Joesph M. Dorava, U.S. Geological Survey

FORM 4B
Personnel
& Travel
DETAIL

1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1996 - September 30, 1997

Contractual Costs:	Proposed
Description	FFY 1997
Helicopter or charter airplane	96.0
Aerial photograph	7.5
University Contra	48.0
USGS Water Quality Lab	13.2
USGS Sediment Lab	3.0
USGS Sedimentary Chemistry Lab	9.0
Film processing	1.0
Tacom District	40.0
Contractual Total	$217.7

Commodities Costs:	Proposed
Description	FFY 1997
Sample containers for sediment	1.1
Sampler containers for water	1.1
Sample containers for bentics	1.0
Waders, Raingear, Packs	1.0
Commodities Total	$4.2

1997

Prepared:3/96

Project Number:
Project Title: Water Resources of Prince William Sound
Name: Joesph M. Dorava, U.S. Geological Survey

FORM 4B
Contractual & Commodities DETAIL

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

New Equipment Purchases:	Number	Unit	Proposed
Description	of Units	Price	FFY 1997
Hydrolab	1	5500.0	5.5
Water Sampler	2	200.0	0.4
			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**	$5.9

Existing Equipment Usage:	Number	
Description	of Units	

1997

Prepared:3/96

Project Number:
Project Title: Water Resources of Prince William Sound
Name: Joesph M. Dorava, U.S. Geological Survey

FORM 4B
Equipment
DETAIL

COMMUNITY-BASED HARBOR SEAL MANAGEMENT AND BIOLOGICAL SAMPLING

Project Number	97244
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	Three years
Cost FY 96	$128,500
Cost FY 97	$155,700
Cost FY 98	$85,000
Cost FY 99	0.0
Cost FY 00	0.0
Cost FY 01	0.0
Cost FY 02	0.0
Geographic Area	Prince William Sound, Cook Inlet, Kodiak, Alaska Peninsula
Injured Resource/Service	Harbor seals; subsistence

ABSTRACT

This project continues work supported through previous harbor seal restoration projects. A biological sample collection program in Prince William Sound and lower Cook Inlet communities will expand to two Kodiak Island and two Alaska Peninsula communities. Village-based technicians will be selected by the Alaska Native Harbor Seal Commission (ANHSC) and trained to collect samples and transport these samples to Anchorage or Kodiak for further sampling and analysis. The traditional knowledge database developed and distributed in FY 96 will be updated, produced on multimedia CD-ROM, and distributed. Maps depicting harbor seal subsistence harvest areas will be prepared based upon data collected during earlier and current phases of the project. The ANHSC will organize a two-day workshop, produce and distribute a

newsletter, and participate in the biological sampling program.

INTRODUCTION

The goal of this continuing project 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.

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 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 will be expanded to collect samples from the Kodiak and Alaska Peninsula (Chignik) areas. An additional goal is to assist the ANHSC to develop a long-term operating plan for biological sampling independent of restoration funds.

Another consensus point reached at the workshops was that there needs to be a cooperative exchange involving the traditional knowledge and skills of subsistence hunters and the research efforts of western scientists. In order to facilitate this exchange, the Division of Subsistence organized a traditional knowledge database (called "Whiskers!") which incorporates the available information about harbor seals. The Division demonstrated the database at the Restoration Workshop in January 1996 and at a ANHSC workshop in March 1996. It was also distributed to subsistence users, resource managers, and scientists through an askSam read-only program. In FY 97, the database will be updated, upgraded using multimedia CD-ROM software, demonstrated, and distributed.

Finally, this project will support other restoration projects proposed for FY 97 and beyond, such as the Marine Mammal Ecosystem Study (97001, 97064), the Community Involvement and Traditional Knowledge Project (97052), the Youth Area Watch (96210)and the Prince William Sound Subsistence Harbor Seal Hunting Documentary (96214 & 97214). The project will also contribute to the Trustee Council's recovery objectives for subsistence by facilitating involvement of subsistence users in the restoration process.

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, as is the involvement of traditional knowledge in research efforts. Several other proposed restoration projects will examine the potential causes of the harbor seal population decline and lack of recovery, including mortality caused by humans. The need exists 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 will be 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. For example, subsistence hunters can provide substantial information about the winter location and abundance of seals, the condition of seals taken for subsistence purposes, and seal behavior. This project will implement the recommendations of the workshops by supporting the activities of the newly formed Alaska Native Harbor Seal Commission, funding a workshop and community meetings which review data and hypotheses, collecting and organizing traditional knowledge into an accessible database, developing a biological sampling program, and providing other technical support to the Alaska Native Harbor Seal Commission.

The FY 96 Work Plan 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 97. 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.

For a harvest sampling program of this nature to succeed, it is important that:

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

2. Samples must be easily collected, stored and shipped; may be subsequently sub-sampled by lab technicians; must be analyzed in due time; and results 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. This has included encouraging principal investigators to use traditional and local knowledge in the development and implementation of restoration projects. Development and upgrading of the Whiskers! database using the multi-media CD-ROM software will contribute to efforts under Project 97052 (Community Involvement and Traditional Ecological Knowledge) to facilitate this use of traditional knowledge.

C. Location

The biological sampling portion of the project will include the Prince William Sound communities of Cordova, Chenega Bay, Valdez, and Tatitlek; Seward; the lower Cook Inlet communities of Seldovia, Port Graham, and Nanwalek, two Kodiak Island communities (tentatively Akhiok and Old Harbor); and two Alaska Peninsula communities (tentatively Chignik Lake and either Perryville or Ivanof Bay). Other communities that will receive information from the project and may be included in the ANHSC Workshop include Ouzinkie, Kodiak, Port Lions, Larsen Bay, Karluk, Chignik Bay, and Chignik Lagoon.

COMMUNITY INVOLVEMENT

Community and subsistence user involvement in the restoration process and in harbor seal recovery is a central purpose of this project. A primary goal is support of the activities of the Alaska Native Harbor Seal Commission. With project funds, the ANHSC, through a subcontract with the Rural Alaska Community Action Program (RurAL CAP), will organize a two-day workshop for representatives of oil spill area communities which use harbor seals for subsistence purposes conducted in conjunction with an ANHSC meeting. The ANHSC will also organize community meetings to inform hunters of restoration activities, harbor seal research, and ANHSC functions. These meetings can serve as a means to develop subsistence hunter involvement in ongoing research efforts. The ANHSC and RurAL CAP will also produce a newsletter. As part of the biological sampling effort, the ANHSC will select technicians (most of whom will be subsistence harbor seal hunters) in participating communities. These technicians

will be trained by a marine mammals biologist 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. Division of Subsistence researchers will continue interviews with knowledgeable seal hunters and users to collect information for updating and upgrading the traditional knowledge database on marine mammals. Also, participants in the Youth Area Watch Project (96210) will be included in project activities, including community technician training sessions and the workshop.

PROJECT DESIGN

A. Objectives

The primary premise upon which this project is based is that restoration of harbor seal populations will be facilitated by developing the involvement of subsistence users in research and management activities, and through facilitating the involvement of traditional knowledge in scientific studies. Key to the success of this effort will be 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, Seldovia, Port Graham, and Nanwalek. Expand this program to include Valdez and Seward. Add to the program sample collection by hunters from two Kodiak and two Alaska Peninsula communities. (Tentatively, it is proposed that Akhiok and Old Harbor be added for Kodiak, and Chignik Lake and either Perryville or Ivanof Bay for the Alaska Peninsula). It is important to add bio-sampling efforts in Kodiak and Chignik because they are within the spill area and within the area of significant seal population declines. Kodiak and Chignik are currently the only "hole" in the statewide network of biosamplers. (The ADF&G through a contract with the National Marine Fisheries Service has a biosampling program for harbor seals in southeast Alaska, the Aleutian Islands, and Bristol Bay.)

    a. Train local technicians and hunters in biological sample collection procedures

    b. Design the program to 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 12 communities: Tatitlek, Chenega Bay, Valdez, Cordova, Seldovia, Port Graham, Nanwalek, and Seward; two Kodiak Island communities; two Chignik Area communities. 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

c. Store samples in a community freezer and periodically ship samples to Anchorage or Kodiak for further processing and distribution for analysis

3. Utilizing the services of the Alaska Native Harbor Seal Commission and its subcontractors, communicate information about results of harbor seal studies to hunters and scientists on a regular basis through community meetings, workshops, and newsletters.

a. Conduct a two-day workshop, in conjunction with a meeting of the ANHSC, which includes hunters from oil spill communities, harbor seal biologists, and agency representatives, to review recent findings about harbor seals and discuss important issues

b. Conduct one community meeting per year in each of communities participating in the biological sampling program for hunters and scientists to review and exchange scientific information and traditional knowledge

c. Produce an informational newsletter describing results of harbor seals studies, ongoing harbor seal research, and community involvement

4. Update and upgrade the Harbor Seal Traditional Knowledge Database ("Whiskers!") and continue to provide access to the database to potential users

a. Incorporate information obtained from ongoing research efforts by the Division of Subsistence ADF&G as part of National Marine Fisheries Service-sponsored research, and Division of Subsistence baseline studies.

b. Collect new information from hunters about topics such as: harvest locations; winter distribution of seals and abundance; changes in distribution and abundance; seasonal use of haulouts; and observations about factors that may be affecting abundance, such as human activities or killer whales

c. Incorporate information collected during other restoration projects, such as 96052 (Community Involvement and Traditional Knowledge) and 96214 (Harbor Seal Video), and make sure that data from this project are available to support these other restoration efforts

d. Upgrade the database (Whiskers! Version 2) using multimedia CD-ROM software

e. Demonstrate the use of the database during the Harbor Seal Commission workshop, and make the database available to potential users such as local communities, schools, subsistence hunters, and scientists

f. Prepare maps of subsistence harvest locations in Prince William Sound and lower Cook Inlet, depicting data collected during this project.

5. 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 workshops and community meetings.

6. Evaluate the program's effectiveness and develop a more long-term funding plan for ANHSC activities and the biological sampling program

7. Coordinate with the Youth Area Watch Program (Project 96/97210) to involve participants in that program in biological sampling and workshops

B. Methods

Objectives 1 and 2: 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, a marine mammal biologist, Kate Wynne of the University of Alaska, and Vicki Vanek of 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 97, these materials will be revised as appropriate.

Instruction. Sampling requires instruction or training of community-based sampling technicians, who ideally are also subsistence seal hunters. Village-based technicians, ANHSC personnel, and ADF&G staff will attend a full-day regional sampling training session in either a Chignik area community or in Kodiak in which Wynne 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. If technicians are replaced in any of the other six participating communities, Vanek to will travel to the community to train a replacement. Vanek will also handle the training of new assistants in Valdez and Seward.

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. If hunters or technicians need additional "hands on" training, Vicki Vanek of the Division of Subsistence or other division personnel may be available to travel to the communities to provide this assistance.

2. Training materials.

Manual: This was produced in FY 96. It includes step-by-step diagrams and a visual guide. It is waterproof and is included in the sampling kit. In FY 97, the manual will be converted into a computerized format that can be easily updated, modified with regional information, and include some photos. Labor is also involved in laying out, laminating, and binding each book.

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

Video. In FY 96, 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 collections

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

Key hunters. Ideally at least two hunters per village will be willing to provide subsistence taken seals from which the technicians will 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 10 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 will train and ask technicians and hunters to record information about harvest location and animals' sex, evidence of tags or markers, and standard measures of length and girth. Technicians will be trained to collect the whole head (with hide and blubber intact); stomach (after tying off both ends), samples of liver, heart, and kidney; and female reproductive tract. Although collecting the reproductive tracts and claws is highly desirable, it may be 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 will be 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 will be placed inside the specimen bag with samples for village-based storage. Technicians will be provided with a kit that includes supplies adequate for sampling of 10 animals. Among the items in each kit will be 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 will then be 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 will be placed in a freezer without sub-sampling, the technician will contact Kate Wynne (for Kodiak and Chignik villages), Vicki Vanek (for Prince William Sound and lower Cook Inlet villages) or the ANHSC when a full shipment has accumulated, and then send the samples to Kodiak or Anchorage.

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

Data collection.

Data will be requested on data forms which will allow for standardization of data with other harvest-sampling programs. Sample label and freezer log forms have been developed to assure adequate sample tracking. Each animal will receive a unique number that is tied to the UAF Museum Archive numbering system.

Sample analysis.

The attached 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.

Data management and reporting

Biological data collected from this program will be managed and maintained in a data base using software that is easily translated or integrated with software used by other agencies and organizations. This database will be centrally maintained (initially 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.

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

Kate Wynne, University of Alaska, will:

1. Compile protocols, develop data forms and sampling kits, and incorporate instructions for their use into a training program (this was completed in FY 96; appropriate revisions will take place in FY 97).

2. Synthesize technical information into "user friendly" data forms, labels, and sampling kits
3. Conduct one-day training workshops in Chignik and Kodiak, each attended by two of the community technicians, ANHSC staff, and agency personnel
4. Receive samples from village-based technicians from the Kodiak and Chignik areas, process samples in Kodiak, and ship samples to participating researchers for analysis
5. Contribute to statewide database of biological data maintained by ADF&G
6. Participate in the Alaska Native Harbor Seal Commission workshop
7. Help collate results of sample analysis (provided by various researchers) into a readily understandable newsletter
8. Work with ADF&G to integrate these results with information contained in the traditional knowledge data base being updated for this project
9. Write a brief summary of the project for inclusion in the interim and final reports for the Trustee Council

Alaska Department of Fish and Game, Division of Subsistence will:

1. Assist Wynne in appropriate revisions to the instruction manual (Vicki Vanek)
2. Help answer community facilitator's questions (Vicki Vanek, Craig Mishler, Ronald Stanek)
3. Train community assistants in Valdez and Seward. Travel to other lower Cook Inlet and Prince William Sound communities if necessary to train new community technicians if replacements are hired (Vicki Vanek).
4. Receive samples from village-based technicians from the lower Cook Inlet and Prince William Sound, process samples in Anchorage, and ship samples to participating researchers for analysis (Vicki Vanek)
5. Maintain database of biological data
6. Collate the results of the sample analysis into a readily understandable newsletter (Vicki Vanek; Vanek's total time charged to this project = 2 months).

The Alaska Native Harbor Seal Commission will:

1. Identify and subcontract with 12 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. Arrange travel to training workshops for Kate Wynne, ANHSC, and the community technicians
5. Participate in training workshops
6. Communicate study findings through workshops, community meetings, and the production of two workshop summaries (the latter produced through the subcontract with RurAL CAP)

Objective 4: Traditional Knowledge Database

Regarding Objective 4, the collection and organization of traditional knowledge, the first release of the Whiskers! database (using askSam software) has been met with considerable enthusiasm by Alaska marine mammal biologists, anthropologists, and tribal councils. For example, they have found Whiskers! a useful interactive tool for testing hypotheses on why harbor seals are declining. Version 1 of Whiskers! includes over 1 MB of data collected from subsistence hunters and elders in Alaska coastal communities.

In FY 97, we see great potential for expanding the database with photographs, drawings, and maps, and with additional field interviews with hunters. Division of Subsistence researchers will continue to conduct interviews with seal hunters in Prince William Sound and lower Cook Inlet communities to collect and review information on harbor seals. Although a variety of topics will be covered, the interviews will focus on such topics as harvest locations, winter distribution and abundance, changes in distribution and abundance, seasonal use of haulouts, and observations of factors that may be affecting seal abundance. These interviews will be taped (with permission of the hunters) and field notes taken.

With the exception of the harvest location data, the results of these interviews, plus those from ongoing National Marine Fisheries Service-sponsored research, will be included in an updated

version of the Whiskers! database using multimedia CD-ROM software. It will be necessary to purchase the necessary computer hardware and software to accomplish this task. Division personnel will also use this hardware and software for addressing the traditional knowledge objectives in Project 97052 (Community Involvement and Traditional Ecological Knowledge).

Division personnel will demonstrate the use of the database at the ANHSC workshop and make the database (Whiskers! Version 2) available on CD-ROMs to potential users. Craig Mishler, the coordinator of the division's harbor seal and sea lion harbor assessment program (funded by NMFS), will provide technical assistance in the updating of the database (2.0 months funded from this project, with additional support from the NMFS project). New fieldwork, preparation of the database, and demonstration of and training in its use will be assigned to Ronald Stanek (1.0 months, lower Cook Inlet) and William Simeone (1.0 months, Prince William Sound).

For harvest location data, cartographer Carol Barnhill will enter harvest site data into a GIS data base. Collection of these data has continued for 1994 and 1995, but data entry and cartography work was not funded in FY 96. Barnhill will produce draft maps to be reviewed by each community and the ANHSC to determine the appropriate format and procedure to make these data available to researchers. This is necessary because of the highly sensitive nature of harvest site data. Based on the results of this review, Barnhill will produce report-sized maps and finalize the database. One month of her time will be supported by this project.

Objectives 3, 5, and 6: Communications, Recommendations, and Evaluation

Regarding Objectives 3, 5, and 6, communication of study findings, development of recommendations, project evaluation, and development of a long-term funding plan, will be a collaborative effort met through a contract with the ANHSC, which will subcontract with RurAL CAP to do the following:

1. Organize one, two-day workshop to be held in conjunction with meetings of the ANHSC. Because the ANHSC is limited to one representative from each region which uses harbor seals (southeast Alaska, the Chugach Region, Cook Inlet, Kodiak, and Aleutian/Pribilofs), participation in the workshop will be expanded to include hunters from spill area communities. This workshop will be modeled after those held under Projects 94244, 95244, and 96244, which involved review of information by scientists and subsistence hunters. A goal of the workshop is discussion of potential recommendations for subsistence hunters concerning how they can support efforts to restore harbor seal populations.
2. Hold community meetings in the communities involved in the pilot biological sampling project, during which scientists and subsistence hunters review data, traditional knowledge is included in ongoing studies, and any recommendations developed at the workshops are discussed.
3. Write, produce, and distribute a workshop summary which provides overviews of findings from harbor seal research and ANHSC activities.

Also,

4. The Commission co-lead for this project will attend Trustee Council workshops and contribute to Trustee Council's annual and final reports

The Division of Subsistence will provide technical assistance to the Commission as needed.

Kate Wynne, through work on the biological sampling program, will write a report which summarizes the results of analysis of the samples taken as part of this project. The report will be written for a general audience.

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

C. Cooperating Agencies, Contracts, and Other Agency Assistance

A. Kate Wynne, University of Alaska Sea Grant Marine Advisory Program, will be contracted through an RSA with the ADF&G to organize the training and coordinate the sampling components of this project. In FY 97, she will:

1. Revise, as appropriate, protocols, data forms, sampling kits, and instructions for their use that were included in the training program developed in FY 96
2. Conduct one-day training workshops attended by community technicians, ANHSC staff, and agency personnel in Kodiak and the Chignik Area
3. Receive samples from village-based technicians in Kodiak and Chignik, process samples in Kodiak, and ship samples to participating researchers for analysis
4. Provide information for the statewide database of biological data maintained by ADF&G
5. Participate in the Alaska Native Harbor Seal Commission workshop
6. Help ADF&G collate results of sample analysis (provided by various researchers) into a readily understandable newsletter
7. Work with ADF&G to integrate these results into the updated traditional knowledge data (Whiskers!)
8. Write a brief summary of the project for inclusion in the interim and final reports for the Trustee Council

Proposed Contract A: Budget

Salary and benefits		
2 training session	0.50 months	
Update and produce manuals	0.25 months	
Sampling handling and transfer	1.00 months (0.25 per community)	
Prepare project summary	0.25 months	
Total, salary and benefits (1.75 months)	=	$11,097
25% UAF overhead		$2,774
Total		$13,871

Travel: will be arranged and paid for out of the ANHSC contract

In-kind contribution: The UAF Fisheries Industrial Technology Center will provide facilities at no cost for storing samples in Kodiak and laboratory facilities for Wynne to process samples and send them to participating researchers.

B. In FY 96 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 FY 97. The ANHSC intends to subcontract with RurAL CAP for assistance in carrying out these responsibilities. Tasks for the ANHSC under this contract will include:

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

Through a subcontract with the Commission, RurAL CAP will do the following:

1. Organize a two-day workshop during which, among other things, this project's performance and findings will be evaluated. This will include making all travel arrangements. The workshop will include hunters from the communities involved in the biological sampling program and two other Kodiak Island Borough communities.
2. Prepare a workshop proceedings summary report

Through subcontracts with the ANHSC, community technicians in 12 communities (Cordova, Tatitlek, Chenega Bay, Valdez, Seward, Seldovia, Port Graham, and Nanwalek; two Kodiak communities and two Alaska Peninsula communities) will do the following:

1. Attend one day training session (if newly hired in FY 97)
2. Collect samples (stomach contents, female reproductive organs, liver, heart, kidney, claws, head)
3. Record information about harvest locations, sex, evidence of tags or markers, length, and girth
4. Label and freeze samples, notify Kate Wynne, Vicki Vanek, or the ANHSC when freezers are full, and load and ship coolers with samples to Kodiak or Anchorage

Contract B: Budget

Personnel	Executive Director for 6.0 months @ $4,000/month	$24,000
Travel	Executive Director travel; training session travel	10,600
Operational costs		
phone		2,400
mailing		1,200
Insurance		1,200
Sampling and Freezer supplies, freezer electricity, shipping		5,800
Subcontract, village-based technicians		6,200
Subcontract, RurALCAP		17,700
15% indirect program cost		10,600
Total		$79,700

Note: in kind contributions for the operations of the ANHSC 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 B1: Village-based Technicians

Training honorarium: $100/day for eight technicians for one day each:	$800
Compensation for taking biological samples of seals	5,400
Total	6,200

Note: it is anticipated that samples will be taken from an average of 10 seals per community, for a total of 100 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 10 seals x 12 communities = $5,400.

