Reconstructing Sockeye Populations in the Gulf of Alaska over the Last Several Thousand Years: The Natural Background to Future Changes

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Proposers:	Mann and Finney, University of Alaska
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Alaska Sea Life Center:	No
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Cost FY 04:	$24,900
Geographic areas:	Prince William Sound, Kodiak, Kenai Peninsula
Injured Resource/Service:	Sockeye salmon, GEM Transition, retrospective study

ABSTRACT

We are reconstructing changes in sockeye salmon abundance over the last 5000 years using the ^{15}N record left by salmon carcasses in the sediments of spawning lakes in Prince William Sound, the Kenai Fjords, the Kenai River watershed, and on Kodiak Island. Our research question is: *What is the normal variability in sockeye salmon populations in the Gulf of Alaska and how does it relate to climatic changes in the Gulf of Alaska region?* Our results provide a valuable background for future monitoring studies within the GEM program and for fisheries managers working to preserve and restore natural salmon runs.

INTRODUCTION

A. Laying a foundation for GEM

A priority for proposals solicited by EVOS for FY 03 is to establish a foundation for the GEM program. The primary mission of the Gulf Environmental Monitoring Program is to understand how natural and human-caused changes affect marine ecosystems in the northern Gulf of Alaska (GOA). We can learn a lot about present ecosystems by documenting their past responses to global changes and human activities. Information on ecosystem history can help us predict future changes. Here we propose a retrospective study of sockeye abundance in Prince William Sound and in the Kenai River watershed using the stable isotope tracers present in the sediments of spawning lakes. Our goal is to describe changes in sockeye salmon abundance over the last several millennia and to relate these changes to shifts in the climate/ocean system of the GOA and to human activities.

B. Sockeye salmon

Sockeye are an important for Native subsistence and for commercial and recreational fishing. The Trustee Council has previously made large investments in sockeye salmon recovery by purchases of stream bank, lakeside, and watershed habitats and by funding studies that detail the effects of over escapement caused by the spill. The over escapement impact was caused by the return of larger than normal numbers of spawning fish because of fisheries closures resulting from concern over oil contamination. Increased juvenile sockeye populations caused overgrazing of zooplankton stocks in spawning lakes, with consequent effects throughout the food chain. Growth rates were reduced during the freshwater part of the sockeyes' life history, and declines occurred in the health of adult fish. We have little idea about the relative severity of these over escapement effects relative to natural, prehistoric variations in sockeye populations.

C. The importance of retrospective studies

Retrospective studies like the one we propose here directly address the GEM program's goals of detecting and understanding of changes in the GOA ecosystem. To detect trends of change, we need historical data. To disentangle human-caused from nature-caused changes, we need historical data that extend back before the arrival of Europeans in the region (e.g., Finney et al., 2000; 2002). To understand the marine ecosystem, we need to describe the natural changes upon which human influences are superimposed. By understanding what happened in the past, we gain valuable perspectives on the present. In this time of global changes, learning how species and ecosystems responded to previous shifts in the environment can inform us about their future responses.

D. Previous retrospective studies of salmon populations

Finney et al. (2000; 2002) describe a 300-year record of sockeye population changes in seven lakes on Kodiak Island and the Alaska Peninsula using measurements of marine-derived nitrogen preserved in the bottom sediments of spawning lakes (Fig. 1). Marked changes in population size were found both before and after the start of intensive fisheries around AD 1900. The prehistoric changes are related to climate change (see next section), and the post-1900 changes to a combination of both climate change and fishery activity. The ^{15}N

method provides a powerful tool for reconstructing changes in salmon populations in the GOA region.

E. Progress to Date on EVOS Project 649

In 2000 we collected sediment cores from Eshamy Lake in Prince William Sound. These cores were analyzed in 2001 and 2002 and results are shown in Figure 2. Rapid sedimentation in Eshamy Lake makes it possibly to reconstruct a high-resolution record of ^{15}N variations and organic-matter content. We are currently working on an age model for the sediments. From the initial data, it appears that sockeye numbers in Eshamy Lake are currently near a 2000-year high. Finer-scale sampling and more precise dating may allow us to describe population trends over the last century. Interestingly, variations in sockeye numbers in Eshamy Lake over the last 2000 years resemble the pattern of changes observed over the same period in Karluk and Red Lakes on Kodiak Island (Finney et al., 2000, 2002). We are currently running additional ^{15}N analyses on the Eshamy core, preparing samples for high-resolution ^{210}Pb dating of sediments at the core top, and ^{14}C dating four additional samples from the lower parts of the core. The Eshamy Lake promises to provide a high-resolution sedimentary record of sockeye abundance over the last 3500+ years.