Subcontract B2: RurAL CAP

Travel for workshops and training	13,608
Plan workshop with ANHSC; do logistics and travel	752
Prepare workshop proceedings and newsletters	1,000
Overhead of 15.5 percent	2,380
Total	17,700

SCHEDULE

A. Measurable Project Tasks for FY 97

Start-up to October 15	Update contracts with the Alaska Native Harbor Seal Commission and the University of Alaska; hire technicians
October/November	Hold regional training sessions for biological sampling in Kodiak and Chignik; train new community technicians in Valdez and Seward
December to September 1997	Biological sample collection
January 1997	Produce and distribute first proceedings report (Alaska Native Harbor Seal Commission)
February 1997	Two-day Workshop (Alaska Native Harbor Seal Commission): Demonstrate Traditional Knowledge Database
June 1997	Finalize harvest location site data base and maps
September 1997	Evaluate second year of program

B. Project Milestones and Endpoints

1. Development of sampling program: October/November 1995
2. Production and distribution of Instructional video: March 1996 Workshops to train local hunters and technicians in collection procedures: October/November 1995
3. Workshop in conjunction with meeting of Alaska Native Harbor Seal Commission: March 1996
4. Produce and distribute first proceedings report: April 1996
5. Maximize coordination with other programs: ongoing
6. Ship samples to appropriate laboratories for subsequent analysis: ongoing
7. Advise villages and scientists of analytical results when available: ongoing
8. Conduct interviews with hunters to collect traditional knowledge: ongoing
9. Second workshop in conjunction with Commission meeting: September 1996
10. Produce and distribute second proceedings report: September 1996
11. Train new village technicians: November 1996
12. Hold workshop in conjunction with ANHSC meeting: February 1997
13. Demonstrate updated Traditional Knowledge Database: February 1997
14. Produce and distribute proceeding for 1997 workshop: March 1997
15. Annual report: April 15, 1997
16. Complete map database and report: June 1997
17. Evaluate the program's effectiveness and develop a more long-term funding plan: September 1997
18. Annual report: April 15, 1998
19. Final project report: April 15, 1999

C. Completion Date

This project should continue as long as the Marine Mammal Ecosystem Research package is

underway. Presently, fieldwork and data analysis for this study package are proposed through FY 97, with close-out in FY 98. The biological sampling program should be viewed as a pilot project to continue for a total of three years (FY 96, FY 97, and FY 98) in order to get the system in place and provide enough time for an evaluation of its performance.

PUBLICATIONS AND REPORTS

Annual report April 15, 1997
Annual report April 15, 1998
Final report April 15, 1999

PROFESSIONAL CONFERENCES

No attendance planned for FY 97.

NORMAL AGENCY MANAGEMENT

The Division of Subsistence of the Alaska Department of Fish and Game has no statutory or regulatory responsibilities for marine mammal management. Without this project, marine mammal biologist who are working on harbor seal recovery would lose a key source of biological information on this species. Trustee Council support of the activities of the Alaska Native Harbor Seal Commission is likely to improve 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 is seeking funding from the National Marine Fisheries Service and Congressional support in accordance with provisions of the Marine Mammal Projection Act to support its long-term activities. Trustee Council support for ANHSC activities at this point enhances the likelihood that this long-term funding will be secured.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

This project will incorporate data on population status, distribution and degree of recovery of harbor seals from the Marine Mammal Ecosystem study package, including restoration project numbers 96001 and 96064. It will also draw on the results of research conducted by the Division of Subsistence under a contract with the National Marine Fisheries Service to monitor subsistence harvests. The project will provide information to researchers working on harbor seal restoration projects and facilitate their work with Alaska Native hunters. The project will provide biological samples from subsistence-taken harbor seals to address potential health and nutritional problems that may be impeding harbor seal recovery, for projects 96001 and 96064. Participants in the Youth Area Watch project (96210) will be invited to participate in community technician training sessions and attend the workshop.

Several programs exist to sample tissues from harbor seals from the spill area. As noted above, we will make every effort to coordinate our efforts 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 has expressed interest and may have funding available to expand this pilot program in FY 96 or in subsequent years. This agency may also have funds available to perform analysis of samples as part of its normal agency management functions. Additionally, NMFS will assist with coordinating the harbor seal sampling and testing programs.

Additional funding for the operations of the Alaska Native Harbor Seal Commission has been sought from the National Marine Fisheries Service and the U.S. Congress. Such funding would support more extensive activities for the Commission across the entire range of the harbor seal in Alaska.

This project will also contribute to 96214, "Documentary on Subsistence Harbor Seal Hunting in Prince William Sound." Its findings will assist in developing themes for the documentary. In turn, the documentary project will provide data for incorporation into the traditional knowledge database.

Also, the traditional knowledge database component of this project will directly support efforts under Project Number 96052 to integrate traditional knowledge of injured resources more broadly into restoration efforts and scientific studies. This will include a model for database organization and training in uses of the database. In turn, Project 96052 will, among other things, develop guidelines and protocols for collecting and using traditional knowledge which will be supportive of the efforts for harbor seal restoration.

EXPLANATION OF CHANGES IN CONTINUING PROJECTS

No major changes in project objectives or methods are being proposed from the detailed project description submitted and approved for FY 96. The number of communities included in the biological sampling program has been increased from 6 to 12. Valdez and Seward have been added in the Chugach Region to provide broader geographic coverage of the sampling effort. Two Kodiak Island and two Chignik area communities have also been added to fill a gap in geographic coverage of the harbor seal biological sampling effort. At the same time, the number of samples per community has been reduced from 20 to 10, which is a more realistic goal given the results of the sampling effort in FY 96. Also, it is proposed that ADF&G handle the subsampling tasks for the Chugach communities, while UAF take responsibility for Chignik and Kodiak samples. The number of ANHSC workshops has been reduced from two one-day workshops to one two-day workshop. This approach will reduce travel costs and will allow for more in-depth treatment of workshop agenda items. Finally, the revised, upgraded Version 2 of the Whiskers! database will be developed using multi-media CD-ROM software.

ENVIRONMENTAL COMPLIANCE

This project is a continuation of Projects 94244, 95244, and 96244, which were classified as categorically excluded under NEAP 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

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PERSONNEL

Kate Wynne is a marine mammal biologist with the University of Alaska, stationed in Kodiak. She has extensive experience in working with Alaska Native subsistence hunters. In 96244, Ms Wynne was responsible for designing and implementing the biological sampling program objectives in this project, including holding two village based technician workshops, and developing data forms and data management procedures. She will continue these responsibilities in FY 97. She will also write a report which summarizes findings from the sampling program, and assist the Alaska Native Harbor Seal Commission in reporting study findings to local communities.

Monica Riedel, an Alaska Native resident of Cordova, is the chairperson of the Alaska Native Harbor Seal Commission. She has extensive experience in marine mammal issues through her work with the Alaska Sea Otter Commission. Ms Riedel is responsible for the ANHSC activities under this project, including identifying and subcontracting with local village technicians, developing subcontracts, and participating in workshops and community meetings.

James Fall is the Regional Program Manager for the Division of Subsistence in Anchorage. Dr. Fall is responsible for overall project performance. He will also coordinate preparation of annual and final reports. No restoration funds are being requested for support of his time on this project.

Craig Mishler has been a Subsistence Resource Specialist with the Division of Subsistence since 1989. He is presently the division's project manager for the Harbor Seal and Sea Lion Harvest Assessment Project. In FY 96, Dr. Mishler developed the Whiskers! database, demonstrated its use, and distributed it to scientists, hunters, and communities. In FY 97, he will be assigned 2.0 months to this project up update and upgrade the Whiskers! database and demonstrate its use at the ANHSC workshop.

Ronald T. Stanek has been a Subsistence Resource Specialist with the Division of Subsistence since 1980, with extensive fieldwork experience in oil spill communities, especially lower Cook Inlet. He will be assigned one month to this project to conduct hunter interviews in Seldovia, Port Graham, and Nanwalek, assist with updating the Traditional Knowledge Database, and provide other technical assistance to the Commission.

William Simeone. Dr. Simeone was added to the Division of Subsistence staff as a Subsistence Resource Specialist in 1995. He has extensive prior research experience in most communities in the oil spill area. He will be assigned for 1.0 month to this project to conduct hunter interviews in Cordova, Tatitlek, and Chenega Bay, assist with updating the Traditional Knowledge Database, and provide other technical assistance to the Commission.

Vicki Vanek is a Fish and Wildlife Technician 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. She will be available as needed to assist hunters and community technicians, and will train newly hired technicians in Valdez and Seward. Dr. Vanek will also process samples received from the Chugach Region communities. She will also prepare a newsletter which

reports results of the biosampling efforts. She is funded for two months on this project, will additional time supported with NMFS-sponsored harvest monitoring and sampling effort.

Carol Barnhill is a Cartographer with the Division of Habitat and Restoration of ADF&G in Anchorage. She has extensive experience with GIS systems and with subsistence harvest area mapping.

1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1996 - September 30, 1997

Budget Category:	Authorized FFY 1996	Proposed FFY 1997	LONG RANGE FUNDING REQUIREMENTS					
			Estimated FFY 1998	Estimated FFY 1999	Estimated FFY 2000	Estimated FFY 2001	Estimated FFY 2002	
Personnel	$28.8	$34.6						
Travel	$4.4	$4.8						
Contractual	$83.6	$95.1						
Commodities	$1.4	$1.9						
Equipment	$0.1	$7.5						
Subtotal	$118.3	$143.9						
General Administration	$10.2	$11.8						
Project Total	$128.5	$155.7	$85.0	$0.0	$0.0	$0.0	$0.0	
Full-time Equivalents (FTE)	0.5	0.6						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments:

Alaska Dept. of Fish and Game	$50.2
Alaska Native Harbor Seal Commission	$79.7
University of Alaska	$14.0
General Administration	$11.8
TOTAL	$155.7

1997

Prepared: 4/10/96

Project Number: 97244
Project Title: Community-Based Harbor Seal Management and Biological Sampling
Agency: Alaska Department of Fish and Game

FORM 3A
TRUSTEE
AGENCY
SUMMARY

4/11/96

1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1996 - September 30, 1997

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FFY 1997
V. Vanek	Fish and Wildlife Technician III	11E	2.0	3.9		7.8
C. Mishler	Subsistence Resource Specialist III	18F	2.0	5.7		11.4
R. Stanek	Subsistence Resource Specialist III	18K	1.0	6.0		6.0
W. Simeone	Subsistence Resource Specialist II	16B	1.0	4.4		4.4
C Barnhill	Cartographer II	16K	1.0	5.0		5.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		7.0	25.0	0.0	
					Personnel Total	$34.6

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FFY 1997
Kodiak - Anchorage	0.2	3	10	0.1	1.6
Anchorage - Valdez	0.2	1	1	0.1	0.3
Anchorage - Seward	0.1	1	1	0.1	0.2
Anchorage - Tatitlek	0.6	1	3	0.1	0.9
Anchorage - Chenega	0.9	1	3	0.1	1.2
Anchorage - Seldovia/Port Graham/Nanwalek	0.3	1	3	0.1	0.6
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$4.8

1997

Prepared: 4/10/96

Project Number: 97244
Project Title: Community-Based Harbor Seal Management and Biological Sampling
Agency: Alaska Department of Fish and Game

FORM 3B
Personnel
& Travel
DETAIL

4/11/96

1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1996 - September 30, 1997

Contractual Costs:		Proposed FFY 1997
Description		
4A Linkage	Alaska Native Harbor Seal Commission Contract	79.7
	University of Alaska Fairbanks, School of Fisheries and Ocean Sciences RSA	14.0
Air freight for shipping samples from Anchorage to participating labs		1.0
Air freight for freezers		0.4
When a non-trustee organization is used, the form 4A is required.	**Contractual Total**	$95.1

Commodities Costs:	Proposed FFY 1997
Description	
Shipping supplies and subsampling supplies	1.0
Cartographic supplies	0.1
Video tapes (additional distribution of 5 -10 training videos; includes copying and shipping costs)	0.1
100 blank compact disks @ $7 each	0.7
Commodities Total	$1.9

1997

Prepared: 4/10/96

Project Number: 97244
Project Title: Community-Based Harbor Seal Management and Biological Sampling
Agency: Alaska Department of Fish and Game

FORM 3B
Contractual & Commodities
DETAIL

4/11/96

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FFY 1997
Small freezers for sample storage in four new sampling communities	4	0.4	1.6
Compact Disk Recorder Drive and Software	1	1.8	1.8
External 1 GB hard drive (to store graphic images)	1	0.6	0.6
Flatbed photo scanner	1	1.0	1.0
Multi-media development software	1	2.5	2.5
			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**	$7.5

Existing Equipment Usage: Description	Number of Units	Inventory Agency

1997

Project Number: 97244
Project Title: Community-Based Harbor Seal Management and Biological Sampling
Agency: Alaska Department of Fish and Game

FORM 3B
Equipment
DETAIL

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

Budget Category:	Authorized FFY 1996	Proposed FFY 1997	LONG RANGE FUNDING REQUIREMENTS					
Personnel	$23.0	$24.0						
Travel	$3.9	$10.6						
Contractual	$31.4	$31.9						
Commodities	$9.1	$2.8						
Equipment		$0.0						
Subtotal	$67.4	$69.3	Estimated FFY 1998	Estimated FFY 1999	Estimated FFY 2000	Estimated FFY 2001	Estimated FFY 2002	
Indirect		$10.4						
Project Total	$67.4	$79.7						
Full-time Equivalents (FTE)	5.8	6.0						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments:

1997

Prepared: 4/10/96

Project Number: 97244
Project Title: Community-Based Harbor Seal Management and Biological Sampling
Name: Alaska Native Harbor Seal Commission

FORM 4A
Non-Trustee
SUMMARY

4/11/96

1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1996 - September 30, 1997

Personnel Costs:			Months	Monthly		Proposed
	Name	Position Description	Budgeted	Costs	Overtime	FFY 1997
	M. Riedel	Executive Director	6.0	4.0		24.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
		Subtotal	6.0	4.0	0.0	
					Personnel Total	$24.0

Travel Costs:		Ticket	Round	Total	Daily	Proposed
	Description	Price	Trips	Days	Per Diem	FFY 1997
	Anchorage - Cordova (training sessions, ANHSC workshop, and 2 restorati	0.1	4	10	0.2	2.4
	Anchorage - Kodiak (Riedel); Kodiak - Anchorage (Wynne)	0.2	2	5	0.2	1.4
	Anchorage - Chignik (Riedel and Wynne)	0.7	2	2	0.2	1.8
	Anchorage - Seward	0.1	1	1	0.2	0.3
	Anchorage -Port Graham/Nanwalek/Seldovia	0.3	1	3	0.2	0.9
	Cordova - Chenega	0.9	1	1	0.2	1.1
	Cordova - Tatitlek	0.6	1	1	0.2	0.8
	Cordova - Valdez	0.2	1	1	0.2	0.4
	Perryville - Chignik Lake (Technician)	0.1	1	1	0.2	0.3
	Akhiok - Kodiak (Technician)	0.2	1	2	0.2	0.6
	Old Harbor - Kodiak (Technician)	0.2	1	2	0.2	0.6
	Note: above includes tech travel to biosampling sessions and K. Wynne travel					0.0
					Travel Total	$10.6

1997

Prepared: 4/10/96

Project Number: 97244
Project Title: Community-Based Harbor Seal Management and Biological Sampling
Name: Alaska Native Harbor Seal Commission

FORM 4B
Personnel
& Travel
DETAIL

4/11/96

1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1996 - September 30, 1997

Contractual Costs:		Proposed
Description		FFY 1997
Phone @ 200/month		2.4
Postage @ 100/month		1.2
Insurance		1.2
Subcontract with RurALCAP to organize a workshop and prepare a summary		17.7
Travel for village participants ($13,608); staff support ($752); write summary ($1000); indirect (15.5 % = $2,380)		
Electricity for village sample freezers		2.2
Subcontracts with 12 community technicians		6.2
Training Honorarium (6 new technicians, 2 replacements; $100/assistant)	$800	
Sample processing (12 communities, 10 seals/community, $45/seal)	$5,400	
Shipping Biological Samples		1.0
	Contractual Total	$31.9

Commodities Costs:	Proposed
Description	FFY 1997
Purchase replacement materials for sampling kits (knives, gloves, plastic bags) (6 kits)	0.1
Purchase of new sampling kits (6 kits @ 120/kit)	0.7
Shipping supplies	2.0
Commodities Total	$2.8

1997

Prepared: 4/10/96

Project Number: 97244
Project Title: Community-Based Harbor Seal Management and Biological Sampling
Name: Alaska Native Harbor Seal Commission

FORM 4B
Contractual & Commodities DETAIL

4/11/96

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

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

Existing Equipment Usage: Description	Number of Units	

1997

Prepared: 4/10/96

Project Number: 97244
Project Title: Community-Based Harbor Seal Management and Biological Sampling
Name: Alaska Native Harbor Seal Commission

FORM 4B
Equipment
DETAIL

4/11/96

1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1996 - September 30, 1997

Budget Category:	Authorized FFY 1996	Proposed FFY 1997	LONG RANGE FUNDING REQUIREMENTS					
			Estimated FFY 1998	Estimated FFY 1999	Estimated FFY 2000	Estimated FFY 2001	Estimated FFY 2002	
Personnel	$11.1	$11.2						
Travel	$0.0	$0.0						
Contractual	$0.0	$0.0						
Commodities	$0.0	$0.0						
Equipment	$0.0	$0.0						
Subtotal	$11.1	$11.2						
Indirect	$2.8	$2.8						
Project Total	$13.9	$14.0						
Full-time Equivalents (FTE)		2.0						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments:

1997

Prepared: 4/10/96

Project Number: 97244
Project Title: Community-Based Harbor Seal Management and Biological Sampling
Name: University of Alaska Fairbanks

FORM 4A
Non-Trustee
SUMMARY

4/11/96

1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1996 - September 30, 1997

Personnel Costs:			Months	Monthly		Proposed
	Name	Position Description	Budgeted	Costs	Overtime	FFY 1997
	K. Wynne	Research Associate Professor	2.0	5.6		11.2
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
		Subtotal	2.0	5.6	0.0	
					Personnel Total	$11.2

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

1997

Prepared: 4/10/96

Project Number: 97244
Project Title: Community-Based Harbor Seal Management and Biological Sampling
Name: University of Alaska Fairbanks

FORM 4B
Personnel
& Travel
DETAIL

4/11/96

1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1996 - September 30, 1997

Contractual Costs:	Proposed
Description	FFY 1997
Contractual Total	$0.0

Commodities Costs:	Proposed
Description	FFY 1997
Commodities Total	$0.0

1997

Prepared: 4/10/96

Project Number: 97244
Project Title: Community-Based Harbor Seal Management and Biological Sampling
Name: University of Alaska Fairbanks

FORM 4B
Contractual & Commodities
DETAIL

4/11/96

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

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

Existing Equipment Usage: Description	Number of Units	

1997

Project Number: 97244
Project Title: Community-Based Harbor Seal Management and Biological Sampling
Name: University of Alaska Fairbanks

FORM 4B
Equipment
DETAIL

Prepared: 4/10/96

4/11/96

Community-Based Harbor Seal Research, Submitted Under the BAA

Project number:	97245-BAA
Restoration category:	Research
Proposer:	Alaska Native Harbor Seal Commission
Lead Trustee Agency:	
Cooperating Agencies:	
Alaska SeaLife Center:	Yes
Duration:	Four years
Cost FY 97:	256.7
Cost FY 98:	237.7
Cost FY 99:	237.7
Cost FY 00:	133.0
Cost FY 01:	00
Cost FY 02:	00
Geographic Area:	Prince William Sound, Kenai Peninsula, lower Cook Inlet, Kodiak Archipelago, Alaska Peninsula
Injured Resource/Service:	Harbor Seals, Subsistence

ABSTRACT

This project aids restoration of harbor seals and subsistence by developing fundamental data sets needed to (1) evaluate factors affecting the harbor seal decline and (2) to strengthen monitoring of subsistence takes. This project involves the knowledge and expertise of subsistence users and other community members to: survey seasonal changes in harbor seal distribution during the fall-winter-spring; develop detailed annotated harbor seal distribution maps; and work with the Community Involvement project to record observations of local marine occurrences and summarize observations in regional newsletters.

INTRODUCTION

The goal of this project is to develop a research program to help the Alaska Native Harbor Seal Commission (ANHSC) effectively monitor subsistence takes of harbor seals and to contribute to the existing scientific research on harbor seals. A primary focus of the research is to assess factors that affect the recovery of the harbor seal population in the oil spill area. Current harbor seal research suggests that factors associated with winter survival of harbor seals may be a primary cause of the decline, however, knowledge of the distribution and activities of harbor seals during the winter is poorly documented. This project proposes to use local and traditional knowledge and winter surveys and observations to develop fundamental data sets needed for the understanding of harbor seal activities during the winter. This project will focus on obtaining information on the distribution and habitat use by harbor seals during the fall-winter-spring by: (1) initiating tri-monthly, vessel-based surveys of selected areas from October through April, (2) documenting the seasonal distribution of harbor seals in the past and present based on local knowledge, traditional knowledge, and scientific data; (3) and recording local observations of marine occurrences.

This project is closely linked to general restoration project \244, Community-based Harbor Seal Management and Biological Sampling. The proposed research was stimulated by needs expressed by scientists and community members at Trustee Council funded workshops conducted by projects (94244, 95244, and 96244) and a National Marine Fisheries Service workshop held in November 1995 to review population assessment research on harbor seals in Alaska. The results of the proposed investigations will be presented to community members and scientists at workshops, organized by project (97244) where the effectiveness of the projects will be reviewed and recommendations for improvements will be made.

This project also will support other restoration projects proposed for FY 97 and beyond, such as the Condition and Health of Harbor Seals (97001), Monitoring of Harbor Seals in Prince William Sound (97064), Isotope Ratio Studies of Marine Mammals (97170), the Community Involvement and Traditional Knowledge Project (97052), the Youth Area Watch (97210), Sound Ecosystem Assessment (97320) and would provide valuable harbor seal seasonal distribution information for Ecosystem Synthesis.

NEED FOR THE PROJECT

A. Statement of Problem

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, in most regions, they are not recovering. Harbor seals are a primary subsistence resource for the Alaska Native communities of the oil spill region. Subsistence harvests of harbor seals also have declined in many communities since the spill because of the seal's reduced population size and the hunter's voluntary efforts to aid recovery by limiting takes.

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. The recovery objective for subsistence states that recovery will have occurred when injured subsistence resources are healthy and productive and exist at pre-spill levels, and people are confident that the resources are safe to eat. Based on the findings from workshops conducted under Project \244, meeting these recovery objectives will be enhanced by involving subsistence hunters in research efforts and developing recommendations for subsistence hunters about how they can help in harbor seal recovery.

Fundamental to understanding the cause of the harbor seal decline, the impact of subsistence takes, and any mitigating measures that can be taken to reduce the adverse impact of takes on harbor seal recovery, is knowledge of the seasonal distribution and activities of harbor seals, especially during the fall, winter, and spring when it is thought that harbor seal numbers are being reduced by natural factors. Scientists have repeatedly stressed a lack of understanding regarding the year-around movements and distribution of harbor seals. This information is needed to: (1) understand important habitats used at different times of the year, (2) document potentially sensitive locations or habitats, and (3) evaluate potential factors adversely affecting the harbor seal populations and contributing to the decline.

Subsistence hunters and other community members can provide important information about the winter location and abundance of seals, the condition of seals taken for subsistence purposes, and the seal's behavior. This project is designed to incorporate local and traditional knowledge and community resources and personnel to: (1) document seasonal harbor seal distribution in the past and present using a Geographic Information System (GIS) to map known harbor seal haulout sites and store information about harbor seal use of each site; (2) document habitat use during the fall, winter, and spring by conducting tri-monthly, vessel-based surveys of selected routes; and (3) document local marine occurrences observed by coastal community members that may be used for understanding and investigating the population decline of harbor seals and other near shore organisms.

C. Location

The proposed studies will involve sites and communities in Prince William Sound, the Kenai Peninsula and lower Cook Inlet area, the Kodiak Island area, and the south side of the Alaska Peninsula. The Fall-Winter-Spring harbor seal surveys will primarily focus on two survey routes in Prince William Sound (probably near Chenega Bay, Tatitlek, or Cordova), two survey routes along the Kenai Peninsula (probably near Nanwalek, Port Graham, Seldovia or Seward) and two survey routes on Kodiak Island (probably near Ouzinkie, Kodiak, Old Harbor, Akhiok, Larsen Bay, or Port Lions). Personnel, vessels, and supplies will be obtained from communities near the selected survey routes.

The annotated harbor seal distribution maps will involve hunters and other knowledgeable persons from all coastal communities of the oil spill region. Focus communities include the Prince William Sound communities of Cordova, Chenega Bay, Tatitlek, and Valdez; the Kenai Peninsula and lower

Cook Inlet communities of Seward, Homer, Seldovia, Port Graham, and Nanwalek; the Kodiak Island communities of Ouzinkie, Kodiak, Old Harbor, Akhiok, Larsen Bay, and Port Lions; and the southern Alaska Peninsula communities of Perryville and Chignik.

The community observation program initially will focus on five communities with village representatives, including two locations in Prince William Sound, one location on the Kenai Peninsula/Lower Cook Inlet, one location on Kodiak Island and one location on the Alaska Peninsula. Each village representative will develop an outreach program to collect information from other communities in their region.

COMMUNITY INVOLVEMENT

In May 1995, The Alaska Native Harbor Seal Commission (ANHSC) was formed to strengthen and increase the role of Alaska Native resource policy affecting harbor seals and their uses. The goals of the ANHSC include the following: educating and informing the public and scientists on the traditional and contemporary relationship between harbor seals and Alaska Natives, informing scientists about the type and extent of knowledge held by the local people about harbor seals, and involving Alaska Natives directly in the research, regulatory and management processes.

The Alaska Native Harbor Seal Commission represents harbor seal subsistence communities throughout the oil spill area and can provide effective coordination and implementation of the proposed projects by: (1) contacting local communities about the project and soliciting their involvement, (2) contracting with local community members to collect data and provide locally available resources and equipment, including vessels, and (3) communicating the results of the studies through reports and newsletters identified in this project and through newsletters, workshops, and workshop proceedings identified in Trustee Council project 97244.

Local and traditional knowledge of Alaska Natives of the oil spill area is essential to the success of this project. The Alaska Native Harbor Seal Commission will: (1) contract and train six observers to conduct fall-winter-spring harbor seal surveys; local vessels and crew will be used to conduct the surveys; (2) solicit information from and contract knowledgeable community members to provide data for the annotated harbor seal distribution project; and (3) contract and train five community representatives to collect and compile information provided by hunters and local community residents for the marine observation program and to develop outreach programs to obtain similar information from residents of other regional communities.

PROJECT DESIGN:

A. Objectives

1. Document the past and present seasonal distribution of harbor seals using traditional and local knowledge, and scientific data.

2. Initiate a pilot fall-winter-spring survey program to investigate seasonal habitat use.

3. Initiate a community observation program to document local marine occurrences.

4. Provide a forum for subsistence hunters to collect and review data and discuss potential recommendations for hunting guidelines.

5. Evaluate the program's effectiveness.

B. METHODS

Objective 1. Seasonal Distribution of Harbor Seals.

The seasonal distribution of harbor seals, will be documented using three techniques (1) fall-winter-spring surveys, (2) annotated harbor seal distribution maps, and (3) community observation programs:

Fall-Winter-Spring Surveys. The proposed fall-winter-spring surveys are the first of a three-year pilot study to document the fall-winter-spring distribution of harbor seals. The study involves conducting vessel surveys of two areas in three regions: (1) Prince William Sound (an area of severe oil impact and declining seal numbers), (2) Kenai Peninsula/Cook Inlet (an area of less severe oil impact and declining seal numbers), and (3) Kodiak Island (an area of less severe oil impact and increasing seal numbers). Each survey route will include areas where seals are known to visit in the fall, winter, and spring, and that can be safely surveyed in about 4-6 hours. Survey routes will be selected to include a variety of habitats including protected coves, anadromous stream mouths, seasonal pan or glacier ice, and rocky semi-protected shoreline. Specific survey routes will be determined with consultation of local community members to identify areas closely meeting the above criteria.

Surveys will be conducted approximately every 10 days (weather permitting) and document the location, estimated age of the seal (e.g., pup/yearling, juvenile, large adult) if it can be ascertained, the seal's activity, whether the seal is on shore, ice, or in the water, existence and activity of other birds, marine mammals, or fishes in the area. In addition, information on the date, time of day, tide, currents, sea condition, and weather will be collected at specific stations and when it noticeably changes. Sightings of harbor seals will be recorded on field maps and related information recorded on data sheets.

Observers will be trained to conduct surveys using consistent methods from survey to survey that minimize disturbance to seals. An effort will be made to standardize survey protocols between routes (e.g., vessel speed, platform height, identification of categorical data such as weather and sea conditions). The assignment of age categories for harbor seals can be very subjective. Surveys will be conducted using highly experienced observers, however, each observer may use different cues to assign age classes to seals. Criteria used by each observer to assign age categories to seals will be

identified before the first survey and after the completion of surveys the following spring. Although certain categories may be reached by consensus (e.g., large adult male, late-term pregnant female, small 0-1 year-old juveniles) other categories may not be reliably identified by all observers. For FY 97 an emphasis will be placed on standardizing categorical assignments within survey routes (observers). After evaluating the results from FY 97 data, recommendations and training will be conducted to standardize age categories between survey routes (observers) for FY 98 and beyond.

Although continuing surveys throughout the summer would be desirable, we believe, it is important to first statistically evaluate winter surveys, when the likelihood of observing seals is lowest and survey conditions are poorest. A primary purpose of the FY 97 surveys will be to provide information to test the feasibility of using winter surveys to monitor seal distribution and to study habitat use during the winter months. Results from FY 97 will be used to estimate sample variances, develop sampling protocol for FY 98, estimate the statistical power of the FY 98 sampling program, and make recommendations for the extension of surveys into the summer.

Annotated, Seasonal Distribution Maps. Information on the location of harbor seal haulouts is available from scientific research programs (including \001 and \064) and a variety of reports and surveys (e.g., see Hoover-Miller (1994), Loughlin (1992), Pitcher and Calkins (1979)), the traditional knowledge program (\224, \052, 96214), and from local coastal residents, knowledgeable about particular areas. Data from the scientific surveys primarily focus on the distribution of harbor seals during pupping and molting periods; the location and use of haulouts at other times of the year are poorly documented.

A goal of this project is to develop a geographic information system where haulout sites are mapped and related information about historical and seasonal use by harbor seals is linked through associated databases. The use of a geographic information system will aid integration of local and traditional knowledge with scientific data by using a common interface. These data can then be used for further analysis and may be particularly suitable for near shore ecosystem modeling and Ecosystem Synthesis.

Initial data collection is proposed to be accomplished in each participating community where knowledgeable persons will review detailed marine charts and mark the location of specific harbor seal haulout sites. For each site identified, one of two data sheets will be filled out to provide information on the year, time of year, number of seals, whether or not pups or molting seals were present, and miscellaneous comments. A detailed data sheet will be available for particularly familiar sites that includes information about the location and description of the site, the observer's experience with the site, historical use of the site by seals, seasonal use of the site by seals, whether or not the site is used for pupping or molting, and miscellaneous comments. Each form also identifies the observer and date the information was provided.

To integrate the results of this project with other ecosystem studies, information from data sheets will be entered into a dBASE data base and the location of associated harbor seal haulouts will be digitized for inclusion into a Geographic Information System using ArcCad software and a coastline base map compatible with other Trustee Council GIS applications.

Community Observations. Occurrences relating to the marine environment (e.g., locating and timing of schooling fishes, feeding concentrations of seabirds and marine mammals) are often observed by coastal residents but rarely are recorded. Such observations can provide valuable information on local conditions, annual variations in marine conditions or occurrences, and documentation of unusual occurrences. These observations are important for recording factors potentially relevant to understanding the cause of the harbor seal population decline and that may enhance recovery. Such observations can then be followed up by scientific investigation.

Information about diverse topics concerning the marine environment is proposed to be gathered using two methods: (1) data sheets requesting information about the date, time, location, observation, and observer will be posted at public places in each village to be filled out by community members. Periodically the data sheets will be collected and processed by a designated community representative; (2) similar information about observations also can be given directly to the community representatives. The community representative would compile and enter information into a database and summarize the information for publication in regional marine newsletters. The ANHSC will publish and distribute the newsletters to residents of each community, scientists, and other interested persons. Community representatives also will develop an outreach program to collect and process similar information from other regional communities.

C. Cooperating Agencies, Contracts, and Other Agency Assistance

Consultation and technical assistance will be provided as in-kind contributions by the Alaska Sea Otter Commission, the Chugach Regional Resources Commission, Rural Alaska Community Action Program, the Indigenous People's Council for Marine Mammals, and the ADF&G, Division of Subsistence. The following contracts are planned:

1. Pacific Rim Research

A. Hoover-Miller at Pacific Rim Research will be contracted by the ANHSC as a biological consultant to develop the year-around distribution of harbor seals based on traditional and local knowledge and fall-winter-spring field surveys. She will:

1. Develop protocols for fall-winter-spring surveys, documentation of harbor seal haulouts, and community observations, develop data forms, and incorporate instructions for their use into training programs.

2. Initiate and conduct village workshops in Cordova, Homer, and Kodiak to train fall-winter-spring survey observers and regional community representatives.

3. Receive information from workshops, surveys, and community observations and enter information into databases; the location of haulout sites and related population information will be digitized and integrated in an ArcCAD based geographic information system.

4. Develop readily understandable reports for distribution to community members that summarize the progress and results of the projects.

5. Participate in ANHSC workshops and provide summaries of the results of the research programs.

6. Evaluate the progress and results of the projects and develop recommendations for improving procedures and protocol.

7. Write a summary of the project for inclusion in the interim and final reports for the Trustee Council.

Proposed Contract 1: Budget

A. Hoover-Miller @ $5,000/mo. for nine mo.	$45,000
Overhead (10% contract, not incl. travel)	$5,625
December ANHSC Workshop (paid by project 97244)	
Compensation to be paid to contributors of annotated harbor seal maps for time	$11,250
(Note: estimated 750 hours to be contributed @ $15/hr)	
Total:	$61,875

2. Fall-winter-spring field surveyors.

Experienced subsistence hunters will be contracted to conduct tri-monthly surveys from mid-October through April and record all sightings of harbor seals within specific routes on data maps and data sheets. Nineteen surveys are expected to be conducted per route each year.

Proposed Contract 2: Budget

Vessels, including crew and supplies:	$86,184
(Vessel costs estimated for an average of 42 ft vessel at a rate of $18/ft/day per survey)	
(42 ft x $18/ft/day x 19 surveys x 6 survey routes)	
Observer @ $150/day	$17,100
(6 persons x $150/day x 19 surveys x 6 survey routes)	
Total:	$103,284

3. Village Representatives for Community Observation

Duties include the following: entering community observations into a data base, summarizing community observations for regional newsletters, compile information from the annotated harbor seal distribution project and submit all data to the ANHSC.

Proposed Contract 4: Budget

Compensation for time spent compiling and processing village observations and assisting with seasonal distribution maps and fall-winter-spring surveys as needed. Note: it is anticipated that 5 village representatives will spend 5 days per month

5 persons x $120/day x 5 days/mo x 12 mo.	$36,000
Overhead (10% of contract)	$3,600
Total	$39,600

SCHEDULE

A. Measurable Project Tasks for FY 97

Start-up to October 15:	Pacific Rim Research, technicians, and community representatives. Apply for Marine Mammal Protection Act Section 104 permit for Level B harrassment.
October 1996:	Hold village training sessions for fall-winter-spring survey program and community observation program.
October-April 1977	Conduct fall-winter-spring surveys Collect annotated harbor seal distribution information.
December 1996	Participate in \244 workshop, summarize and evaluate progress to date, make necessary changes to sampling protocol, and provide follow-up training, if needed.
January 1997	Participate in the Trustee Council Restoration Workshop
April 1997:	Produce and distribute first community observation newsletters.
September 1997:	Produce and distribute second community observation newsletters. Evaluate second year of program.

B. Project Milestones and Endpoints

1. Conduct workshops in Cordova, Homer, and Kodiak to train hunters and village representatives on providing and recording information for the annotated harbor seal distribution maps and community observation programs: October 1996.
2. Begin fall-winter-spring surveys: October 1996

3. Begin developing geographic information system coverage for annotated harbor seal distribution maps. November 1996.
4. Participate in \244 workshop, summarize and evaluate progress to date, make necessary changes to sampling protocol, and provide follow-up training, if needed: December 1996
5. Produce and distribute first community observation newsletters: April 1997
6. Produce and distribute second community observation newsletters: September 1997
7. Evaluate the program's effectiveness: September 1997
8. Participate in the Trustee Council Restoration Workshop: January 1998
9. First annual report: April 15, 1998.
10. Produce and distribute third community observation newsletters: April 1998
11. Produce and distribute fourth community observation newsletters: September 1998
12. Begin 1998 fall-winter-spring surveys: October 1998
13. Begin to incorporate scientific data into harbor seal distribution GIS: October 1998
14. Participate in the Trustee Council Restoration Workshop: January 1999
15. Produce and distribute fifth community observation newsletters: April 1999
16. Second annual report: April 15, 1999.
17. Produce and distribute sixth community observation newsletters: September 1999
18. Begin 1999 fall-winter-spring surveys: October 1999.
19. Complete and distribute the annotated harbor seal distribution GIS: December 1999
20. Participate in the Trustee Council Restoration Workshop: January 2000
21. Produce and distribute seventh community observation newsletters: April 2000
22. Final Report: April 15, 2000.

D. Completion Date

Community-based harbor seal research should continue as long as the Marine Mammal Ecosystem Research package is underway. Presently, fieldwork and data analysis for this study package are proposed through FY 99, with close-out in FY 00. The harbor seal distribution program should be viewed as a pilot program to continue for three years. At the end of three years a harbor seal distribution GIS coverage should be complete and distributed. Fall-winter-spring surveys and the recording of local observations will be evaluated annually to assess needed modifications. After two years their contribution to Trustee Council objectives will be evaluated and recommendations for future continuance or discontinuance of the programs will be made.

PUBLICATIONS AND REPORTS

No manuscripts are planned for publication in peer-reviewed journals for FY 97.

Two community observation newsletters each fiscal.
First annual report: April 15, 1998.
Second annual report: April 15, 1999.
Final Report April 15, 2000.

PROFESSIONAL CONFERENCES

Alaska Native Harbor Seal Commission Workshop
Indigenous People's Council for Marine Mammal Meetings

NORMAL AGENCY MANAGEMENT

Not Applicable.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

This project will supplement and use data about the population status, distribution, and degree of recovery of harbor seals collected by the Marine Mammal Ecosystem study package, including restoration project numbers 97001 and 97064. It also will draw on the results of research conducted by the Division of Subsistence under a contract with the National Marine Fisheries Service to monitor subsistence harvests and project 97244. The project will provide information to researchers working on harbor seal restoration projects and aid their access to local and traditional knowledge of Alaska Native hunters. In addition this project will rely highly on the participation of community members and will coordinate activities with the Community Involvement project (\052) and the Youth Area Watch (97210).

PROPOSED PRINCIPAL INVESTIGATOR, IF KNOWN

Monica Riedel
Alaska Native Harbor Seal Commission
P.O. Box 2229
Cordova, AK 99574
Phone: (907) 424-5882
FAX: (907) 424-5883

Monica Riedel

MONICA RIEDEL

P.O. Box 2229 ▪ Cordova, AK 99574 ▪ (907) 424-5882

OBJECTIVE

To be fully involved in tribal and cultural preservation. Main focus of interest is conservation of marine mammals and preservation of traditional and customary use of marine mammals.

EMPLOYMENT

Present: **Chairperson**. Alaska Native Harbor Seal Commission, P.O. Box 2229, Cordova, Alaska. ph. (907) 424-5882, Fax (907) 424-5883.

Duties: (1) to call and preside at all meetings of the Commission of the Executive Committee; (2) to speak on behalf of the Commission and the Executive Committee; (3) to authorize public statements of Commission position; (4) to sign documents on behalf of the Commission; and (5) to perform other such duties of the office as prescribed by the commission of Executive Committee.

Co-Project Leader. *Exxon Valdez* Trustee Council Restoration Project on Community-based Harbor Seal Management and Biological Sampling.

Duties: facilitating workshops related to the harbor seal population and issues, facilitating training sessions for biological sampling, setting up accounts for shipping samples, hiring/subcontracting hunters for program, creating and distributing newsletters to tribes, financial accounting to funding agencies. Writing proposals and applying for grants.

Owner. Dineega Specialty Furs. P.O. Box 1005. Cordova, Alaska, 99574. Phone (907) 424-3241.

Specializing in Alaska Native Parkas, decorated with traditional beadwork, and in-lay applique. Work involves managing all phases of the business and training employee in measuring, altering patterns, grading fur, creating designs for parka trims, buying fur, leather, tools and other materials. Also teach at various spirit camps and villages.

1989 **Expediter**. City of Cordova.

Duties: Transporting dignitaries to and from airport, taking television crews to interviews, logging and filing daily Coast Guard reports, preparing information for Senators, and other decision makers.

1983-1986 **Administrative Assistant** to Harbor master. City of Cordova.

Duties: Billing and posting all department charges and receivables via electronic cash register and maintaining computerized records. Perform all normal reception and clerical duties (correspondence, memos, minutes, etc), maintain radio watch and overseen grid assignments, insure proper registration and moorage of vessels, perform facilities check and security presence.

1979-1981 **Cannery Worker**. Chugach Alaska Fisheries, North Pacific Processors, Glacier Packing. Cordova, Alaska.

1977-1979 **Real Estate Agent**. Red Carpet Realtors. 7300 Franklin Blvd., Sacramento, California.

Duties: Writing contracts, updating listings by reconnaissance, computer researching, comparison, and other functions related to position. Developed skills in public relations, marketing, referral techniques, and follow-up. Served as council member to Red Carpet Realtors at branch office.

Boards and Committees

Chairperson: Alaska Native Harbor Seal Commission
Native Village of Eyak Representative Chugach Regional Resources Commission

Education

- Monroe High School, Fairbanks, Alaska (1970-1974)
- Western Michigan University (July-August 1973):
  Cultural Anthropology, Environmental Observation
- Kenai Peninsula Community College, Kenai, Alaska (Sept.-Dec. 1973)
- Anchorage Community College, Anchorage, Alaska (Jan.-May 1974)
- Alaska Methodist University (July-August 1974)
  Field Study: Archaeology in Kachemak Bay and Homer, Alaska
- University of Alaska Fairbanks, Alaska (Sept.-Dec 1974)
- Anthony Real Estate Schools, Sacramento, California (July-Nov 1977)
- Red Carpet Realtors School, Sacramento, California (April-May 1979)
  Comprehensive sales and financial course.
- Prince William Sound Community College, Cordova, Alaska (1981 on)
  Various courses to supplement continuing education.
- David Green Furs, Anchorage, Alaska (Feb 1987)

Honors and Scholarships

- First place trophy winner for Eskimo Contemporary Parka at 1991 and 1992 World Eskimo Indian Olympics

- Scientific Award from Monroe High 1973 Scientific Scholarship through Explorers Club of America to participate with a group from Western Michigan University for six week Environmental Study of the Aleutian Islands. Studies included: anthropology, biology, botany, glaciology, scuba diving, natural habitat.

- Top salesman award for second quarter from Red Carpet Realtors, Sacramento, California, 1978.

- Certificate from Prince William Scound Community College for participating in the Elder Hostle Program from 1988 through 1990.

Personal

Athabascan Indian of the lower Koyukon dialect. Born in Anchorage, Alaska, July 23, 1956. Raised in a bilingual home in Kaltag, Alaska. Able to relate to own people through our native language and cultural background. Wife and mother of 13 year old daughter and 8 year old son.

CURRICULUM VITAE

Name: A. Anne Hoover-Miller

Address: Anchor Cove, Day Harbor
P.O. Box 2507
Seward, AK 99664

Title: Biologist/Computer Specialist

Education: 1978: B.A., (Psychobiology and Environmental Studies: Natural History). University of California, Santa Cruz.

1983: M.Sc., (Biology). University of Alaska, Fairbanks.

EXPERIENCE

Present **CO-OWNER** of Pacific Rim Research/Wilderness Images, P.O. Box 2507, Seward, AK 99664. Scientific research, desktop publishing and computer consulting. Samples of work include the following:

1991-1994. Contracted with the Marine Mammal Commission to evaluate the possible use of a Geographic Information System for conserving marine mammals in Alaska and conduct a workshop with appropriate state and federal agencies.

1985-1994. Contracted with the U.S. Marine Mammal Commission to develop species accounts with management recommendations for Steller sea lions and harbor seals in Alaska and to revise the harbor seal species account.

1995. Contracted with the U.S. Marine Mammal Commission to review traditional knowledge about harbor seals documented by the Division of Subsistence, and develop recommendations for the ANHSC to collect and manage traditional knowledge information for cultural, scientific, and co-management purposes.

Present **FISHERMAN**. Crew on commercial halibut longline and salmon driftnet vessels F/V *Ouzel* and F/V *Eagle Point*.

05/89 - 05/90 **TECHNICAL SPECIALIST** for the National Park Service, Seward, Alaska, regarding the *Exxon Valdez* oil spill. Designed and coordinated biological studies, developed and maintained computer databases, wrote and evaluated

reports, and represented the National Park Service in multi-agency meetings and operations.

01/87-06/88 **INSTRUCTOR** for Prince William Sound Community College, Cordova, AK. Instructed students in use of personal computers and software.