BACKGROUND

A. Recent changes in the GOA atmosphere/ocean system

The northern Gulf of Alaska has seen dramatic environmental changes over the last several millennia, many of which resulted from shifts in the position and intensity of the Aleutian Low (Cayan and Peterson, 1989; Lackmann and Gyakum, 1996; Mock et al., 1998). The intensity of the Aleutian Low varies at all time scales, though only those within the span of the instrumental record (ca. 100 years) are known with any certainty (Francis et al., 1997). The best studied of these variations is the Pacific Interdecadal Oscillation (PDO), which is the coupled variation in sea surface temperature (SST) and sea level pressure (SLP) resulting from the alternation between two, self-reinforcing, and quasi-stable circulation regimes in the North Pacific climate system (Latif and Barnett, 1996; Minobe, 1997; Overland et al., 1999). The PDO has undergone two complete oscillations since AD 1900 (Mantua et al., 1997). During positive phases of the PDO, the Aleutian Low moves eastward and intensifies, resulting in increased precipitation along the coast of the Gulf of Alaska. SSTs are cooler in the Alaska Gyre but warmer in nearshore waters. During negative phases of the PDO, the central northeastern Pacific warms, the Aleutian Low weakens, coastal precipitation lessens, and nearshore temperatures warm. Longer time-scale fluctuations (centuries to millennia) have occurred repeatedly in the North Pacific climate system (Mann et al., 1999). Studies of coastal tree rings extend the PDO record back to AD 1760 (Wiles et al., 1996, 1998, 199a).

Most of our proxy data for GOA climate prior to AD 1900 come from terrestrial sources (Mann and Hamilton, 1995). Both the Medieval Warm Period (ca. AD 900-1250) and the Little Ice Age (ca. AD 1250-1900) occurred in the GOA region, where they are evidenced by glacier fluctuations and by climatic changes recorded in tree rings (Wiles and Calkin, 1994; Wiles et al., 1998; Wiles et al., 1999 b). Fluctuations in summer temperature of several degrees centigrade are suggested (Wiles et al., 1996). The Medieval Warm Period is especially interesting for us today because it was the last time when global temperatures approached their post-1900 AD levels.

Moving further back in time, the Neoglacial interval (ca. 6000 BP – AD 1900) saw alternating cold and warm intervals each lasting several hundred years to one millennium (Calkin, 1988). Precipitation fluctuated as well, and in combination with temperature changes, caused snowlines to rise and fall by several hundred meters. Transitions from milder to colder conditions during the Neoglacial occurred rapidly in the space of several years to several decades. In general terms, the magnitudes and rates of natural climate changes occurring in the GOA over the last several millennia are similar to those predicted to occur over the next several centuries (Mann et al., 1999). In effect, nature has done a series of experiments in the past about how the GOA ecosystem may respond to future changes in the atmosphere-ocean system.

B. Salmon responses to changes in the atmosphere/ocean system

Climatic shifts have dramatic effects on the biota of the North Pacific, including salmon, at a variety of time scales (Finney et al., 2002). Climate variability is linked to ecosystem change in the North Pacific primarily through its forcing effects on lower trophic levels (Francis et al., 1997). These effects work their way through the food web and are modified as they proceed by species' life histories, subsistence strategies, and by top-down effects like predation. Intensification of the Aleutian Low during phases of positive PDO triggers increased zooplankton biomass in the Alaskan Gyre, probably in response to increased wind-induced upwelling and vertical mixing (Brodeur and Ware, 1992; Brodeur et al., 1996; Sugimoto and Tadokoro, 1997). Phytoplankton and zooplankton populations seem to have increased during the reorganization of upper ocean circulation in response to the 1976/1977 regime shift (Francis et al., 1998).

Some of the most dramatic effects of climatic shifts on the marine biota are evident in the histories of salmon catches (Downton and Miller, 1998). Salmon catches in Gulf of Alaska waters closely track the PDO oscillation, with stock size positively correlated with the average winter/spring strength of the Aleutian Low (Beamish and Bouillon, 1993; Mantua et al., 1997). Northern (Alaskan) and southern (Oregon, California) salmon stocks vary roughly 180^{o} out of phase (Francis and Sibley, 1991; Gargett, 1997).