10/84 - 06/85 **COMPUTER PROGRAMMER** for the Center for Disease Control via the Indian Health Service, 225 Eagle St. Anchorage, AK, 99510. Maintained, modified and designed software, data collection forms, and data bases for laboratory and research personnel.

01/84 - 05/84 **INSTRUCTOR** for Kenai Peninsula Community College, Seward, AK. Taught Biology of Marine Mammals and Birds of Alaska.

01/84 - 05/84 **SUBSTITUTE TEACHER** Seward High School, Seward, Alaska, 99664. Taught biology, math, physics, special education, and computer classes.

09/78 - 03/83 **RESEARCH ASSISTANT** at the Institutes of Marine Science and Arctic Biology, University of Alaska, Fairbanks. Contributed to field and literature research on ecology, behavior, population dynamics, and disturbance of marine mammals and birds in the Gulf of Alaska, Bering and Chukchi seas.

01/80 - 05/80 **TEACHING** ASSISTANT at the University of Alaska, Fairbanks. Prepared and taught lab and discussion sections for Biology and Man.

05/78 - 08/78 **CONSULTANT** for EG&G Analytical Services Center, Rockville, Maryland. Surveyed the status and distribution of manatees and sea turtles on Vieques Island, Puerto Rico.

12/75 - 09/78 **RESEARCH ASSISTANT** for the Division of Life Sciences, University of California, Santa Cruz. Participated in field studies on population ecology and reproductive behavior of elephant seals, Steller sea lions and harbor seals.

Reports and Publications:

Fay, F. H., B. P. Kelly, P. H. Gehnrich, J. L. Sease, and A. A. Hoover. 1984. Modern populations, migrations, demography, trophics, and historical status of the Pacific walrus. Final Report. Research Unit 611. NOAA Outer Continental Shelf Environmental Assessment Program. Anchorage. Alaska. 142 pp.

_____, B.P. Kelly, A.A. Hoover, and R.R. Nelson. In prep. The reactions of walruses (*Odobenus rosmarus*) in the Bering and Chukchi seas to disturbance by vessels and aircraft.

Hoover, A. A. 1978. Sexual dimorphism in dentition and molting of northern elephant seal pups. Senior Thesis. University of California, Santa Cruz. 64 pp.

_____. 1983. Behavior and ecology of harbor seals (*Phoca vitulina richardsi*) inhabiting glacial ice in Aialik Bay, Alaska. M.Sc. Thesis. University of Alaska, Fairbanks. 133 pp.

_____. 1988. Harbor seals (*Phoca vitulina*). *In*: Selected marine mammals of Alaska: species accounts with management recommendations, 1991 update. Jack Lentfer (ed.). Marine Mammal Commission. Washington D.C.

_____. 1988. Steller sea lions (*Eumetopias jubatus*). *In*: Selected marine mammals of Alaska: species accounts with management recommendations. Jack Lentfer (ed.). Marine Mammal Commission. Washington D.C.

Hoover-Miller, A.A. 1992. Assessment of the possible use of a cooperative/coordinated geographic information system (GIS) to facilitate access to, and integration and analysis of, data bearing upon the conservation of marine mammals in Alaska. Final report for MMC contract T75136297. NTIS PB93-128429.

_____. 1994. Harbor seals (*Phoca vitulina*): Biology and Management in Alaska. Report to the Marine Mammal Commission. Contract Number T75134749. Washington, D.C. 45 pp.

_____. 1995. Report of the Workshop on Enhancing Methods for Locating, Accessing, and Integrating Population and Environmental Data Related to Marine Resources in Alaska. April 5-7, 1994, Hotel Captain Cook, Anchorage, Alaska.

_____. 1995. Recommendations for an Alaska Native Harbor Seal Commission Traditional Knowledge Program. Report to the Alaska Native Harbor Seal Commission, Cordova, AK. 13pp.

Murphy, E. C. and A. Anne Hoover. 1981 Research study of the reactions of wildlife to boating activity along Kenai Fjords coastline. Final Report for the National Park Service, Anchorage, Alaska. Contract No. CX-9000-8-0151. 125 pp.

_____. A.A. Hoover, R.H. Day, K.L. Oakley. 1992. Intracolony variability during periods of poor reproductive performance at a glaucous-winged gull colony. The Condor. 94:598-607.

LITERATURE CITED

Frost, K.J., L.F. Lowry, and J. Ver Hoef. 1995. Habitat use, behavior, and monitoring of harbor seals in Prince William Sound, Alaska. *Exxon Valdez* oil spill restoration science study. Restoration Study Number 94064. Alaska Department of Fish and Game, Fairbanks, AK. 88pp.

Loughlin, T. R. 1992. Abundance and distribution of harbor seals (*Phoca vitulina richardsi*) in the Gulf of Alaska and Prince William Sound in 1992. 1992 Annual Report to the MMPA Assessment Program, Office of Protected Resources. Silver Springs. MD. 25pp.

Hoover-Miller, A. A. 1994. Harbor seals (*Phoca vitulina*): Biology and Management in Alaska. Report to the Marine Mammal Commission. Contract Number T75134749. Washington, D.C. 45 pp.

_____. 1995. Recommendations for an Alaska Native Harbor Seal Commission Traditional Knowledge Program. Report to the Alaska Native Harbor Seal Commission, Cordova, AK. 13pp.

Pitcher, K.W., and D. Calkins. 1979. Biology of the harbor seal, *Phoca vitulina richardsi*, in the Gulf of Alaska. U.S. Dep. Commer., NOAA, OCSEAP Final Rep. 19:231-310.

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

Budget Category:	Authorized FFY 1996	Proposed FFY 1997						
Personnel		$24.0						
Travel		$11.3						
Contractual		$204.7						
Commodities		$0.0						
Equipment		$0.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	$0.0	$240.0	Estimated FFY 1998	Estimated FFY 1999	Estimated FFY 2000	Estimated FFY 2001	Estimated FFY 2002	
Indirect		$16.7						
Project Total	$0.0	$256.7	$237.7	$237.7	$133.0			
Full-time Equivalents (FTE)		6.0						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments:

Indirect costs: 15% of Personnel + 7 % of Contractual. Indirect costs will be used to cover expected high communication costs , production and distribution of newsletters, and extra administration needed to manage and account for project and contracts.

Costs expected to be incurred after FY 97 to complete FY 97 data analysis and report requirements:
First Annual Report due April 15, 1998: $ 8,000
Data analysis for FY 97 data, to be conducted in FY 98: $20,000
Final Report: $8,000

Community Involvement: 100% of project involves data or activities related to community involvement.

1997

Prepared: 4/2/96

Project Number:
Project Title: Community-Based Harbor Seal Research
Name: Alaska Native Harbor Seal Commission

FORM 4A
Non-Trustee
SUMMARY

4/3/96

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

Personnel Costs:			Months	Monthly		Proposed
Name	Position Description		Budgeted	Costs	Overtime	FFY 1997
Monica Riedel	Principal Investigator		6.0	4.0		24.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		6.0	4.0	0.0	
					Personnel Total	$24.0

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FFY 1997
Annual Restoration Workshop and Technical Review Session					0.0
M. Riedel, costs incl. in Project 97244;					0.0
* A Hoover-Miller: San Francisco to Anchorage	0.8	2	6	0.2	2.8
Training Workshops:					0.0
San Francisco to Anchorage	0.8	1	2	0.2	1.2
Anchorage to Cordova	0.2	2	3	0.2	1.0
Anchorage to Homer	0.2	2	4	0.2	1.2
Anchorage to Kodiak	0.3	2	4	0.2	1.4
Chenega Bay/Tatitlek to Cordova	0.2	2	2	0.2	0.8
Nanwalek/Port Graham/Seldovia to Homer	0.1	3	3	0.2	0.9
Kodiak Island Area to Kodiak	0.3	2	2	0.2	1.0
Perryville to Kodiak	0.8	1	1	0.2	1.0
				Travel Total	$11.3

1997

Prepared: 4/2/96

Project Number:
Project Title: Community-Based Harbor Seal Research
Name: Alaska Native Harbor Seal Commission

FORM 4B
Personnel & Travel DETAIL

4/3/96

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

Contractual Costs:	Proposed
Description	FFY 1997
Contract with Pacific Rim Research to provide biological consulting, survey and data collection design, training, and implementation, data management and analysis	61.8
Fall-winter-spring harbor seal surveyors (total of six contracts)	103.3
Village representatives (total of five contracts)	39.6
Contractual Total	$204.7

Commodities Costs:	Proposed
Description	FFY 1997
Commodities Total	$0.0

1997

Prepared: 4/2/96

Project Number:
Project Title: Comunity-Based Harbor Seal Commission
Name: Alaska Native Harbor Seal Commission

FORM 4B
Contractual & Commodities DETAIL

4/3/96

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

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

Existing Equipment Usage: Description	Number of Units	

1997

Project Number:
Project Title: Community-Based Harbor Seal Research
Name: Alaska Native Harbor Seal Commission

FORM 4B
Equipment
DETAIL

Prepared: 4/2/96

4/3/96

Kametolook River Coho Salmon Subsistence Project

Project Number:	97247
Restoration Category:	General Restoration
Proposer:	Perryville Village Council
Lead Trustee Agency:	ADF&G
Cooperating Agencies:	NONE
Alaska SeaLife Center:	NO
Duration:	7 years
Cost FY 97	$46,200
Cost FY 98	$10,900
Cost FY 99	$10,200
Cost FY 00	$16,000
Cost FY 01	$11,200
Cost FY 02	$11,200
Cost FY 03	$21,200
Geographic Area:	Perryville/ Kametolook River/ Alaska Peninsula
Injured Resources/ Service	Subsistence

ABSTRACT

Subsistence users from the remote Alaska Peninsula Native Village of Perryville have noted significant declines in the coho salmon run in the nearby Kametolook River since the *Exxon Valdez* oil spill (EVOS) in 1989. This project is a continuation of a project funded for one year (1996) through the EVOS criminal settlement. The criminal settlement will fund the first year of the project for an assessment team consisting of approximately 4 specialist staff from ADF&G and 3 or 4 local assistants of the Native

Village of Perryville, to assess the Kametolook River and determine what method, would best be suited for the river in efforts to restore its coho runs to historic levels.

This project would provide funding through FY 2003 for ADF&G to try conservative and safe enhancement methods best suited for the river as determined the first year of the project. Instream incubation boxes will be evaluated as an enhancement tool to rebuild the depressed coho (or possibly chum) salmon stock needed for subsistence in the Kametolook River. Habitat improvements for spawning and rearing habitat will also be considered. Ultimately, some combination of both may be the best approach to restoring salmon as a subsistence resource.

INTRODUCTION

This subsistence project is designed to restore coho (or chum) salmon subsistence opportunities in the Alaska Peninsula village of Perryville. The project was initiated during community workshops held by the Subsistence Restoration Planning Team. These workshops in Perryville took place in September 1994 and May 1995. The project was subsequently endorsed by the Perryville Village Council. The project was also discussed with and endorsed by the Chignik Regional Planning Team in the spring of 1995. Alaska Department of Fish and Game, Division of Commercial Fisheries, westward region staff assigned to the Chignik and Alaska Peninsula regions, have been involved in the planning and development of the project. In addition, an ADF&G biologist in the Norton Sound Region has provided technical expertise regarding the use of instream incubator boxes, which have been successful in the Norton Sound Region.

Funding for an initiation of the evaluation phase of the project in 1996 was provided through a grant to the Native Village of Perryville by the Alaska Department of Community and Regional Affairs, using EVOS criminal settlement funds. During consultation about this grant, the State members of the Trustee Council requested that a proposal to the full Trustee Council be prepared to support the implementation of the project in subsequent years.

If it is determined by the assessment team that local salmon stock instream incubator boxes will work for the Kametolook River, an application for an ADF&G fish transport permit will be prepared. The assessment team will work with the Principal Geneticist, Principal Pathologist and Area Management Biologist to have the most safe and satisfactory project possible to help bring coho salmon in the Kametolook River back to historic levels.

NEED FOR THE PROJECT

A. Statement of Problem

Since Perryville was founded in 1912, the Kametolook River has provided the community with much of their supply of subsistence coho salmon. Since the Exxon Valdez oil spill, Perryville residents have noted that there are fewer and fewer of these salmon in the river. It has become such a problem that many families must travel further away from Perryville to find sufficient amounts of salmon. Their use of these other areas has put additional pressure on fish stocks used for subsistence by the neighboring villages of Ivanof Bay, and the three Chignik villages.

Salmon are very important for Native people of Perryville, which are relied on greatly for their subsistence as well as economic livelihoods. Commercial fishing is the mainstay of Perryville's cash economy, where many residents travel to fish camps in Chignik Lagoon and Chignik Bay in the summer months to commercial fish, as well as to put up fresh

sockeye salmon for smoking, canning or freezing (sockeye do not come to the Kametolook River). Those that spend summer months in Chignik return to Perryville in the fall to put up coho salmon that are also smoked, as well as dried. Many other Perryville residents, however, do not commercial fish and stay in Perryville year around. Gradually throughout the summer, they travel to the Kametolook River to catch their year's supply of subsistence salmon which are primarily coho, chums, and pinks.

Division of Subsistence personnel first did research in Perryville in 1984. Starting in 1990, the division has documented concerns by local residents that coho availability in the Kametolook River is far below their normal levels. Fish and Game biologists working in the Chignik region believe coho stocks in the Kametolook River might be depressed, but have little data regarding historic or present escapement levels for this small, remote river.

B. Rationale/Link to Restoration

Salmon runs to the Kametolook River have been declining in recent years. Members of the village of Perryville have asked the EVOS Trustee Council to fund a restoration project and they have asked ADF&G to assist with this project. The cause of the decline in numbers is unknown. A restoration project cannot be successful unless the cause of the decline is understood and the project is "fixing" the "right problem".

An appropriate salmon restoration project will hopefully bring Kametolook River salmon relied on for subsistence by Perryville people back to historic levels. If more fish are available for subsistence, it will not only provide people with more coho and / or chum salmon, but it will also take pressure off of other subsistence resources that were hurt by the spill, such as clams and seals.

C. Location

The remote Native village of Perryville is located approximately 340 air miles southwest of Anchorage on the Pacific side of the Alaska Peninsula. Veniaminof Volcano overlooks the village that is situated directly along the Pacific Ocean coastline with beaches of volcanic black sand. The Kametolook River is located three miles northeast from Perryville, and is easily accessible from the community via ATV, or foot, or boat.

COMMUNITY INVOLVEMENT

The Trustee Council's goal of achieving more local involvement in the restoration process is addressed, for Perryville will be partner with ADF&G biologists in this project. This project has been discussed and endorsed by the Chignik Regional Planing Team and the Perryville Village Council. The Perryville Village Council will be responsible for hiring local assistants, and providing necessary support for the operation, all paid for under this project. The community will also contribute much in terms of local knowledge

of the environment, including: historic to contemporary salmon run timing and numbers, subsistence harvest levels over time, identifying physical changes to the Kametolook River over time, helping ADF&G identify spawning areas, and potential characteristics of the river, such as where winter freeze over or summer flooding might occur. Three residents of Perryville will work side by side with ADF&G during assessment and implementation phases of the project. In addition, they will continually monitor the project throughout the year, when ADF&G will not be present.

PROJECT DESIGN

The project objective is to increase the coho and/ or chum salmon returns to the Kametolook River. The method(s) used to accomplish this will be determined in 1996 by a team of ADF&G specialists, and local Perryville residents. Funding for the first portion of the project is provided through a grant to the Native Village of Perryville under the criminal settlement. Once an appropriate method is determined by the team, this project has the potential to make restoration of salmon in the Kametolook River possible. Similar projects in other regions of Alaska have proven to be successful.

Instream incubation boxes will be one method evaluated. The incubation boxes would be positioned in either the Kametolook River or a tributary of the river to use the natural flow of water from the stream to incubate the salmon eggs. Genetic integrity of the Kametolook River coho salmon would be assured under the guidance of the department's Principal Geneticist. Potential incubation sites will have water temperatures consistent with natural spawning sites to insure that fry development and emergence occur at the same time as naturally occurring fry. The small scope of this project is not expected to noticeably add any additional coho salmon to other common property harvest groups (i.e. commercial fisheries).

From similar projects in Norton Sound, it has been found that improved returns were noticeable in about five years. If instream incubators are employed, they will be expected to operate from 1997 until 2003. Since the major expense is in the boxes, and establishing a site, the annual cost of operation and maintenance is not significant.

Other enhancement methods o be evaluated will be habitat manipulation to create or provide access to better spawning and rearing habitat.

A combination of methods may be most appropriate.

A. Objectives

The goal of the project is to restore the salmon runs into the Kametolook River. The Primary species is coho salmon and secondary species is chum salmon. Phase 1 of the project will include a complete assessment of the river; phase 2 will be the implementation of the project.

B. Methods

1996 (May 96 through September 96) - This phase of the project is funded through the Criminal Settlement. May, 1996, the 4 ADF&G assessment team members fly to Perryville and join with Perryville local assistants to assess the Kametolook River in order to make recommendations for the best restoration efforts. Thermographs will be purchased and installed in various portions of the river. If an appropriate incubator site is located, the team will return in the fall to construct and install a test incubation box (2 foot square plywood box) which will house a thermograph to determine the potential of the project.

Based on findings of the May and September reconnaissance, and other research, the assessment team makes interim decision of what restoration effort is best for the Kametolook River. A fish transport permit will be submitted if egg boxes are suggested.

Criminal Settlement- Funded Evaluation Phase (FFY 1996)

1. Survey the potential spawning, rearing and migratory habitat

    a. Review available data
        - Catch history/ commercial, sport, subsistence
        - Escapement information
        - Local knowledge
        - Aerial photos
        - USGS/ geologic changes that might affect changes to river channels/ such as tectonic uplifting/ flooding?
        - Overfishing/ subsistence or commercial
    b. Visit to Kametolook River for qualitative and quantitative assessment
        - Local Perryville assistants and ADF&G personnel work as assessment team
        - Rearing habitat and migratory blockages or" problem sources" Inventory spawning and
        - Look for changes in drainage patterns/ compare with USGS maps and aerial photos
        - Measure approximate amounts of habitat types
        - Minnow trapping/ dip netting/ seining for juvenile salmon
        - Evaluate for potential opportunities for habitat improvement egg boxes, rearing areas, migration, create spawning channel

2. Select and install several monitoring devices at various sites in the Kametolook River for data collection to evaluate spawning and rearing habitat.

    a. Thermographs, staff gages, photos, observations
    b. Spawning, rearing; identify the problem

c. Spring, fall, pre and post breakup
d. Intake box for egg incubation chamber/ installed in appropriate location in Kametolook River, with thermograph placed inside

3. Collect pertinent data and information.

3. Train local Perryville researchers
   a. Photos of selected locations of River throughout summer, fall, winter and spring
   b. Data retrieval and recording
   c. Observations
   d. Communication of information back to ADF&G

4. Develop tentative long-range plans for enhancing the coho and or chum stocks returning to the Kametolook River.
   a. Problem Identification
   b. Problem Solution
   c. Proposal for method determined appropriate by assessment team to bring
      more coho and/ or chum salmon back to Kametolook River.
   d. Decision made by assessment team in spring/summer of 1997

FFY 1997: (October 96) Evaluation Phase Continues
(Civil Settlement Money Begins)

October 96 through September 97- One day every month, one or two trained Perryville researchers will return to the thermometer sites and record the temperatures and photograph the area near thermometers. They will also be responsible for reporting their findings to the ADF&G team monthly.

March 97- Two ADF&G members of the assessment team will return to Perryville to assess the river in the winter/ and observe success of test sites.

Late March/ early April- Review meeting in Anchorage with ADF&G and Perryville researchers, Chief Scientists and Peer Reviewers.

July- Three members of the ADF&G research team return to Perryville and work with three local researchers to install incubation boxes.

Phase 2- Project Design and Implementation
(June 1997 through September 2003.

June through September 1997- Project is initiated

August 1997- Revised project and budget submitted to Trustee Council

September 1997- Three members of the ADF&G research team return to Perryville and work with three local researchers to capture coho and fertilize eggs, add to incubation boxes.

Example of a potential enhancement project that might be determined by the assessment team after Phase 1 of the project.

The evaluation will include a variety of techniques to improve the salmon runs in the Kametolook River as mentioned above. A proper diagnosis and decision will not be known until after the assessment phase of the project. If the assessment team determines that instream incubation boxes are appropriate for the river, then the following case scenario is likely to occur for the years of the project:

Scenario- If Instream incubation boxes are used:

If it is determined that instream incubation boxes are the best way to restore depressed salmon runs, the project would use Kametolook River coho (or possibly chum) salmon as stock and release all fry directly back into the Kametolook River.

Fish transport permit must be approved by ADF&G.

Technical assistance is needed in site selection, test box construction in the village and installation, and large capacity incubation box construction as well as in fish culture, fish transport, adult enumeration, and coho rearing habitat. ADF&G will cover cost and logistics of shipping the materials to Perryville, but not the material costs. The materials can be transported and dropped off in Perryville in early May when a general freight run is made by the M/V Resolution or later in the summer during the ADF&G South Peninsula groundfish/ crab survey. It will be necessary for someone in Perryville to use their skiff to haul the material from the M/V Resolution to Perryville.

ADF&G biologist will determine the potential coho and/ or chum salmon rearing habitat and construct and install one or two incubation boxes (4 foot by 4 foot) capable of supplementing the natural run without exceeding the natural habitat. Take the required number of eggs from Kametolook River coho salmon and incubate them in the boxes to increase the egg to fry survival rate (approximately 100,000 eggs). Fish and Game Chignik biologists will obtain an estimate of the adult coho and/or chum escapement and subsistence harvest from the Kametolook River.

Take the required number of eggs from the Kametolook River coho or chum salmon and incubate them in the boxes to increase the egg to fry survival rate. Fish and Game Chignik biologists will continue annually to obtain an estimate of the adult coho escapement and subsistence harvest from the Kametolook River.

The process will be repeated annually through FY 2003, at which time will be determined if the boxes can be removed or continue operating. This determination will be made by biologists as well as the community of Perryville. If the team determines that the project should continue beyond 2003, Perryville may look for another source of funds for the last few years of the project.

Summary if instream incubator boxes are used/ possible itinerary:

1996: Material for the test incubator boxes will be shipped to Perryville in the spring or summer. Site selection and installation of the test incubation box and thermograph will occur in the spring.

1997: In March the success of the installation box will be determined. If successful, two large capacity (100,000 egg potential) will be constructed and shipped to Perryville during the summer. In the summer and the large capacity boxes will be installed. Coho eggs (or possibly chum) will be taken in September or October as the salmon become ripe.

1998-2003?: Annually, collect eggs and place them in the incubation boxes to increase the natural run.

One day each month of the project, one or two local Perryville researchers will monitor the incubation boxes to insure their safety and success.

ADF&G and Perryville researchers, peer reviewers and ADF&G Chief Scientists meet in Anchorage for major project review meetings in 1997, 2000, and 2003, inn addition to annual ADF&G staff meetings.

Plan B
If after the first year the test incubator box fails, then it is suggested that recirculating incubator boxes be built. These boxes are set up in a room in Perryville such as the school or the subsistence cultural education center presently under construction. The technology for these boxes is somewhat new, but have proven to be successful for streams that instream incubator boxes fail. The only difference that is the eggs are incubated inside rather than in the boxes in the river. In the spring, the alevins must be transported to the river, rather than leaving on their own. They also require more care such as constant electricity. The village project leader would be trained to maintain the box. If recirculating incubator boxes are considered, it is possible that additional funding will be required, since these boxes are slightly more expensive to build and maintain (approximate total cost for 2 recirculating indoor boxes and refrigeration unit, $5,000).

Another possible option
If the test box fails (or in combination with boxes), then the project will concentrate on habitat modification such as clearing blocked river channels, and improving spawning and rearing habitat for both coho and chum salmon. This scenario would likely be more

costly than the incubation boxes, and require more assistance from the community of Perryville and use of much of their machinery.

C. Cooperating Agencies, Contracts, and Other Agency Assistance

Perryville

Perryville Village Council will hire a local project administrator to track the project, arrange for logistical support, and assist ADF&G with field work and long term monitoring of the project. Two additional Perryville residents will be hired (by the Village Council) to work annually as needed in the spring to assist ADF&G and the project administrator with building and hauling materials, site selection, and placement of boxes. In the fall, they will also be hired to assist the ADF&G personnel to assist with the project identified to be used. If instream incubation boxes are used for example, local assistants will assist with the with capturing coho salmon, taking biological genetic samples, removing eggs, fertilizing eggs, and adding to incubation boxes. Village assistants will also need to provide a skiff, and 4-wheelers. The project administrator will by responsible for checking the boxes throughout the winter to insure they are operating efficiently, and safe from natural or human harm. Wages for the three village assistants will be included in the cost of the grant.

For the first months of the evaluation phase, funding for Perryville's participation will be through a grant from the Department of Community and Regional Affairs. In subsequent years, the contract with Perryville may be developed through the Alaska Regional Development Organization or through a sole source contract with ADF&G.

Alaska Department of Fish and Game

Several ADF&G personnel will provide all technical assistance for the project. Personnel responsible for the project will be: Pete Velsco, Fish Culturist II for Commercial Fisheries, Nome; Jim McCullough, Fish Biologist III for Commercial Fisheries, Kodiak; Dave Owen, Fish Biologist II, Chignik Area Bill Hauser, Fish Biologist IV for Habitat and Restoration, Anchorage; Wayne Dolezal, Habitat Biologist III for Habitat and Restoration, Anchorage; and Lisa Scarbrough, Subsistence Resource Specialist II for Subsistence, Anchorage.

Pete has several years of varied experience in stream incubation box projects, particularly in Norton Sound. Jim McCullough with ADF&G has several years of varied experience with fisheries enhancement and research projects as well as salmon management in the Alaska Peninsula. Dave Owen is Chignik's Area Management Biologist with several years of experience with fisheries in the Chignik/ Perryville region. Bill has extensive experience in fisheries enhancement with the department. Wayne is one of the state's leading experts on habitat restoration. Lisa Scarbrough, has been doing subsistence research in the Alaska Peninsula (including Perryville) and Aleutian Island communities for several years. Labor will be provided by ADF&G as part of their normal salary, however, transportation costs and perdiem will be covered through the grant.

SCHEDULE

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

1. May 96 through May 97- DCRA funds Assessment portion of project
2. June 97 through September 97- Assessment team decides which project best suited for Kametolook River and improving salmon runs/ project commences.

B. Project Milestones and Endpoints

1. FY 98 through FY 03- Project continues/ annual evaluations
2. Major project review meeting in Anchorage, 1997, 2000 and 2003.

C. Completion Date

2. September 2003

PUBLICATIONS AND REPORTS

Annual reports each April 15, commencing in 1998.

PROFESSIONAL CONFERENCES

None planned at this time.

NORMAL AGENCY MANAGEMENT

This proposed rehabilitation effort is not part of ADF&G's normal management responsibilities in the Chignik area.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

This project is a continuation of Perryville 96-01, funded by DCRA funds from the EVOS Criminal Settlement.

PROPOSED PRINCIPAL INVESTIGATORS

Jim McCullough, Fish Biologist III
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Fax: 486-1841

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Alaska Department of Fish and Game
Division of Subsistence
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Anchorage, Alaska 99518-1599
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Fax: 267-2450

OTHERS ASSISTING WITH THE PROJECT

Perryville Traditional Village Council
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Perryville, Alaska 99648
Phone: (907) 853-2203
Fax: 853-2230
Chief Community Coordinator- *Jerry Yagie* - Phone: (907) 853-2261

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

Budget Category:	Authorized FFY 1996	Proposed FFY 1997	LONG RANGE FUNDING REQUIREMENTS					
			Estimated FFY 1998	Estimated FFY 1999	Estimated FFY 2000	Estimated FFY 2001	Estimated FFY 2002	Estimated FFY 2003
Personnel		$15.0						
Travel		$13.5						
Contractual		$9.7						
Commodities		$5.1						
Equipment		$0.0						
Subtotal	$0.0	$43.3						
General Administration		$2.9						
Project Total	$0.0	$46.2	$10.9	$10.2	$16.0	$11.2	$11.2	$21.2
Full-time Equivalents (FTE)		0.3						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments:
Budget projections for FFY 1998 and beyond assume that instream incubation boxes are the only rehabilitation method employed. If the evaluation in FFY 1997 identifies other appropriate methods, future budgets will be modified to include the cost of these methods.

The final evaluation of the project is projected to be FFY 2003 , but this may occur sooner depending upon project circumstances.

1997

Prepared: 4/15/96

Project Number: 97247
Project Title: Kametolook River Coho Salmon Subsistence Project
Agency: Alaska Department of Fish and Game

FORM 3A
TRUSTEE
AGENCY
SUMMARY
4/15/96

1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1996 - September 30, 1997

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FFY 1997
L. Scarbrough	Subsistence Resource Specialist II	16F	3.0	5.0		15.0
						0.0
One month of staff time is for developing and monitoring the subcontract with Perryville; the other two months						0.0
are for preparing the Environmental Assessment. Specific staff for the latter will be determined at a later date.						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		3.0	5.0	0.0	
					Personnel Total	$15.0

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FFY 1997
Kodiak - Perryville	0.9	3	20	0.1	4.7
Anchorage - Perryville	0.7	5	28	0.1	6.3
Anchorage - Kodiak	0.4	2	6	0.1	1.4
Anchorage - Nome	0.7	1	4	0.1	1.1
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$13.5

1997

Prepared: 4/15/96

Project Number: 97247
Project Title: Kametolook River Coho Salmon Subsistence Project
Agency: Alaska Department of Fish and Game

FORM 3B
Personnel
& Travel
DETAIL

4/15/96

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

Contractual Costs:		Proposed
Description		FFY 1997
4A Linkage	Contract with Native Village of Perryville	9.7
When a non-trustee organization is used, the form 4A is required.	**Contractual Total**	$9.7

Commodities Costs:		Proposed
Description		FFY 1997
Materials for Construction of Two Instream Incubator Boxes (two @ $2,500 each)		5.0
12 disposable cameras @ $20/each		0.1
	Commodities Total	$5.1

1997

Prepared: 4/15/96

Project Number: 97247
Project Title: Kametolook River Coho Salmon Subsistence Project
Agency: Alaska Department of Fish and Game

FORM 3B
Contractual & Commodities DETAIL

4/15/96

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

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

Existing Equipment Usage: Description	Number of Units	Inventory Agency

1997

Prepared: 6/15/96

Project Number: 97247
Project Title: Kametolook River Coho Salmon Subsistence Project
Agency: Alaska Department of Fish and Game

FORM 3B
Equipment
DETAIL

4/15/96

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

Budget Category:	Authorized FFY 1996	Proposed FFY 1997	[redacted]					
Personnel		$6.5						
Travel		$2.6						
Contractual		$0.0						
Commodities		$0.1						
Equipment		$0.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	$0.0	$9.2	Estimated FFY 1998	Estimated FFY 1999	Estimated FFY 2000	Estimated FFY 2001	Estimated FFY 2002	
Indirect		$0.5						
Project Total	$0.0	$9.7	$3.0	$3.1	$3.1	$3.1	$3.1	
			[redacted]					
Full-time Equivalents (FTE)		1.5						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments:
For FFY 1998 and beyond, budget assumes that instream incubator boxes will be the only rehabilitation used. If the evaluation in FFY 97 identifies other appropriate methods, the contract with Perryville will be modified to reflect the needed level of involvement by the local project facilitator and project assistants.

1997

Prepared: 4/15/96

Project Number: 97247
Project Title: Kametolook River Coho Salmon Subsistence Project
Name: Native Village of Perryville

FORM 4A
Non-Trustee
SUMMARY

4/15/96

1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1996 - September 30, 1997

Personnel Costs:			Months	Monthly		Proposed
	Name	Position Description	Budgeted	Costs	Overtime	FFY 1997
	To be determined	Project Facilitator and Assistants	1.5	4.3		6.5
						0.0
	Note: approximately 44 days of work anticipated @ about $150/day					0.0
	Months and monthly cost estimated to accommodate this spreadsheet					0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
		Subtotal	1.5	4.3	0.0	
					Personnel Total	$6.5

Travel Costs:		Ticket	Round	Total	Daily	Proposed
	Description	Price	Trips	Days	Per Diem	FFY 1997
	Anchorage - Perryville	0.7	2	6	0.2	2.6
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
					Travel Total	$2.6

1997

Prepared: 4/15/96

Project Number: 97247
Project Title: Kametolook River Coho Salmon Subsistence Project
Name: Native Village of Perryville

FORM 4B
Personnel
& Travel
DETAIL

4/15/96

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

Contractual Costs:	Proposed
Description	FFY 1997
Contractual Total	$0.0

Commodities Costs:	Proposed
Description	FFY 1997
Office supplies for project facilitator	0.1
Commodities Total	$0.1

1997

Prepared: 4/15/96

Project Number: 97247
Project Title: Kametolook River Coho Salmon Subsistence Project
Name: Native Village of Perryville

FORM 4B
Contractual & Commodities DETAIL

4/15/96

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

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

Existing Equipment Usage:	Number	
Description	of Units	

1997

Prepared: 4/15/96

8 of 8

Project Number: 97247
Project Title: Kametolook River Coho Salmon Subsistence Project
Name: Native Village of Perryville

FORM 4B
Equipment
DETAIL

4/15/96

EXXON VALDEZ OIL SPILL TRUSTEE COUNCIL
FY97 DETAILED PROJECT DESCRIPTION

Collection of Historical Data and Local Environmental Knowledge of Forage Fish and Herring

Project Number: 97248

Restoration Category: Research/general restoration

Proposer: University of Alaska Fairbanks/Individual

Lead Trustee Agency: Alaska Department of Fish and Game

Cooperating Agencies: NOAA

Duration: one year

Cost FY 97: 58,836

Geographic Area: Prince William Sound

Injured Resource/Service: herring, subsistence

ABSTRACT

Using personal interviews, surveys, and mapping, this project will collect historical and contemporary knowledge about the ecology of herring and other forage fish; map information on their distribution; create an ascii file of mapped data; and create a subject index of textual information on the ecology and life cycle of the fish by species. Data and reports will be provided to participating projects - the Sound Ecosystem Assessment Herring program, and the APEX project.

INTRODUCTION

The project will compile local environmental knowledge about forage fish and herring to assist principal investigators research questions about the life cycle, distribution, and ecological characteristics of forage fish and herring. A variety of sources indicate that long term resource users have extensive and valuable ecological knowledge about a number of species, including forage fish species.

To date a pilot program has been undertaken by the UAF herring program. The program will interview fishermen, pilots, hunters, and other users of Prince William Sound, to learn more about the distribution of herring throughout the Sound, at all times of the year.

NEED FOR THE PROJECT

A. Statement of Problem

Historical data from official published sources regarding the distribution of forage fish and herring throughout Prince William Sound is limited. Principal investigators of both the SEA project herring program and APEX predator program are interested in the seasonal and interannual locations of forage fish and herring as factors in their survival and recovery from the oil spill.

As it is impossible to study the whole sound simultaneously or know the historical distribution of fishes through historical data, SEA and APEX Principal Investigators want to utilize personal interviews to collect and incorporate the ecological knowledge of residents and long time resources users in Prince William Sound regarding forage fishes. They are likely to have knowledge of historical patterns of distribution and population size for several forage fish species. The information gives valuable perspective on current populations in the ecosystem and the factors that influence their populations.

These two projects require similar types of data obtained by interviewing the same groups of people and individuals. Therefore, researchers from both projects have expressed interest in contributing to a single project to gather information about forage fish and herring. This project will decrease duplication of effort in research projects and decrease the survey burden on small communities, groups, and individuals.

B. Rationale/Link to Restoration

The work will contribute contemporary and historical data on the distribution of forage fish and herring. The distribution of these fishes is an important question in the overall effort to understand ecosystem processes affecting the production and recovery of injured resources such as salmon, herring, birds, and marine mammals. In particular there may be nursery areas which provide critical habitat to developing juvenile fish, and the location of certain forage fishes may be important in the recovery of seabirds and marine mammals (Tyler and Haldorson 1995; Brown 1996)

C. Location

The project will take place in Anchorage, Cordova, Valdez, Chenega Bay, Seward, Tatitlek, Kodiak, Homer, and Whittier as needed.

COMMUNITY INVOLVEMENT

This project is one of several efforts cooperating with EVOS project (052). This project coordinates the collection of information about forage fishes from locals and resource users throughout the spill area with principal investigators. As part of the project, the project leader or principal investigator will present the project to city and village councils for approval and work with community facilitators to engage participants for the project. No vessels or special equipment are required for this project.

Herring is a critical resource for subsistence, commercial, and recreational uses in the communities of Prince William Sound and throughout the spill area. In early spring, children around the sound fished for herring with rod and reel, and fishermen set out small nets for herring to use as bait for winter kings. Spawning activity around Tatitlek draws the community out to the grounds to pick spawn for home use. The annual event evokes the very essence of spring, and marks the end of winter. The commercial herring fisheries brought new vitality to local economies around the Sound.

The 1993 population crash of Prince William Sound herring brought a halt to much of this activity and increased the uneasiness residents feel regarding the long term effects of the spill. This project provides an opportunity for residents to be part of the effort to help herring recover, and in so doing, puts them in contact with researchers and information about this critical resource.

Forage fishes such as sandlance and capelin are considered important food for seabirds and researchers believe that food availability may be limiting their recovery (Draft 1996 Restoration Project Abstracts). Researchers with APEX bird research projects are interested in any basic life history information, seasonal occurrence, schooling characteristics, relative abundance of the past twenty years or more, predators of sandlance, and overall, how important residents believe sandlance are as forage fish in Prince William Sound (Rob Suryan, personal communication April 3, 1996.)

PROJECT DESIGN

A. Objectives

The project has two objectives:

1. Collect, organize, and disseminate historical and contemporary local knowledge about forage fishes.

2. Assist researchers in incorporating this ecological knowledge about fish in their current projects. It will provide valuable perspective on current conclusions being drawn from contemporary data collection efforts. The data may also help researchers determine important areas or habitat on which to focus in their data collection efforts.

B. Methods

The project will follow protocols established by the Exxon Valdez Oil Spill Trustee Council traditional knowledge project. Researchers will work with community facilitators to present the project to the small communities and pertinent resource user group organizations in larger towns; and to engage the participation of individuals and focus groups. Participants will be paid $15/hour. Interviews and records obtained during the course of the project are confidential. Individuals wishing to be credited for the information they contribute will be credited in follow-up reports.

The project will use mapping and interviews to document the historical and contemporary distribution of forage fishes and herring. Interviews will be accompanied by notes and tape recorded. Respondents will be those known in the spill area for having extensive knowledge of the resources. Interviews will be carried out with pilots, hunters, fishermen, and subsistence users throughout the spill area.

Researchers will map seasonal and interannual fish distribution on nautical charts. The data from the mapping will be entered

into ascii files using a cruise planner developed by the Sound Ecosystem Assessment data management project. Notes will be indexed by subject and location using software compatible with Division of Subsistence Whiskers database.

The project will rely on interviews with some structured and some open questions to allow a broad range of information to be recorded. A statistical sampling design may be used for confirmation of some types of data.

C. Cooperating Agencies, Contracts, and Other Agency Assistance

The APEX project, with the National Oceanic and Atmospheric Association, and the University of Alaska Fairbanks Herring Program, through the Alaska Department of Fish and Game, wish to cooperate in this project.

SCHEDULE

Oct. 1 - November 1:	Consult with ADF&G Subsistence Division, EVOS RO, statistician, and fish projects. Agree on interview protocol and sampling design.
November 1:	Begin interviews. Begin data entry for notes, digitizing mapped data, and statistical data entry.
January 22-25:	Attend Annual Restoration Workshop
February 1:	Finish interviews.
March 15 :	Finish digitizing map data.
April 15:	Submit annual report of progress to date. Data entry complete.
May 31:	Statistical data entry complete. Deliver data to Principal Investigators with SEA and APEX.
July 31:	Enter and index texts from surveys in a notes database.
Sept.30:	Reports to SEA, APEX, and the Trustee Council. Project End.

B. Project Milestones and Endpoints

We will consider that sufficient information has been collected to meet our goals pending consultation with several individuals

regarding methods: ADF&G Division of Subsistence, a consulting statistician regarding sampling design, the Spill Area Wide Community Coordinator; and facilitators in each community.

C. Completion Date

The project will be complete once the respondent information is compiled into a notes database, the map data is in ascii files, and the final report is delivered to APEX and to SEA herring researchers, September 30, 1997.

PUBLICATIONS AND REPORTS

Pending funding, the Project Leader will prepare a manuscript for publication, to be submitted to ARCTIC, by December 1997.

Given that this is a one year project, the final report mentioned above will constitute an annual report to the Council.

PROFESSIONAL CONFERENCES

Results of the project will be presented at the Alaska Anthropological Association meeting next spring.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

The purpose of this project is to coordinate the gathering of information on fish species of interest to two large ecosystem projects funded by the Trustee Council - APEX and SEA.

The project will incorporate questions about fish ecology, biology, and distribution to serve both projects.

PROPOSED PRINCIPAL INVESTIGATOR
unknown at this time

PROPOSED PROJECT LEADER:

Jody Seitz
University of Alaska Fairbanks Herring Program
P.O. Box 2694
Cordova, Alaska 99574
phone: 907-424-5916
fax: 907-424-5906
e-mail: jody@grizzly.pwssc.gen.ak.us

PERSONNEL

Jody Seitz, UAF Herring Program
Ms. Seitz has five years experience conducting research on resource harvests, ecology, and regulatory issues for the Subsistence Division of the Alaska Department of Fish and Game, beginning in 1989 - from 1991 until 1994 focusing on Prince William Sound. She has extensive experience conducting social science research in the communities of Prince William Sound, and collected much of the first year's harbor seal notes for EVOS TC project 94244. For the last two years she disseminated scientific information to the public from the Sound Ecosystem Assessment, through the SEA Bulletin, news articles and columns in regional newsletters. She is familiar with the data needs of the APEX and SEA projects through her work as a science journalist and the originator of two radio broadcast series - SoundWaves and Alaska Coastal Currents. Education: M.S. 1989, Rural Sociology, University of Wisconsin-Madison, B.A. Magna cum laude Anthropology, 1980, Beloit College.

LITERATURE CITED

Brown, Evelyn, Memorandum to SEA Principal Investigators. March 14, 1995.

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Suryan, Rob. Personal communication, April 3, 1996

Tyler, A. et. al.
1995 "Forage Fish Study in Prince William Sound, Alaska." UAF NMFS Forage Fish Research Contract. Restoration Project 94113. School of Fisheries and Ocean Science Sciences. University of Alaska Fairbanks.

1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1996 - September 30, 1997

Budget Category:	Authorized FFY 1996	Proposed FFY 1997	LONG RANGE FUNDING REQUIREMENTS					
Personnel		$41,400.0						
Travel		$6,640.0						
Contractual		$0.0						
Commodities		$2,600.0						
Equipment		$0.0						
Subtotal	$0.0	$50,640.0	Estimated FFY 1998	Estimated FFY 1999	Estimated FFY 2000	Estimated FFY 2001	Estimated FFY 2002	
Indirect		$8,196.1						
Project Total	$0.0	$58,836.1						
Full-time Equivalents (FTE)		12.0						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments:

1997

Project Number: 97248
Project Title: Colletion of Historical Data and Local Environmental Knowledge of Forage Fish and Herring
Name:

FORM 4A
Non-Trustee
SUMMARY

Prepared:

4/15/96

1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1996 - September 30, 1997

Personnel Costs:			Months	Monthly		Proposed
Name	Position Description		Budgeted	Costs	Overtime	FFY 1997
	Principal Investigator		3.0	4000.0		12,000.0
Jody Seitz	Project Leader		6.0	3600.0		21,600.0
	Statistician		1.0	3600.0		3,600.0
	Community Facilitators - 3		2.0	2400.0		4,800.0
	Participants 100 people@15hr * 2 hrs					3,000.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		12.0	13600.0	0.0	
					Personnel Total	$45,000.0

Travel Costs:		Ticket	Round	Total	Daily	Proposed
	Description	Price	Trips	Days	Per Diem	FFY 1997
	Cordova - Chenega Bay	900.0	1	2	150.0	1,200.0
	Cordova - Tatitlek	320.0	1	2	150.0	620.0
	Anchorage - Homer	200.0	1	3	150.0	650.0
	Anchorage - Kodiak	190.0	1	2	150.0	490.0
	Cordova - Valdez	180.0	1	3	100.0	480.0
	Cordova - Whittier	900.0	1	2	150.0	1,200.0
	Anchorage - Seward	200.0	1	2	150.0	500.0
	Cordova - Anchorage	200.0	3	6	150.0	1,500.0
						0.0
						0.0
						0.0
						0.0
					Travel Total	$6,640.0

1997

Prepared:

Project Number:
Project Title: Collection of Historical Data and Local Environmental Knowledge
Name:

FORM 4B
Personnel
& Travel
DETAIL

4/15/96

1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1996 - September 30, 1997

Contractual Costs:	Proposed
Description	FFY 1997
Contractual Total	$0.0

Commodities Costs:	Proposed
Description	FFY 1997
Supplies - tapes, paper, copies, charts	600.0
Phone	2,000.0
Commodities Total	$2,600.0

1997

Prepared:

FORM 4B
Contractual & Commodities DETAIL

4/15/96

1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1996 - September 30, 1997

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

Existing Equipment Usage:	Number of Units	
Description		
Tape Recorders- ADF&G	3	

1997

Project Number:
Project Title: Collection of Historical Data and Local Environmental knowledge of Forage Fish and Herring
Name:

FORM 4B
Equipment
DETAIL

Prepared:

4/15/96

ECOSYSTEM SYNTHESIS AND MODELING

Project Number:	97249
Restoration Category:	Research
Lead Trustee Agency:	
Cooperating Agencies:	
Alaska Sea Life Center:	No
Duration:	1st year, 5 to 6-year project
Cost FY 97:	234,486
Cost FY 98:	235,000
Cost FY 99:	150,000
Cost FY 00:	100,000
Cost FY 01:	100,000
Cost FY 02:	100,000
Geographical Area:	Prince William Sound, Kodiak Island
Injured Resource/Service:	All resources and services

ABSTRACT

This project will bring field results and local, traditional knowledge together in a single model. The modeling effort will progress through a logical sequence of steps, including verbal conceptual modeling, static and dynamic numerical modeling, and stochastic modeling. The final model will be a coupled physical-chemical-biological model; it will be driven by the physical environment and have parallel chemical and biological sub-models addressing interactions between petroleum hydrocarbons and the biota. The model will be designed to serve as a platform for description, prediction, and hypothesis development and testing. Traditional knowledge will enter the model through the verbal conceptual model and hypothesis testing.