There is no generally accepted explanation for how the Aleutian Low controls salmon populations in the North Pacific (Francis et al., 1998). One possible explanation is that increased wind mixing stimulates primary productivity in the Alaska Gyre, which provides more food for young salmon during the early marine stages of their lives. Gargett (1997) suggests that the critical link between physical forcing and salmon survival is the enhanced water-column stability in coastal areas during positive PDO phases, which increases primary productivity and subsequently food supply for salmon juvenile stages. Increased stream flow caused by increased rainfall in coastal areas during positive PDO phases may increase spawning success and hatchling survival. Probably all these factors interact to increase salmon stocks during positive phases of the PDO. Historical records are too short to tell us how climate/oceanographic parameters affect salmon populations.

C. Stable Isotopes in lake sediments as records of salmon abundance

Measurements of the natural abundance of stable isotopes make it possible to trace the flow of selected elements in ecosystems (Fry and Sherr, 1984; Owens, 1987; Peterson and Howarth, 1987; Wada et al., 1987). This has application in anadromous Pacific salmon systems because of the dichotomous nature of the two important nitrogen (N) sources, which are marine N from the decay of carcasses of returning adult salmon, and atmospheric N_2 (Kline, 1991). The two sources of N can be distinguished by del^{15}N, which is defined as the per mil difference in $^{15}N/^{14}N$ compared to an air N_2 isotope standard. The premise underlying the use of stable isotope abundance is the relative enrichment of ^{15}N in Pacific salmon (~ +12) in comparison with atmospheric N_2 (0). Food webs based on N_2 fixation tend to be low in ^{15}N (Minagawa and Wada, 1984; Owens, 1987; Wada and Hattori, 1991).

When Pacific salmon return to freshwater to spawn and die, they import significant quantities of marine-derived nutrients. Because these nutrients carry a distinctive signature of heavy nitrogen (^{15}N), the amount of ^{15}N present in the accumulating in the sediments of the spawning lake can be used as a proxy for escapement (Kline, 1991). Studies have quantified the proportion of marine-derived nitrogen (MDN) released by adult salmon as a result of spawning migration (Kline et al., 1993). Measurable shifts in the MDN content of juvenile sockeye have been observed between years of strong and weak escapement. The N-isotope composition of lake biota reflects the recent history of MDN import into the lake ecosystem (Kline et al., 1993; 1994). In some lakes, this signal is transferred to the underlying sediments. Downcore changes in the abundance of MDN can reflect changes in the number of returning adult salmon (Finney et al., 2000).

D. Preliminary data for this study

Data from Karluk and Frazer Lakes on Kodiak Island indicate that sedimentary del^{15}N effectively tracks sockeye escapement (Fig. 1, Finney et al., 2000). We chose Frazer Lake as a test case for this method, as the lake was a "barren system" isolated by a waterfall from salmon prior to stocking in the late 1950s. Subsequently, a fish bypass was constructed and run size significantly increased, with an average escapement of about 200,000 since 1980 (Blackett, 1979; ADF&G, written comm., 1994). Such a large increase in escapement is clearly recorded by sedimentary del^{15}N (Fig. 1). The enrichment in del^{15}N is significant and strongly supports the hypothesis that sediment del^{15}N is influenced by salmon input of MDN. Similarly, data from Karluk Lake indicate a strong relationship between sediment del^{15}N and salmon escapement (Finney et al., 2000). Karluk Lake, one of the greatest sockeye systems in the world, had historical returns >5 million fish. Escapements averaged more than 1 million fish from the turn of the century until about 1935 but then fell to an average of less than 300,000 in the 1960s and 70s (Fig. 1; Koenings and Burkett, 1987a, ADF&G, written comm., 1994). The sedimentary del^{15}N in Karluk is significantly higher than Frazer, and it is consistent with greater salmon escapement. The large decline in sedimentary del^{15}N of about 3 parts per mil towards the top of the core reflects the decline in escapement in this system since the 1930s. These results indicate that sedimentary del^{15}N provides a valuable tool for reconstructing long-term changes in sockeye abundance.

In 2000 we retrieved four cores each from Solf and Eshamy Lakes in Prince William Sound. Solf is a “barren” lake into which salmon have been recently introduced, and Eshamy Lake naturally supports a vigorous sockeye run. Analyses of the Eshamy Lake cores in 2001 and 2002 show a striking del^{15}N record (Fig. 2). Solf Lake will serve as a control for possible changes in non-salmon (e.g., aerosol) input of del^{15}N into Prince William Sound lakes.

NEED FOR THIS PROJECT

A. The Problem: What is “normal” for sockeye populations?

The recovery objective set by the EVOS Trustee Council for sockeye salmon is that adult returns-per-spawner should regain normal levels. But what is normal? If both the global environment fisheries management were stable then we might be able to define “normal”. But change reigns in both nature and society, and what is normal for the last several decades may be unusual over longer time spans.

The retrospective studies we propose here can establish long-term, baseline records of changes in salmon populations in the GOA. We can use these records to define normalcy by estimating the frequency with which the observed population size occurred in the past. By knowing the extremes of natural population fluctuations in the past, we can identify abnormal population excursions as they occur in the future.

Understanding how environmental factors affect salmon populations is crucial for fisheries management in a time of global change. Also, sockeye may prove to be a useful indicator species for events within the larger GOA ecosystem. Before we can use sockeye as an indicator species, we need to understand how nonhuman factors control their numbers. From retrospective studies, we can generate testable hypotheses about how changes in the atmosphere/ocean system of the GOA will affect salmon populations in the near future. Nature has performed a series of experiments in past millennia, and we can gain access to the results of these experiments through analyses of del^{15}N in lake sediments.

B. Links: Giving GEM a time perspective

The goals of GEM are to detect, understand, and predict ecosystem changes in the GOA with the purpose of informing and assisting resource managers. Besides providing a more rigorous means of defining what is normal, our study will help lay the foundations for GEM by generating hypotheses that relate changes in the atmosphere/ocean system of the GOA to fluctuations in salmon numbers. The past is the key to the present, and climate has varied repeatedly over the last 2000 years. How did sockeye population respond to changes of several C^{o} in the past? The last time temperatures were as warm as today was during the Medieval Warm Period (AD 900-1250). How did sockeye populations respond to this previous warm period?

C. Study Sites

This study involves sockeye lakes in the northern GOA region that were affected by over escapement after the 1989 oil spill (Eshamy and several lakes in the Kenai River watershed) and two recently formed lakes in McCarty Fjord (Delight and Desire Lakes). Detailed sediment chemistry has been completed in two Kodiak Island lakes, Karluk and Frazer (Fig. 2), though we plan to return to Karluk Lake this summer to obtain a longer core that could push the Kodiak sockeye record back into the early Holocene (ca. 9,000 year ago). Analysis is nearing completion for Eshamy Lake (Fig. 1) in Prince William Sound. We leave next week to retrieve cores from Upper Russian Lake. We plan on coring Delight and Desire Lakes in Kenai Fjords and Skilak, Hidden, and a control lake in the Kenai River watershed during the late summer of 2002.

COMMMUNITY INVOLVEMENT AND TRADITIONAL KNOWLEDGE

Archaeological records contain unsynthesized data concerning the interactions between humans and salmon populations during prehistoric times (see review in Mann et al., 1999). We suspect there is also a rich oral tradition in Native communities about the history and causes of changes in salmon abundance.

Within the time constraints of this one-year project, our goals are to get data on sockeye population history and then to develop hypotheses about salmon-climate interconnections. Once we have the science figured out, we want to turn to the local people, the people actually living on the land, to share our ideas and get their ideas back. We anticipate asking EVOS for additional funds in FY 2004 to pay for several trips to Kodiak Island and to villages in PWS and on the Kenai Peninsula, where we will give brief presentations showing our results and initiate conversations about what factors control salmon populations in the GOA region.

PROJECT DESIGN

A. Objectives

We intend to reconstruct sockeye abundance in Eshamy, Upper Russian, Delight, and Desire Lakes using established methods of isotope analysis of lake-bottom sediments that are retrieved by coring. The specific objectives of this study are:

1) Develop sediment-core chronologies and measure downcore changes in lake-productivity indicators (organic C and C/N ratios) as well sedimentary del^{15}N.

2) Compare sediment data corresponding to the past few decades (e.g., the period of intensive investigations by ADF&G) to salmon population statistics. We then will develop calibration relationships between del^{15}N and salmon numbers.

3) Reconstruct paleolimnologic changes in each lake over the past several thousand years, using the results of Specific Objectives 1 and 2. Specifically, we will reconstruct time-series of lake productivity, input of marine-derived nutrients, and salmon escapement.

4) Compare del^{15}N records from PWS and the Kenai Peninsula to Finney's published and ongoing work on Kodiak Island. This synthesis will result in a valuable new perspective on changes in sockeye abundance in the GOA at decadal time scales over the last several millennia.

5) Compare reconstructed sockeye population fluctuations with published data sets on paleoclimatic changes in the GOA region. These data sets include tree rings, glacial records, and pollen records of vegetation change. From these comparisons, we will develop a series of hypotheses about how changes in the atmosphere/ocean system affect salmon populations.