INTRODUCTION

This section addresses the goals of the proposed project, provides a broad outline of the proposed effort, and gives certain information required by the Invitation. More detailed discussions are presented in other sections of this proposal.

This is a new project and not the continuation of a previous project, although it will be dependent on nearly all Exxon Valdez Oil Spill (EVOS) Restoration projects that have gone before. It is anticipated that this project will continue for the remainder of the EVOS Restoration program.

The goals of this project are two-fold:

1. the synthesis of scientific data and traditional knowledge;

2. the development of a comprehensive ecosystem model of Prince William Sound (PWS).

The two goals are really part and parcel of the same thing. The synthesis of scientific data and traditional knowledge will help to tell the overall story of the oil spill, its effects and consequences, and our attempts to restore PWS. The data and information synthesis will be guided by model development while, at the same time, it drives many aspects of model development. In other words, the synthesis will feed the development and application of the model while the model provides the framework for telling the story of the oil spill. Both data synthesis and model will address PWS in general and the resources and services identified by the EVOS Restoration program in particular.

The specific tasks and objectives required to achieve the goals of this project are listed in Project Design-Objectives. A brief summary of these objectives and tasks follows:

1. ascertain the current state of scientific data and traditional knowledge;

2. acquire scientific data from other EVOS projects;

3. acquire traditional information and local information;

4. structure and format selected data;

5. archive selected data in IBM-PC accessible format;

6. develop a conceptual model of PWS (a non-mathematical, stylized description of the system);

7. review and validate the conceptual model;

8. develop a numerical model of PWS (a mathematical expression of the conceptual model);

9. extend the numerical model to a stochastic model (to test statistical hypotheses);

10. investigate chaotic processes inherent in the data and the model;

11. test and validate the model using scientific data and traditional knowledge;

12. use the model to predict the consequences of potential restoration actions;

13. create a popular science level description of PWS, the spill, its consequences, and the restoration effort.

Scientific data and information as well as modeling background will come from the following sources (note that this list is by no means exhaustive):

1. previous and on-going EVOS Research and Restoration projects,

2. long-term fisheries and oceanographic trends,

3. previous studies of petroleum hydrocarbons in marine ecosystems,

4. previous studies of oil weathering and toxic effects,

5. other risk assessment modeling efforts,

6. ecosystem and oceanographic theoretical considerations,

7. applied and theoretical statistical studies of the behavior of stressed systems.

Exact methods of using scientific data, acquiring and using traditional information, incorporating modeling theory and information, and treating traditional knowledge statistically are discussed in Methods.

Certain assumptions underlie this data synthesis and modeling project; the more important of them are as follows:

1. we need to model PWS prior to EVOS - this will require model parameter estimation to establish starting (temporal boundary) conditions;

2. the model is useless for restoration evaluation unless it is placed within a broader context than just the resources it seeks to evaluate;

3. the nature of the model must be more general than the current EVOS Restoration program - this is one method of embedding the parts of the model relevant to PWS restoration in a larger system;

4. the model must incorporate elements relevant to the ecosystem itself but outside of immediate or obvious relevancy to the EVOS Restoration program;

5. chaotic processes occur in the highly stressed PWS ecosystem - the model, to have any realistic predictive value, must detect and deal with transition to chaos problems.

As stated above, this project will last for the remainder of the EVOS research effort and should ideally be the last research project to be completed. The first year (FY97) will see the following:

1. data acquired, synthesized, formatted, archived, and rendered into an accessible form;

2. conceptual modeling completed;

3. simple versions of the stochastic model completed;

4. model validated and tested;

5. first attempts at using the model to evaluate potential restoration actions.

NEED FOR THE PROJECT

A. Statement of the Problem

This project is designed to address the following:

1. the need for a clear, accessible synthesis of existing scientific data and traditional knowledge telling the story of PWS, EVOS, and the restoration program;

2. the need for an ecosystem model fully capable of describing PWS processes and predicting the consequences of potential restoration actions.

The project is designed to help restore any and all of the injured resources and services through its ability to evaluate potential restoration actions.

B. Rationale/Link to Restoration

This work should be done because it is the best way to accomplish the following:

1. make the scientific data readily accessible;

2. bring scientific data and traditional knowledge together;

3. give results back to everyone impacted by the spill;

4. predict the consequences of potential restoration actions;

5. support all restoration actions within a single model framework.

In total, this project is linked intimately to the rationale and objectives of restoration. Its entire reason for being is to directly support restoration efforts individually and to sort out conflicts among competing restoration efforts. For instance, the effect of increasing pink salmon hatchery releases might be modeled in order to ascertain the effect on other resources such as seabirds, marine mammals, salmon fisheries, herring fisheries, etc. The strength is that all consequences are considered simultaneously. This is important because of a well-known statistical fact: the ultimate confidence level of a multiple hypothesis is not necessarily related to the confidence level of the same hypotheses tested individually; thus the danger of drawing conclusions from individual, independent tests. This link is covered thoroughly in the Introduction and Methods.

C. Location

The majority of the work will be undertaken in Juneau, Alaska. As to where potential benefits of this project will be realized, the answer is all communities and areas impacted by the spill.

COMMUNITY INVOLVEMENT

This point is covered thoroughly in the Introduction. To amplify, it is our intention to work through the Community Involvement Coordinator and the local facilitators to make contact with as many holders of traditional knowledge and local experience as possible. The PI will then interact directly, whenever possible on the home ground of the holder of traditional knowledge. If further help is needed, we will hire personnel of the Chugach Development Corporation in Anchorage as consultants.

The PI of this project grew up in a fishing community and is an adopted member of the Cherokee (Buck Clan, Otter Family). We feel confident that he can establish the necessary rapport with both non-native and native locals. In fact, he has already done so with some of the local facilitators.

Note that the tasks and objectives listed below in Project Design-Objectives are designed to maximize the accessibility of information and data for everyone. In particular, traditional knowledge holders will be better able to understand what is going on and therefore better able to participate. From the scientific point of view, it is both possible and desirable to treat traditional knowledge statistically and thus use it directly in model validation and hypothesis testing.

The following is a partial list traditional knowledge and information that will be used in data and

knowledge synthesis, model development and validation, hypothesis testing, and evaluation of restoration options. This list is merely an example of the data that can and will be used:

1. commercial catch and subsistence temporal and spatial trends;

2. additional commercial and subsistence harvest information;

3. additional information on the temporal and spatial distribution of seabirds and marine mammals;

4. condition of intertidal and subtidal habitats;

5. general information and beliefs held about the condition of PWS overall.

PROJECT DESIGN

A. Objectives

The goals of this project are as follows:

1. the synthesis of scientific data and traditional knowledge;

2. the development of a comprehensive ecosystem model for Prince William Sound (PWS).

The specific tasks and objectives required to achieve the goals of this project over the five to six year life of the project are as follows:

1. ascertain the current state of scientific data and traditional knowledge;

2. acquire scientific data from other EVOS projects;

3. acquire traditional information from other EVOS projects and local sources;

4. structure and format selected data to enhance accessibility;

5. archive selected data on CD-ROM in IBM-PC accessible format;

6. develop a conceptual model of PWS (a conceptual model is a non-mathematical, stylized description of the structure of the system and the workings of relevant processes - it is designed to be highly accessible to scientists and non-scientists);

7. review and validate the conceptual model with scientific PIs and holders of traditional knowledge and revise the model as necessary;

8. develop a numerical coupled physical-chemical-biological ecosystem model of PWS (a numerical model is a mathematical expression of the conceptual model - two types will be developed: static and time-varying);

9. extend the numerical coupled model to a full stochastic model (a stochastic model makes it possible to test statistical hypotheses via multivariate inference and other related methods);

10. investigate chaotic processes inherent in the collected data and in the model itself (this is an advance in the state of the art of ecosystem modeling and has enormous implications regarding our ability to predict the consequences of restoration actions taken in PWS);

11. test and validate the stochastic model against existing scientific data and traditional information;

12. use the model to predict the consequences of potential restoration actions and/or to optimize selection among competing restoration alternatives;

13. create a popular science level description of PWS, the spill, its consequences, and the restoration effort (the aim, like task 5, is accessibility);

The above tasks and objectives are not mutually exclusive. Many of the tasks, except the main modeling tasks (6 through 11), will run consecutively. The main modeling tasks are sequential but iterative. The application tasks (12 and 13) depend largely on completion of model validation. The data and local knowledge acquisition tasks and the model validation and testing are iterative.

B. Methods

The first four tasks are the data synthesis tasks:

Task 1. ascertain the current state of scientific data and traditional knowledge;
Task 2. acquire scientific data from other EVOS projects;
Task 3. acquire traditional information and local information;
Task 4. structure and format selected data;
Task 5. archive selected data in IBM-PC accessible format.

These tasks will draw data from various sources. An early part of these tasks will be to ascertain the exact nature and availability of data from the other EVOS Restoration projects. This data will support both data synthesis and modeling. The following is a preliminary list of EVOS Restoration projects and the types of data that seem the most useful. Notice that this list incorporates both scientific data and traditional knowledge.

95001: Recovery of harbor seals: condition and health status.

morphometric and hematological data
historical morphometric data base from ADFG
changed body condition and age structure: 1970s - 1990s
evidence of heavy metal and other stressors
local knowledge from seal hunters

95064: Monitoring, habitat use, and trophic interactions of harbor seals

population trends
spatial movements
types of prey
connection to Alaska Native Harbor Seal Commission

95007A: Archaeological Site Restoration - Index Site Monitoring

sites monitored for oil

95009D: Survey of octopus in intertidal habitats

octopus at 58 sites by sampled beach survey, SCUBA, and pots
based on local subsistence users, fishermen, Seattle collector (aquarium trade), literature

95012: Comprehensive killer whale investigation

spatial data base and GIS
impact on harbor seals

95021: Seasonal movements and pelagic habitat use by common murres and tufted puffins

limitation of murres by food
puffins as fish samplers
satellite tracking of forage areas and IR images

95025: Mechanism of impact and potential recovery of nearshore vertebrate predators

recruitment, oil in benthic habitats, EVOS induced changes in benthic prey
population density (dynamics) and demographics at oiled vs. unoiled sites
recovery monitoring of sea otter, harlequin duck, pigeon guillemot, river otter

95038: Pacific seabird group EVOS Workshop

common murre, harlequin duck, marbled murrelet, pigeon guillemot

guidelines for identifying seabirds requiring restoration
specific goals - assumptions, constraints, monitoring potential
restoration techniques - assumptions, deficiencies
importance of modeling restoration activities
population, community, ecosystem factors affecting restoration
recommendations about general restoration issues and specific techniques

95041: Predator removal from islands (removal of introduced foxes)

track future populations of black oystercatchers, pigeon guillemots

95052: Community interaction and use of traditional knowledge
95138: Community conference on subsistence and the oil spill
95244/95244: Harbor seal and sea otter cooperative harvest assistance
95428: Subsistence restoration planning and implementation

connection to Alaska Native Harbor Seal Commission
connection to Alaska Sea Otter Commission
obvious interface to tradition knowledge and local experience

95074: Herring reproductive impairment

genetic damage to progeny from oil exposure of adults
impact on herring eggs exposed to oil during incubation
survey of PWS herring stock for impairment due to EVOS

95076: Effects of oiled incubation substrata on straying and survival of wild pink salmon

effects of oil during embryonic development on straying, survival, gamete viability
survival rates of returning stock

95086C: Herring Bay monitoring and restoration studies

population dynamics of mussels, barnacles, algae
compare oiled and unoiled sites and cleaned and uncleaned sites

95090: Recovery monitoring and restoration of intertidal oiled mussel beds

mainly oiled, but uncleaned sites
data on restored sites

95090: Geographical extent and recovery monitoring of intertidal mussel beds

extent of contaminated mussel beds

hydrocarbon contamination over time
samples of mussels and sediments

95106: Subtidal monitoring: eelgrass communities

population parameters of dominant taxa in subtidal (<20m) eelgrass beds
compare oiled and unoiled sites
measure petroleum hydrocarbons

95110/95126: Habitat protection support

results of evaluation, scoring, ranking of 1 million+ acres
human use values on grid system

95115: The sound waste management plan

information collected to define other chronic sources of pollution

95131: Nanwalek, Port Graham, Tatitlek subsistence clam restoration

clam species to use in restoration as broodstock for hatchery use
monitor growth and estimate population growth parameters

95139A1: Salmon instream habitat and stock restoration - Little Waterfall barrier bypass

effect of improvements
data on coho egg-to-fry survival and adult escapement surveys
coho rearing abundance

95139A1: Port Dick tributary restoration and development project
95139C1: Montague Island riparian rehabilitation

restoration surveys 91 and 92 to select habitat restoration areas
pink and chum salmon data and monitoring

95163A: Forage fish studies in PWS
95163B: Seabird/forage fish interactions
95163C: Diet overlap of forage fish species

hydroacoustic sampling and ground truthing with mid-water trawl
foraging behavior of birds
food habits of forage fish taken by mid-water trawl
includes species, age classes, seasons, & areas
resource partitioning

95163D: Diet and growth of tufted puffin chicks in PWS

diet and growth of puffin chicks on Seal Island

95163E: Reproduction and foraging of black-legged kittiwakes
95163F: Recovery monitoring of pigeon guillemot
95163G: Diet composition, reproductive energetics, and productivity of seabirds
95163K: Barren Islands seabird studies

seabird productivity and energetics
relative food availability
foraging and reproductive parameters
historical data
changes in marine trophic structure
species composition and energy quality of seabird forage

95163J: Using predatory fish to sample forage fish

spatial and temporal data on forage fish from sport fish charter operators
stomach contents

95163L: Historical review of small-mesh trawl sampling with special reference to forage species

1953 - 1994 data

95163L: Seabird and forage fish population dynamics

historical seabird population dynamics
oceanographic, seabird and hydroacoustic surveys, trawls, seines around colonies
forage fish energy content and condition

95165: Herring genetic stock identification

comparisons to known spawning aggregates

95166: Herring spawn deposition and reproductive impairment

diver and acoustic surveys
estimate of adult spawning population
estimated number of eggs deposited
factors effecting egg loss
spatial distributions

95170/95320A2: Isotope ratio studies marine mammals

harbor seal and prey trophic interactions and status
historical data from whisker studies

95191A: Oil-related pink salmon embryo mortalities
95191B: Injury to pink salmon eggs and pre-emergent fry incubation in oiled gravel

comparison of oiled and unoiled streams
data on embryo, embryo to pre-emergent fry mortality
lab mortality data
survival of offspring of oiled parents

95255: Kenai River sockeye salmon restoration

genetic data to partition populations
hydroacoustics for population estimates in Cook Inlet
monitoring data

96258: Sockeye salmon overescapement - Upper Cook Inlet & Kodiak
96259: Restoration of Coghill Lake sockeye salmon

adult returns
juvenile, fry, and molt numbers
prey abundance estimates
physical and chemical parameters

95266: Experimental shoreline oil removal
95266: The fate and persistence of oil stranded on National Park coasts
95279: Subsistence restoration project, resource abnormalities study
95285: Subtidal monitoring recovery of sediments
95290: Hydrocarbon data analysis, interpretation, and database maintenance

current distribution of oil
opinions on effects of further beach cleaning
historical data
petroleum hydrocarbons in subsistence resources
distribution of petroleum hydrocarbons in subtidal sediments
Trustee hydrocarbon database (tissue, sediment, water, other samples)

95320A: Salmon growth and mortality

daily foraging times of pink salmon
prey abundance and composition

diet composition of pink salmon
size composition and growth rate of pink salmon

95320B: Coded wire tag recoveries from pink salmon
95320C: Otolith mass marking of hatchery pink salmon

adult return numbers by area

95320D: Genetic structure of pink salmon

temporal and spatial structuring of population

95320E: Salmon and herring

juvenile salmon consumption rate by fish predators
species and size composition of fish predators
fish species that prey on juvenile herring

95320G: Phytoplankton and nutrients

influence of phytoplankton stocks and productivity of food webs
regional and inter-annual influences
biomass and water column dissolved inorganic nutrients

95320H: The role of zooplankton in the ecosystem

oceanographic and biological processes forcing inter-annual variations in zooplankton

95320I: Confirming fish food web dependencies using natural isotope tracers

connectivity of model components

95320J: Information systems and model development

overall databasing
some aspects of ecosystem model structure

95320K: Experimental fry releases

returns from releasing larger fry

95320M: Seasonal variability of water mass properties

physical forcing functions
model results and observations

94320N: Nekton and plankton acoustics

migration routes of pink salmon
zooplankton potential prey distribution
predator distribution

95320Q: Avian predation on herring spawn

stomach contents of most abundant avian predators

95320S: Disease factors affecting declines of Pacific herring - lab
95320S: Disease impacts on PWS herring populations - field
95320S: Effects of viral hemorrhagic septicemia on Pacific herring

disease susceptibility and mortality
evaluation of 1993 crash due to viral infection

95320T: Juvenile herring growth and habitat partitioning

habitat definitions
distribution, feeding, and condition of herring

95320U: Energetics of herring, pollock, and pink salmon

trophic structure of plankton feeding fish
energy indices vs. Length and age

95320Y: Estimating local avian predation rates on hatchery released fry

seabird predation rates on pink salmon and herring
availability of alternate prey

95427: Harlequin duck recovery monitoring

shoreline surveys
abundance, distribution, population structure, productivity

95505B: Aerial photograph, channel-type interpretations to predict habitat availability

inventory, catalog, evaluate stream habitats
define spawning habitat

The next set of tasks (6 through 8) are the primary modeling tasks. The overall modeling effort represents an approach to the problem of integrating information and data from the various EVOS Restoration projects and traditional knowledge into a model of the fates and effects of petroleum hydrocarbons in the PWS ecosystem. Each of the tasks is discussed below.

Task 6. develop a conceptual model of PWS

The conceptual model will be a non-mathematical, stylized description of the system; it will be made up of several components designed to be highly accessible. The conceptual model will make no attempt to translate concepts into mathematics; it will have optimum accessibility and scope, but little resolution. Dr. David Bella of Oregon State University in an unpublished manuscript defines these characteristics:

1. Accessibility is the degree to which the model is readily understandable to any potential user with a reasonable investment of effort. It is also the extent to which the assumptions and systematic structure of the model can be critically examined and discussed.

2. Scope is the degree to which the model takes a broad view of environmental systems, issues, and problems. It describes the extent to which the model is holistic.

3. Resolution is the degree to which the model can make distinguishable individual parts, components, and relationships. It describes the degree to which the model is specific.

The first component of the conceptual model will be one or more verbal system models (VSM). The VSMs will be similar to a set of hypotheses in diagrammatic form, except that they will reflect conclusions based on research results and traditional knowledge. The value of the VSM is that they will be easily understandable and will provide a framework for integrating sometimes disparate data and information. Individual statements within the VSMs will be cross-referenced to conclusion statements from various individual studies. Figure 1 gives an example of a VSM.

Other components of the conceptual model will be the following:

1. a compartment diagram of the PWS ecosystem;

2. adjacency tables related to the compartment diagram;

3. descriptions and diagrams of processes represented in the adjacency tables.

Figure 2 shows an example of a compartment diagram. Here, each compartment is a "black box" representing a state variable in the ecosystem. Each compartment (or state variable) is usually a trophic type or intangible functional element such as microbial cells or suspended particulates. An adjacency (or connectivity) table is a convenient way of presenting compartment interactions. Figure 3 is the adjacency table for the model shown in figure 2. Each filled cell in the table represents a directed interaction (usually an energy or material flow) in the compartment model.

System interactions displayed in the adjacency table, as well as input and output process (e.g., primary production or migration) are controlled by a variety of factors such as temperature, salinity, light, and current velocities. These factors and their effects on the system will be displayed in Forrester symbolism. A modified set of Forrester symbols are given in Figure 4. Figure 5 is an example Forrester diagram of a primary producer compartment..

Task 7. review and validate the conceptual model

This task will probably be iterated several times during the life of this project. It involves getting peer reviews from the PIs whose data, information, and expertise are used. Reviews will also be obtained from holders of traditional knowledge and local experience and will be treated with the same respect as the more traditional peer reviews. Suggestions and criticisms will be evaluated and used to update the conceptual model.

Task 8. develop a numerical model of PWS

During this task, we will develop two non-stochastic (meaning non-statistical or non-probabilistic) models: a static model (one with time-invariant coefficients) and a dynamic model (one with time-varying coefficients). Both will be direct mathematical statements of the conceptual model.

To develop the static model, the compartmental model will be expressed as a system of ordinary differential equations (ODE) with two sets of state variable: one set representing living matter and the other representing petroleum hydrocarbons in the system. The coefficients of the ODEs will be constant and will represent time-averaged flows of living matter and hydrocarbons between compartments of the model.

The static model will provide the basis for a valuable assessment of ecosystem function, accomplished through what is called static environs analysis. Briefly, environs analysis will quantitatively describe the input and output environ for each compartment of the system. More specifically, the output environ of a compartment will show the fate of one unit of output from that compartment. The input environ of a compartment will show the origins of one unit of input to that compartment. Taking the environs of all compartments together, major critical pathways of material flow through the system will be identified. In this way, holistic responses of the system to proposed restoration actions will be examined for impact assessment.

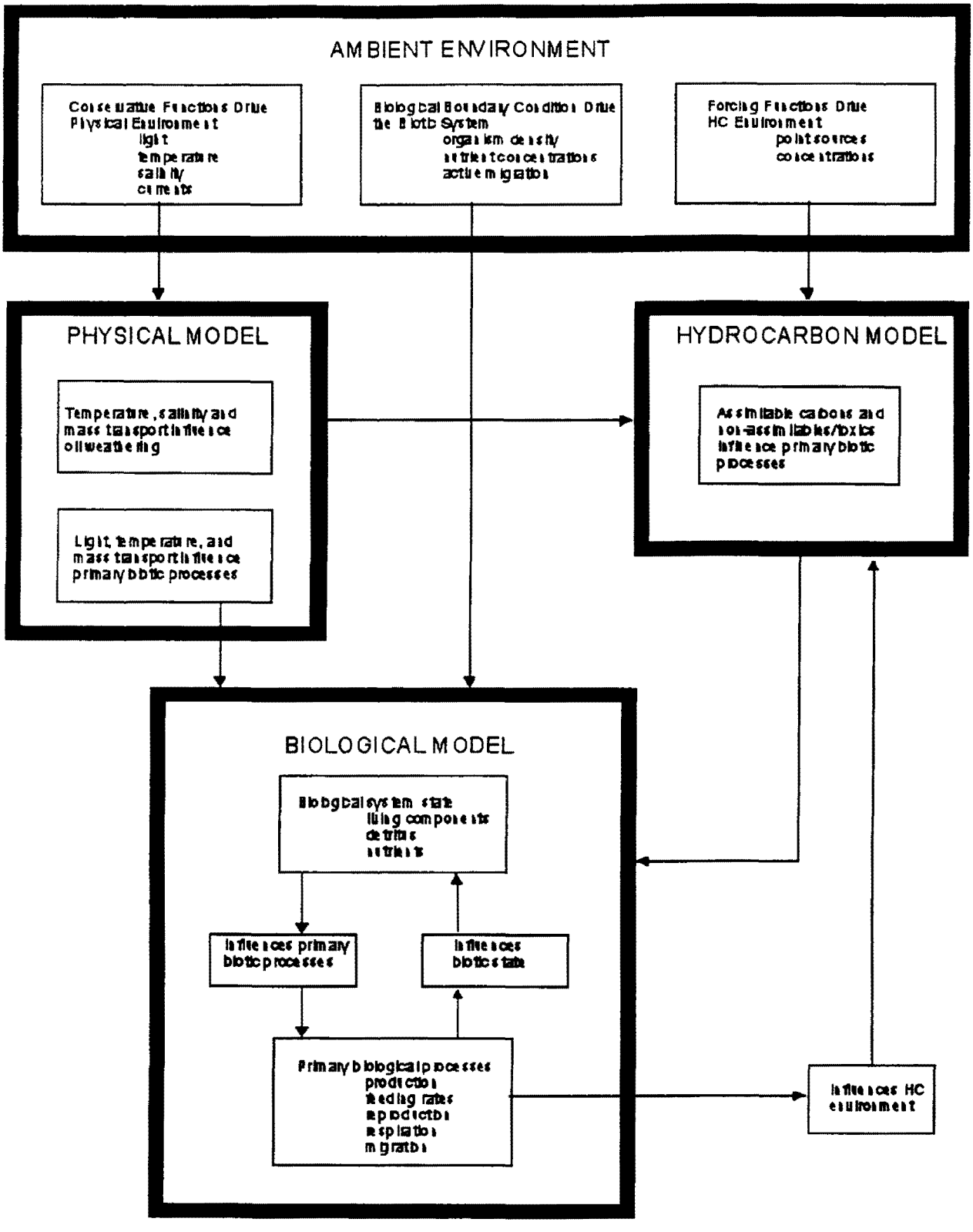

FIGURE 1. Verbal System Model

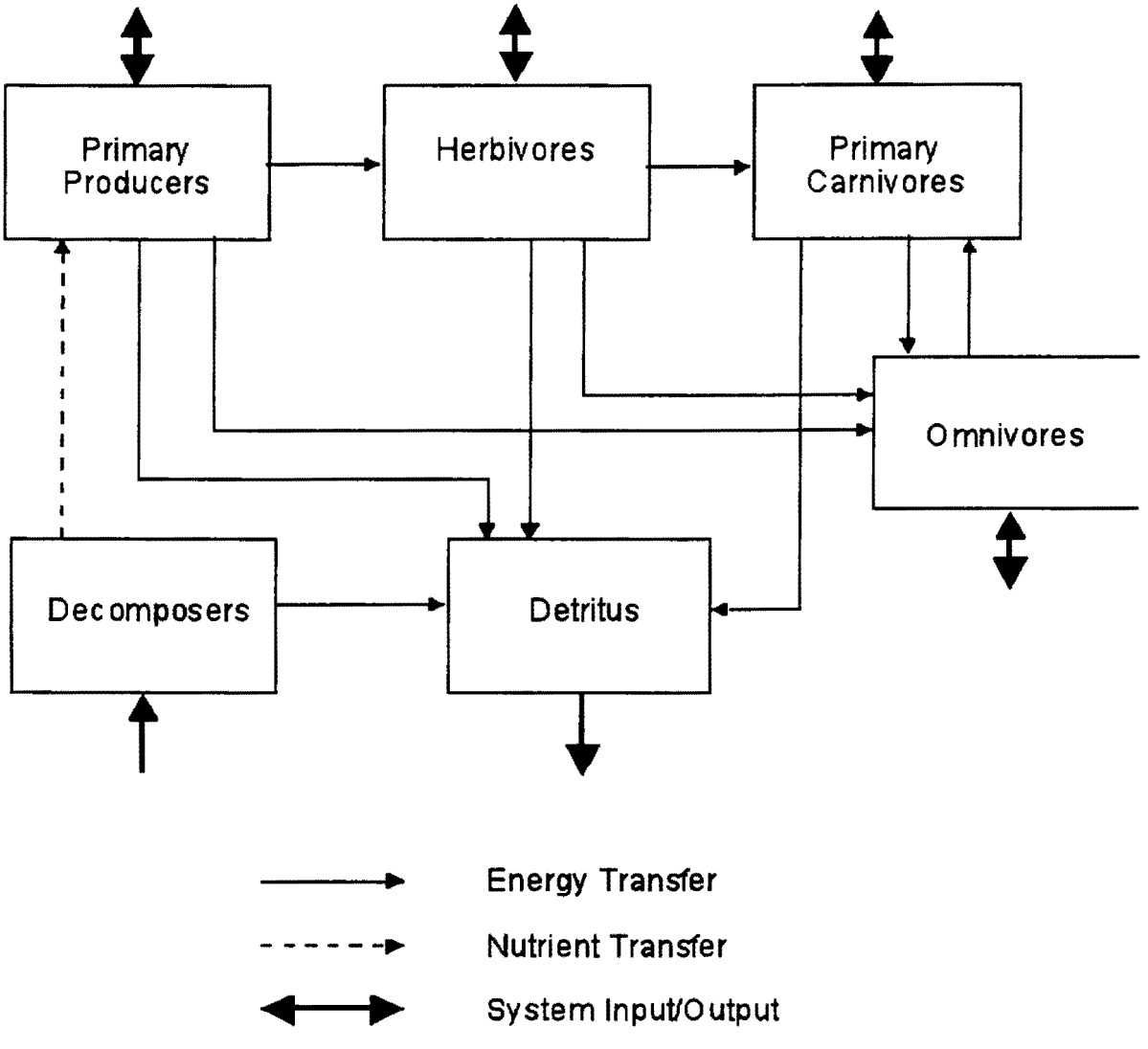

FIGURE 2. A simple, idealized box and arrow diagram.

	PP	Herb	PC	Omn	Det	Dec	Ext
PP	P	T		T	T		T
Herb			T	T	T		T
PC				T	T		T
Omn			T		T		T
Det						T	T
Dec	N						T
Ext	T	T	T	T	T	T	

FIGURE 3. Adjacency table for Box and Arrow Diagram in Figure 2. In the body of the table, P = primary production, T = material or energy transfer, and N = nutrient transfer. Column are compartments to which action is directed. Rows are compartments from which action is originated.

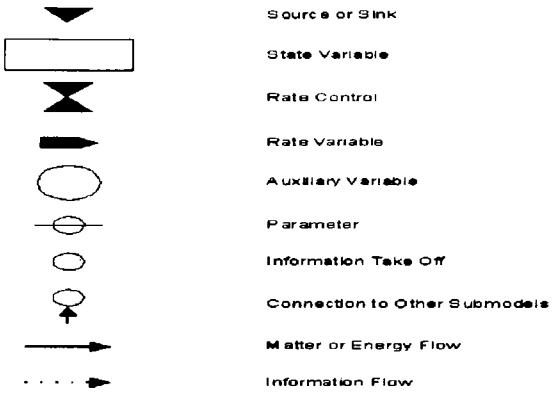

FIGURE 4. Forrester Symbols

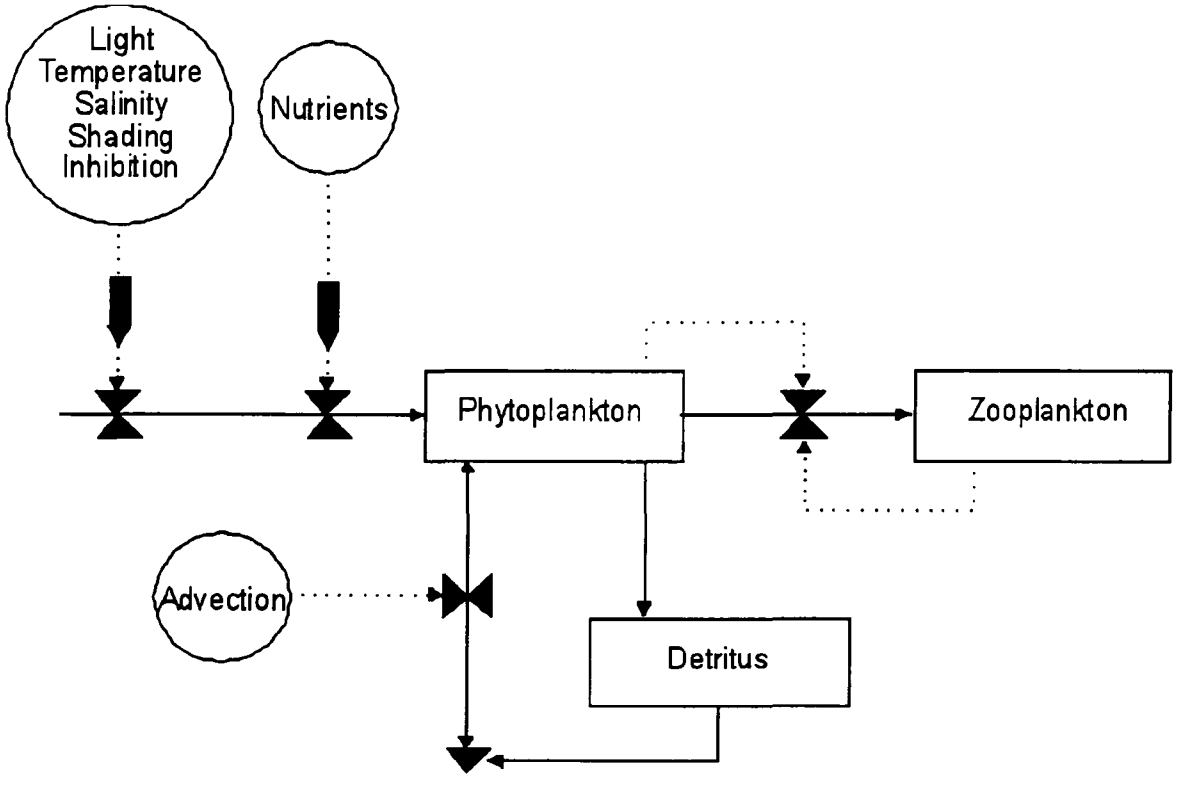

FIGURE 5. Forrester Diagram

The static model will describe the PWS ecosystem as it appears over some limited period of time. The dynamic model will describe temporal changes. The dynamic model will incorporate time-varying control functions to determine the magnitude of the coefficients of the ODEs representing the system; control functions directly regulate inter-compartmental flows of living matter and hydrocarbons. Because the control functions will vary as a function of time, a dynamic simulation of the functioning of the ecosystem will result.

Once the dynamic model is developed, dynamic environs analysis will be performed. Dynamic environs analysis differs from the previously discussed static analysis only in that it can handle temporally ordered data. In application, it will be used in a manner analogous to the static analysis. That is, the analysis will be used to evaluate the short-term response of the system to perturbations or proposed restoration actions.

In matrix notation, both numerical models will be expressed as

$$D(\vec{X}) = \mathbf{K}\,\vec{X} - \mathbf{L}\,\vec{X} + \mathbf{E}.$$

The matrix

$$\vec{X} = \begin{bmatrix} x_1(t) \\ x_2(t) \\ \vdots \\ x_n(t) \end{bmatrix}$$

represents the state variables, in this case the biomass of each compartment at time "t". D is the ordinary differential operator. Therefore

$$D_t(\vec{X}) = \begin{bmatrix} \frac{dx_1}{dt} \\ \frac{dx_2}{dt} \\ \vdots \\ \frac{dx_n}{dt} \end{bmatrix}$$

represents the time rate of change of the independent variable x_i. The matrix of donor controlled transfers between compartments (expressed in units of time^{-1}) is

$$\mathbf{K} = \begin{bmatrix} k_{11} & k_{12} & \cdots & k_{1n} \\ k_{22} & k_{22} & \cdots & k_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ k_{n1} & k_{n2} & \cdots & k_{nn} \end{bmatrix}$$

where k_{ij} represents the transport from compartment "I" to compartment "j". The losses from compartments are represented by

$$\mathbf{L} = \sum_{j=1}^{n} \begin{bmatrix} k_{ij} & 0 & \cdots & 0 \\ 0 & k_{ij} & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & k_{ij} \end{bmatrix}$$

The matrix **E** represents external gains to and losses from the system (e.g., by advection, immigration, or emigration) as

$$\mathbf{E} = \begin{bmatrix} k_{10} - k_{01} \\ k_{20} - k_{02} \\ \vdots \\ k_{n0} - k_{0n} \end{bmatrix}$$

Task 9. extend the numerical model to a stochastic model
Task 10. investigate chaotic processes inherent in the data and the model

This task will involve the incorporation of mechanisms for generating stochastic output, i.e., generating output variances. At this point, the model will be the most capable of testing and validation and will be the most useful.

The model will be express as a full rank system of ODEs. Solution of the system will yield the expected values of the state variable at time t (expressed as $X_n(t)$ for compartment n at time t). We will calculate the approximate variances for $X_n(t)$ by a method derived by Thakur and Resigno (1978). They showed the $\mathrm{Var}[X_n(t)]$ depends approximately on the magnitude of the input to compartment "n" only through the exponential values of the precursor compartments. Their approximation is given by:

$$\mathrm{Var}\,[X_n(t)] = X_n(0)\, e^{-h(t)}\, [1 - e^{-h(t)}] + E\,[X'_n(t)]$$

where $X_n(0)$ is the content of compartment "n" at time "t" that was not initially in that

compartment and

$$h(t) = \int_0^t U(s)\ ds.$$

Here, U(s) is the fractional rate of transport out of compartment "n" and "s" is a dummy independent variable of integration. $X_n(t)$ is difficult to determine. The difficulty is overcome, however, by considering all contents of compartment "n" entering the compartment as not having been in compartment "n" initially. Thereby,

$$\Delta X'_n = X'_n(t)\ u(t).$$

Taylor and Karlin (1984) give other techniques for stochastic modeling using markov techniques. These techniques might be used to help determine critical material and energy flow pathways and ultimate fates of materials, energy, and petroleum hydrocarbons. Anderson (1984) and Seber (1984) both present graphical and data-oriented techniques that might be useful.

Task 11. test and validate the model
Task 12. use model to predict the consequences of potential restoration actions.

The stochastic model will have particular advantages in that it will permit a direct statistical comparison between real world observations and model results. This will allow a definitive answer to two questions:

1. Has the system changed?

2. What are the probable causes of the change?

The first question will be answered by statistically comparing real world observations with the stochastic model outputs for a run under unperturbed conditions. Here, unperturbed conditions might be defined as without any specific restoration actions. The second question will be answered by comparing real world observations with those obtained for a model run under perturbed conditions. Here, perturbed could mean with a specific restoration action. Decision makers will therefore be able to determine whether or not a restoration action-related impact has occurred or might occur. In themselves, these results do not answer the question of whether restoration actions or perturbation related impacts are acceptable. Such decisions will require human value judgments. Such judgments could come from both the Trustee Council and the local communities and could be formalized within the framework of the PWS ecosystem model.

There are several reviews of multivariate methods appropriate for model testing and validaton. Puri and Sen (1971) present multivariate nonparametric techniques for hypothesis testing for location, independence, and dispersion. Anderson (1984) gives multivariate techniques for testing

hypothesis involving classification, independence of sets of variates, and principal components andctor analyses. Seber (1984) deals with general inference issues and discriminant analysis.

In its final form, the PWS ecosystem model will be a powerful assessment instrument containing the following:

1. graphical ecosystem representations,

2. flow diagrams and Forrester diagrams,

3. static and dynamic model output,

4. static and dynamic environs analysis output,

5. verbal descriptions of model results,

6. a user's guide and complete documentation.

Task 13. create a popular science level description of PWS, the spill, its consequences, and the restoration effort

There is absolutely no reason why the results of the modeling effort should not be highly accessible to everyone. In fact, we would consider that effort a failure if the modeling results are not made readily comprehensible to all concerned: Trustee Council, scientific PIs, and local residents. The Trustee Council and PIs will want to see rigorous results, but these are not accessible to most local residents and other interested parties. To be fair, the most rigorous descriptions and results will not be accessible to many of the scientific PIs. The purpose of this task is to produce an exposition of the modeling results that is accessible, relevant, and hopefully interesting.

We conclude this discussion of methods with a few general considerations about model construction. Obviously, all of the information, data, and local knowledge needed to build an ecosysten model of PWS will not be directly available directly from EVOS Restoration projects. Therefore, other sources will be used to fill in gaps.

Methods for dealing with spatial resolution and coupled physical-biological process will those developed by Show (1977), Platt et al. (1981), and Kremer and Nixon (1978) and expanded by Show (1978, 1979a, 1979b, 1980, 1986), Fucik and Show (1981) Much of the theoretical and applied modeling background dealing with the coupling between living matter and petroleum hydrocarbons will be drawn from by Show et al.(1984).

Many of the process formulations as well as sensitivity and stability considerations will be those developed by Kremer and Nixon (1978). Further techniques for input-output analysis developed by Platt et al. (1981) will be considered. Also, Platt et al. (1981) and Ulanowicz and Platt (1985)

give techniques that will be used to incorporate irreversible thermodynamics and statistical mechanics; this will lead to the ability to detect transitions to chaotic behavior such as the period doubling behavior described by Rudnick (1982). Some classic, but extremely valuable work will also be used, for instance, Aseltine (1958), Udlvardy and Papp(1969), Smith (1974), Steele (1974), and Platt and Gallegos (1980). Computational methods will be derived largely from Press et al. (1988) and Kennedy and Gentle (1980).

SCHEDULE

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

1 Oct 96 - 30 Nov 96:	Task 1.	ascertain the current state of scientific data and traditional knowledge
1 Oct 96 - 30 Sep 97:	Task 2.	acquire scientific data
	Task 3.	acquire traditional and local information
	Task 4.	structure and format selected data
	Task 5.	archive selected data in IBM-PC accessible format
1 Oct 96 - 31 Mar 97:	Task 6.	develop conceptual model (first iteration)
1 Apr 97 - 30 Sep 97:	Task 7.	review and validate conceptual model
	Task 8.	develop numerical model (first iteration)
	Task 9.	develop stochastic model (first iteration)
	Task 10.	investigate chaotic processes
1 Jul 97 - 30 Sep 97:	Task 11.	test and validate numerical model
22 Jan 97 - 25 Jan 97:	attend Annual Restoration Workshop	
1 Oct 97 - 31 Oct 97:	prepare Annual Report	
FY98-FY02:	Task 12.	use model to predict the consequences of potential restoration actions
	Task 13.	create popular science level description

B. Project Milestones and Endpoints

30 Nov 96:	Complete Task 1: determination of initial state of data and information
31 Mar 97:	Complete Task 6: first version/iteration of the conceptual model
30 Sep 97:	Complete Tasks 2-5: first version/iteration of data compilation/CD-ROM
30 Sep 97:	Complete Tasks 7-11: first version/iteration of numerical/stochastic model

C. Completion Date

Due to its nature, this project will be completed in FY 02. If the model is used to evaluate restoration actions, the project might extend beyond the end of the EVOS Restoration program.

PUBLICATIONS AND REPORTS

Except for the required Annual Report, no publications are anticipated in FY 97; it will be too soon in the project.

PROFESSIONAL CONFERENCES

Except for the Annual Restoration Workshop in January 97, no related attendence at professional conferences is anticipated. Again it is too early in the project.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

Due to the nature of this project, this aspect has been thoroughly covered in other sections of this proposal. One additional note, however, is that other EVOS Restoration project PIs will be consulted early in the project to avoid duplication of effort. This will be a problem in two areas:

1. databasing and archiving of scientific data;

2. development of mechanistic and empirical models of specific ecosystem processes.

The problem will be particularly severe in the area of databasing and archival. One major step we will take to alleviate the problem will be to archive only data that has been acquired and specifically structured for use in support of the modeling effort.

PROPOSED PRINCIPAL INVESTIGATOR

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PERSONNEL

PI: IVAN T. SHOW, PH.D.:

EDUCATION:

Texas A&M University	PhD	1977	Biological Oceanography Mathematical Statistics
Univ of Southern Miss	MS	1973	Zoology & Statistics/Computer Science
US Air Force Institute		1971	Mathematics/Statistics
Univ of Maryland			Oceanography/Limnology
Univ of Southern Miss		1967	Biology
Univ of Southern Miss	BMEd	1966	Music Education

RESEARCH EXPERIENCE:

Currently performing long-term studies of marine mammal distribution and migration, environmental impacts on coastal lagoons, sea-bird foraging, and large-scale epidemiological and statistical studies. Chaired the America's Cup 92 and America's Cup 95 Environmental Committee, a governmental advisory committee under the US Coast Guard; served also on Port Activities, Syndicate Relations, and Executive Committees.

Founded and managed a scientific small business and the Biology and Biostatistics Division of SAIC. Directed for SAIC the benthic and water column portion of the Bureau of Land Management (BLM) Southern California Bight Oceanographic Program. Administered many other environmental projects.

Aided several government agencies including US Environmental Protection Agency (USEPA), National Marine Fisheries Service (NMFS), US Fish and Wildlife Service (USFWS), and Nuclear Regulatory Commission (NRC) in developing agency-wide policies and procedures. Designed and implemented the US Army Yuma Proving Ground (YPG) environmental program. Served as principle ecologist for the Pacific Northwest River Basins Commission and Oregon State University on effects of the Mount St. Helen eruption on the Columbia River Estuary includijng salmoin fisheries before and afeter the Mt. St. Helens 1980 eruption. Served as chief oceanographer on the National Oceanic and Atmospheric Administration (NOAA) Damage Assessment Team studying the IXTOC I oil spill.

Developed and implemented field methods for plankton and benthic sampling in riverine, lake, and marine environments for USEPA, USFWS, AND NMFS. Designed and carried out aerial surveys of marine mammals, fish, and turtles for NMFS and BLM. Created the aerial survey methods currently used on all NOAA programs for sampling marine mammals, birds, surface fish, and turtles. Conducted behavioral studies of the North American Plains Bison on Camp Pendleton. Supervised analytical modeling of the USEPA Combustion Research Facility including

prediction of incineration by-products and emissions. Consulted with the state of Minnesota on the effects of chlorine discharge into the Mississippi River.

Developed biological-physical and biological-chemical models for NOAA and Sea Grant. Wrote and evaluated plume dispersion models for USEPA and NRC; also three-dimensional oceanographic models for Sea Grant and oil weathering models for NOAA. Investigated and modeled effects of bioluminescence on undersea laser signal transmission for the US Navy. Analyzed 30 years of shrimp catch and effort data and prepared commercial fisheries port sampling plans for NMFS. Determined statistical characteristics of line transect estimation for marine, fresh water, and terrestrial plant and animal surveys for NMFS, BLM, and the International Whaling Commission.

Designed station sampling and QA/QC protocols for lake acidification monitoring (USEPA), power plant intrainment studies (Southern California Edison), and major oceanographic cruises. Designed and evaluated horticultural experiments for the State of Hawaii to relocate and extend the range of a critically endangered *Euphorbia*. Wrote comprehensive ecological description of San Diego Bay. Evaluated habitat utilization/preferences for fishers (Mustellidae).

Developed and supervised QA/QC for studies of toxicology in natural plant and animal populations for NOAA and USEPA. Evaluated worldwide potential of marine algae as a renewable energy resource for the Electric Power Research Institute. Designed and implemented large-scale experiments for in-vivo and in-vitro oncological screening and survivorship testing for USEPA and Maxwell Laboratories.

Helped develop a mathematical theory of multivariate chemical cross-reactivity and created statistical methods for industrial waste sampling for USEPA. Worked extensively in QA/QC methods and Data Quality definitions for USEPA. Designed statistical experiments and analytical methods and refereed large-scale collaborative laboratory studies for USEPA. Developed and evaluated experimental designs for bench-scale and pilot-scale engineering studies for USEPA and NRC.

Created and implemented large-scale environmental sampling and monitoring programs dealing with natural radiological background, physical/biological transport of radio-isotopes, and recovery of radioactive materials for NRC and YPG. Analyzed radionuclide dispersion from uranium mining for NRC. Developed data acquisition and analysis software systems for several private and government organizations. Worked extensively (in some cases, for more than 25 years) with a large number of computer hardware and software systems.

Acquired many years of sea experience as crewman, officer, and scientist on commercial fishing and research vessels. Supervised operations of large seafood packing plant. Hold international master diver and pilot certificates. Participated in the Gulf of Mexico shrimp fishery as a trawler crewman and captain, factory supervisor, and researcher. Directed oceanographic cruises as Chief Scientist and Dive Master.

TEACHING EXPERIENCE:

Accumulated over 18 years of teaching at the college/university level. Certified by The California Community Colleges in Biology, Mathematics, and Marine Sciences. Taught Biology and Mathematics on the adjunct faculties of Palomar College, California State University San Marcos, and Grossmont College. Active in college services; voluntarily assisting with Faculty Professional Development projects, development of Learning Community combined courses, biology and mathematics curriculum development, and Directed Studies programs.

Instructed oceanography graduate students in shipboard methods and procedures at Texas A&M. Supervised biology laboratory instructors in the USM Preprofessional program. Presided over Oceanography Graduate Student Council at TAMU and sat on College and University advisory committees at TAMU and USM.

EMPLOYMENT HISTORY:

1993-1995	Grossmont College	Adjunct Faculty
1992-1995	Univ California San Marcos	Part-Time Faculty
1988-	Southwest Research Associates	Partner/Chief Scientist
1986-1995	Palomar College	Adjunct Faculty
1980-	Private Consultant	
1977-1980	Science Applications, Inc.	Senior Oceanographer Senior Statistician Division Manager
1973-1977	Texas A&M University	Graduate Student Teaching Fellow
1971-1973	Univ of Southern Mississippi	Graduate Student Teaching Fellow
1967-1971	US Air Force	
1967-1967	Florida State University	Research Assistant
1966-1967	Univ of Southern Mississippi	Graduate Student Teaching Assistant

PUBLICATIONS:

Show, I.T. 1973. Distribution of Near-Coastal Zooplankton off the Coast of Mississippi. MS Thesis, University of Southern Mississippi.

Show, I.T. 1975. Estuarine and Coastal Zooplankton. In Christmas, J.Y. (ed). Biological Inventory of the Northeastern Gulf of Mexico. Special Report, Gulf Coast Research Laboratory, Ocean Springs, Mississippi.

Show, I.T. 1977. Spatial Modeling Approach to Pelagic Ecosystems. PHD Dissertation. Texas A&M University.

Show, I.T. 1977. Assessment of Marine Biomass Materials. I. Potential Yields. Electric Power Research Institute, Advanced Fossil Power Systems, Technical Report 77-979-1.

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Bull, C.S. and I.T. Show. 1980. Measuring mitigation. In Hanna, D.C. and C.S. Bull (eds). Perspectives on Mitigation. Southwestern Anthropological Association. pp. 54-65.

Bull, C.S., G. Stickel, and I.T. Show. 1980. Historical and Prehistorical Archeology New Melones, Calaveras County, California. Final Report, US Army Corps of Engineers.

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Show, I.T. and M.R. White. 1995. Development of an Interactive Epidemiological Projection System. NHRC Technical Document 95-2b.

OVERALL SUMMARY OF RESEARCH EXPERIENCE:

Investigated and modeled biological/physical processes related to the following:

- o effects of kinematic and dynamic physical processes on ecosystems,
- o biotic spatial distributions and ecosystem dynamics,
- o marine mammal and other migrations,
- o plankton intrainment by power plants and other facilities,
- o relative impacts of natural and man-made catastrophic events,
- o introduction of toxic materials into natural ecosystems,
- o long-term changes in rivers due to urban development,
- o changes in rivers and estuaries due to brine disposal,
- o impacts of oil development, and LNG terminals.

Developed stochastic numerical models and estimation methods for the following:

- o ecosystem function and health in oceans, rivers, and lakes,
- o environmental risk assessments,
- o studies of oil weathering,
- o determination of pesticide and priority pollutant toxicity,
- o applicability and efficiency of toxic waste disposal methods,
- o behavioral effects of various toxic materials.

Provided experimental designs, analyses, interpretations, and implementations for the following laboratory and clinical activities:

- o phytoplankton and zooplankton sample processing,
- o oncological screening in laboratory animals and humans,
- o drug effects in dermatological treatment,
- o general QA/QC evaluations and operations,
- o analytical chemistry,
- o instrument calibration and testing,

- o toxicant destruction by incineration,
- o toxicant removal by filtration and carbon absorption,
- o explosive chemicals reactivity and storage,
- o automated chemical detection equipment testing.

Created statistical sampling designs, analyses, QA/QC, and interpretations for the following field activities:

- o marine, terrestrial, and fresh water environmental studies,
- o gene mapping experiments,
- o horticultural studies of endangered plant species,
- o mariculture and aquaculture experiments,
- o epidemiological sampling and modeling,
- o marine mammal and other migrations,
- o archaeological mitigations,
- o toxic and hazardous materials in animal and human populations,
- o hydrocarbon weathering and toxicity,
- o distribution and toxicity of hazardous materials,
- o CO2, PCB, and dioxin monitoring,
- o radiological monitoring and chemical reactivity,
- o manganese nodule resource estimation,
- o estimation of free-fall grab sampler efficiency.

Completed additional projects on the following subjects:

- o marine and fresh water macrophytes,
- o lake and river phytoplankton and zooplankton,
- o fishes of the Pearl and Tombigbee River systems,
- o decapod crustaceans,
- o echinoderm larvae,
- o estuarine and deep-ocean zooplankton,
- o coral self-cleaning,
- o reproductive and diving physiology,
- o commercially exploited fisheries populations,
- o Gray Whales, bison, and fishers.

ASSISTANT PI: MARTI B. SHOW

EDUCATION:

Univ of Calif, San Diego	Ph.D. Candidate	1988	Mathematics
Univ of Calif, San Diego	M.A.	1986	Mathematics
Univ of Texas	B.S.	1975	Life Sciences
	Graduate Study		Biology/Psychology

EXPERIENCE:

Until recently member of Adjunct Faculty at Palomar College; developed course and taught Business Math with Calculus. Supervised Mathematics Tutorial Center and taught Finite Math. Taught Stochastic Processes and Pre-calculus at UCSD. Headed math division of private secondary school; evaluated curricula, teaching materials and methods; advised student body and parents; analyzed achievement tests for entire school; taught biology and six levels of math.

Currently Program Manager for development of statistical and Markov probalilistic methods for epidemiological research being carried out by the Naval Health Research Center; methods include sampling and analytical techniques for the study of human disease and injury rate estimation and prediction. Developed analytical methods and functioned as designer and field observer on studies of California Least Tern Foraging and the effects of water management practices on coastal lagoons.

Developed probability measures for multivariate classification and analytical techniques. Aided in development of a mathematical theory underlying chemical binding of Monoclonal Antibodies; used probabililistic and functional analytic properties of reaction kinetics. Developed real-time pattern recognition methods for sea-surface phenomena using Hilbert space transformations. Collaborated on statistical designs and implementations related to impacts on endangered species; formulated sophisticated mathematical/statistical mapping methods. Created experimental designs and estimation procedures for permeation of hazardous materials through encapsulation container walls. Evaluated graph theoretic concepts associated with ecosystem stability. Researched marine habitats and effects of catastrophic events on marine ecosystems. Collaborated on state-of-the-art model for the effects of petroleum hydrocarbons on marine ecosystems.

Functioned as designer, field observer and data analyst for studies of effects of natural oil seeps and military operations on migratory behavior of California Gray Whales. Helped develop population dynamic models and wildlife management plan for North American Plains Bison on Camp Pendleton, California. Designed and implemented experiment to test effects of essential mineral deficiencies on growth of flowering plants. Identified and quantified microbiological contaminants in water samples. Developed organizational system for HMS Challenger Expedition biological and hydrographic data.

Identified properties of over 200 components of crude oils; compiled and analyzed data on toxicities of specific hydrocarbons. Designed and implemented QA/QC procedures for large industrial waste disposal program, including documentation, chain-of-custody, and sample handling. Formulated preliminary mathematical models depicting effects of oceanographic processes on oil weathering. Developed complete method for reduction and comparative analysis of gas chromatographic data. Prepared priority pollutant standards and performed laboratory verification and recovery experiments. Evaluated gas chromatographic results to determine hydrocarbon and pesticide concentrations.

Devised and implemented stratified sampling designs for large archaeological field programs; participated in data management and statistical analyses. Defined and examined eight statistical methods for effectiveness in estimating population size and density from line-transect data. Analyzed and interpreted data from large-scale atmospheric plume dispersion models.

Proficient with programming languages as well as main-frame and microcomputer analytical and data management systems. Researched and developed algorithms for statistical software; responsible for system specification and design of the following: minimum variance unbiased descriptive statistics; data transformations; traditional parametric inference; analysis of variance; regression; correlation; multivariate analysis; non-parametric inference; line transect statistics; automated sampling design and analysis; multi-stage mean comparisons; probability integrals; and data base management.

Managed new personnel for a prominent real estate firm; recruited and interviewed applicants; planned and implemented extensive training agenda for new personnel. Initiated and coordinated nation-wide real estate referral service. Increased productivity of personnel through design of a system of forms and checklists and implementation of state-of-the-art computer systems.

Currently a Certificated Airplane Flight Instructor with additional ratings as Airplane Multi-engine and Instrument Instructor; also Advanced and Instrument Ground Instructor. Accumulated over 2000 hours of flight time including extensive experience in aerial survey, photogrammetry, and search and rescue. Serves as US Coast Guard .Auxiliary 11th District Assistant Staff Officer for Member Training (Air). Developed several aviation ground instruction programs and is active as an FAA Accident Prevention Counselor.

EMPLOYMENT HISTORY:

1992 - present	President, Southwest Research Associates, Inc.
1990 - present	Flight Instructor, Aviation Consultant, Hangar 10 Aero Services
1987 - 1992	Vice-President, Southwest Research Associates, Inc.
1987 - 1996	Adjunct Faculty, Palomar College
1983 - present	Independent Consultant
1983 - 1990	Graduate Student and Teaching Assistant (UCSD)
1982 - 1983	BETASOFT (Senior Partner)
1980 - 1982	IDS Associates, Inc. (Associate Scientist)
1979 - 1980	Science Applications, Inc. (Associate Scientist)
1978 - 1979	Century 21 (Sales Manager)
1976 - 1977	Trinity School (Math Department Head)
1973 - 1974	Jack E. Blake Oil Co. (Oil Rights/Land Lease Admstr.)

PUBLICATIONS:

Show, I.T., B.J. Kallman, M.B. Show, and E. Mishuck. 1981. Measurements and Impacts of Natural Perturbations Upon Marine Ecosystems. American Petroleum Institute.

Show, I.T., B.J. Kallman, and M.B. Show. 1981. Development of a Stochastic Risk Assessment Model of the Fates and Effects of Petroleum in Marine Ecosystems. NOAA/Office of Marine Pollution Assessment, Final Report NA80-RAD-00049.

Leatherwood, S., I.T. Show, R.R. Reeves, and M.B. Show. 1981. Proposed Modification of Transect Models to Estimate Population Size from Aircraft with Obscured Downward Visibility. International Whaling Commission, Special Report.

Show, I.T., S. Swartz, M.L. Jones, S. Leatherwood, and M.B. Show. 1981. Aerial inventory of bottle-nose dolphin, Tursiops Truncatus, near St. Petersburg: September and November 1979. Fla. J. Sci.

Leatherwood, S., R.R. Reeves, I.T. Show, and M.B. Show. 1982. Aerial inventory of bottle-nose dolphin, *Tursiops truncatus*, in and adjacent to Laguna Madre and Corpus Christi Bay, Texas., Amer. Midl. Nat.

Show, I.T., S. Leatherwood, and M.B. Show. 1983. A Comparison of Results Between Aerial and Boat Surveys for Bottle-Nose Dolphin, *Tursiops truncatus*, In Inshore and Offshore Waters. International Whaling Commission, Special Report.

Show, I.T., S. Leatherwood, and M.B. Show. 1983. Design Criteria, Field Conduct, and Analytical Methods for Marine Aerial Surveys. International Whaling Commission, Special Report.

Show, I.T. and M. B. Show. 1986. Simulation, multivariate statistics, and the degradation of coastal and estuarine ecosystems. Proc., Oceans '86: 1050-1055.

Show, I.T., M. B. Show, S.H. Schulberg, and D.R. Van Schoik. 1987. Results of the 1986-1987 Gray Whale Migration and Landing Craft, Air Cushion Interaction Study. Naval Facilities Engineering Command Report PO N62474-86-M-0942.

Show, I.T., M. B. Show, and L.R. Williams. 1989. Modeling the contributions of cross-reactant chemicals in immunoassays. Aquatic Toxicology and Hazard Assessment: 12th Volume. ASTM STP 1027, U.M. Cowgill and L.R. Williams, Eds., American Society for Testing and Materials, Philadelphia, 1989, pp. 21-33.

Show, I.T., M.B. Show, S.H. Schulberg, and D.R. Van Schoik. 1990. Results of the 1988-1989 Gray Whale (*Eschrichtius robustus*) Migration Study. Naval Facilities Engineering Command Report N62474-86-M-0942/P00002.

LITERATURE CITED

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R.J. Conover and M.E. Huntley. 1980. General rules of grazing in pelagic ecosystems. In Falkowski, P.G. (ed). Primary Productivity in the Sea. Brookhaven Symposia in Biology: 31. Plenum Press, NY.

Fucik, K.W., and I.T. Show. 1981. Environmental synthesis using an ecosystem approach. In Middleditch, B.S. (ed). Environmental Effects of Offshore Oil: The Buccaneer Gas and Oil Field. Plenum Press, NY. pp. 3-85.

Kennedy, W.J. and J.E. Gentle. 1980. Statistical Computing. Marcel Dekker, NY.

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T. Platt and C.L. Gallegos. 1980. Modeling primary production. In Falkowski, P.G. (ed). Primary Productivity in the Sea. Brookhaven Symposia in Biology: 31. Plenum Press, NY.

Platt, T., K.H. Mann, and R.E. Ulanowicz. 1981. Mathematical Models in Biological Oceanography. UNESCO Press, Paris.

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Show, I.T. 1977. Spatial Modeling Approach to Pelagic Ecosystems. PHD Dissertation. Texas A&M University.

Show, I.T. 1978. A spatial modeling approach to estuarine and aquatic ecosystems. Invited paper, American Society of Limnology and Oceanography. Victoria, B.C.

Show, I.T. 1979a. An application of compartment models to meso-scale marine ecosystems. In Matis, J.H., B.C. Patten, and G.C. White (eds). Applications of Compartmental Modeling. International Co-Operative Publishing House, Fairland, MD. pp. 73-97.

Show, I.T. 1979b. Plankton community and physical environmental simulation for the Gulf of Mexico. Proc. Summer Computer Simulation Conference. Toronto, Ontario. pp. 432-439.

Show, I.T. 1980. Movements of a marine copepod in a tidal lagoon. In Hamilton, P. and K.B. MacDonald (eds). Estuarine and Wetland Processes. Plenum Press, NY. pp. 561-602.

Show, I.T., B.J. Kallman, and M.B. Show. 1981. Development of a Stochastic Risk Assessment Model of the Fates and Effects of Petroleum in Marine Ecosystems. NOAA/Office of Marine Pollution Assessment, Final Report NA80-RAD-00049.

Show, I.T. and M.B. Show. 1986. Simulation, multivariate statistics, and the degradation of coastal and estuarine ecosystems. Proc. Oceans '86: 1050-1055.

Smith, J.M. 1974. Models in Ecology. Cambridge Univ. Press, Cambridge, MA.

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Ulanowicz, R.E. and T. Platt. 1985. Ecosystem Theory for Biological Oceanography. Can. Bull. Fish. Aquat. Sci.: 213.

1997 EXXON VALDEZ TRUS.__ COUNCIL PROJECT BUDGET

October 1, 1996 - September 30, 1997

Budget Category:	Authorized FFY 1996	Proposed FFY 1997						
Personnel		$218.8						
Travel		$8.9						
Contractual		$0.0						
Commodities		$0.0						
Equipment		$7.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	$0.0	$234.7	Estimated FFY 1998	Estimated FFY 1999	Estimated FFY 2000	Estimated FFY 2001	Estimated FFY 2002	
Indirect								
Project Total	$0.0	$234.7	$235.0	$150.0	$100.0	$100.0	$100.0	
Full-time Equivalents (FTE)		28.0						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments:
Overhead is included in direct labor, monthly personnel costs.
G&A and profit are included in the indirect cost estimates.

1997

Project Number: 97249
Project Title: Data Synthesis and Ecosystem Modeling
Name: SRA, Inc.

FORM 4A
Non-Trustee
SUMMARY

1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1996 - September 30, 1997

Personnel Costs:			Months	Monthly		Proposed
Name	Position Description		Budgeted	Costs	Overtime	FFY 1997
Ivan T. Show	PI		8.0	11.8	0.0	94.4
Marti B. Show	Assistant PI		8.0	11.8	0.0	94.4
	Data Clerk		12.0	2.5	0.0	30.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		28.0	26.1	0.0	
					Personnel Total	$218.8

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FFY 1997
EVOS Annual Workshop, Anchorage	0.2	1	4	0.1	0.6
EVOS Offices. Anchorage	0.2	1	2	0.2	0.6
PWSSC, Cordova	0.4	2	5	0.2	1.8
Univ of Alaska, Fairbanks	0.6	2	6	0.2	2.4
Various Towns Around PWS	0.7	2	10	0.1	2.4
Kodiak	0.7	1	2	0.2	1.1
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$8.9

1997

Prepared:

Project Number:
Project Title: Data Synthesis and Ecosys Modeling
Name: SRA, Inc.

FORM 4B
Personnel
& Travel
DETAIL

4/10/96

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

Contractual Costs:	Proposed
Description	FFY 1997
Contractual Total	$0.0

Commodities Costs:	Proposed
Description	FFY 1997
Commodities Total	$0.0

1997

Project Number:
Project Title: Data Synthesis and Ecosystem Modeling
Name: SRA, Inc.

FORM 4B
Contractual &
Commodities
DETAIL

Prepared:

4/10/96

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

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FFY 1997
GIS / Database Dedicated IBM-PC	1	4.0	4.0
ARCVIEW II	1	1.0	1.0
CD-ROM WRiter	1	2.0	2.0
			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**	$7.0

Existing Equipment Usage: Description	Number of Units
IBM-PC	4
Scanner	1

1997

Project Number:
Project Title: Data Synthesis and Ecosystem Modeling
Name: SRA, Inc.

FORM 4B
Equipment
DETAIL

Prepared:

4/10/96