B. Methods

1) Sediment cores

We already have cores from Eshamy, Solf, Karluk, and Frazer Lakes. Upper Russian Lake, Delight Lake, Desire Lake, Skilak Lake, Hidden Lake, and a control lake in the Kenai River watershed will be cored for the first time in this study. We hope to obtain a longer core from Karluk Lake.

Coring sites are identified from bathymetric maps, and sites are selected to avoid gravity-flow deposition and complicated bottom topography. We will obtain at least two, 1- 2 m long cores using the percussion corer that we built last year to obtain cores from each lake. High quality surface cores will be obtained with a device (Glew corer) designed for sampling unconsolidated sediments and obtaining an undisturbed sediment-water interface. The cores will be stored in a cold room and excess material archived for future studies.

Cores will be described for lithology, texture, color, and other properties, and photographed. Each core will be continuously scanned for magnetic susceptibility. Magnetic susceptibility, a measure of the abundance of magnetic minerals, provides important stratigraphic and sedimentologic information (e.g., King et al., 1983). For example, magnetic susceptibility is sensitive to volcanic ash abundance; visually undetected ashes often are easily detected in susceptibility profiles. Ash layers should be common in many of the lakes, given the close proximity to active volcanoes, and they are useful for correlating between cores and between different lakes. Sediment chronologies will be determined by a combination of ^{210}Pb-dating (Bruland et al., 1974) in the upper several tens of centimeters and by AMS-^{14}C dating of terrestrial plant macrofossils in sediments older than several centuries.

<u>2) Reconstructing changes in sockeye salmon abundance</u>
Changes in input of marine-derived nutrients (MDN) will be determined by analysis of del^{15}N. As discussed earlier, downcore changes in the abundance of MDN (from del^{15}N) reflect changes in the number of returning adult salmon, and thus is a proxy for escapement. Organic carbon content, C/N ratio, and del^{13}C also indicate changes in organic matter source (Hedges and Parker, 1976; Meyers, 1990). Time-series of organic C content, C/N ratios, and stable C and N isotopes will shed light on changes in the source and supply rate of organic matter. We will calibrate our MDN-based reconstructions in sockeye salmon escapement with recorded escapement records. The lakes we propose to study have had significant changes in escapement during the past few decades. These variations allow us to determine how well sedimentary del^{15}N reflects escapement (e.g., Fig. 1). Using recent calibrations, we will estimate prehistoric escapements from downcore changes in del^{15}N.

C. Cooperating agencies, contracts, and other agency assistance

Though no formal collaborations are planned with federal agencies within this brief project, in fact we are collaborating closely with ADF&G and USFWS in ongoing, similar studies of salmon paleoecology (e.g., Schmidt et al., 1997).

SCHEDULE

A. Project Tasks and Endpoints

30 April, 2002:	Core Upper Russian Lake, Kenai Peninsula.
1 September, 2002:	Complete del^{15}N analyses on cores from Upper Russian Lake; submit samples from this lake and from Eshamy Lake for ^{14}C and ^{210}Pb dating. Core Delight and Desire Lakes in Kenai Fjords. Also core Hidden and Skilak Lakes (Kenai Peninsula) and obtain a new, long core from Karluk Lake (Kodiak Island).
November 1, 2002	Complete laboratory analyses of Upper Russian Lake and the two Kenai Fjords lakes
December 1, 2002:	Submit manuscript for publication in peer-reviewed journal concerning the Eshamy Lake ^{15}N records.
January 2003:	Present results and discuss implications for GEM projects at Restoration Workshop.
February 1, 2003	Complete laboratory analysis of Hidden and Skilak Lakes
April 15, 2003:	Annual report on results from FY2002
May 1, 2003:	Finish laboratory work on the Karluk Lake long core
July 1, 2003:	Submit manuscript for publication in peer-reviewed journal concerning nitrogen-isotope records from Kenai Peninsula lakes.
February 1, 2004:	Submit our synthesis paper concerning climate-oceanographic drivers of salmon populations in the GOA region.
April 15, 2004:	Submit final report to EVOS.

PUBLICATIONS AND REPORTS

We plan to submit a manuscript describing our results from Eshamy Lake to either *Fisheries Oceanography* or *Canadian Journal of Fisheries and Aquatic Science* in the autumn of 2002. A second publication concerning the Kenai Peninsula lakes will be submitted in November 2003 to a similar journal. Our final synthesis about the connections between salmon populations and climatic change in the Gulf of Alaska region will be submitted to a journal like the *Journal of Geophysical Research.*

PROFESSIONAL CONFERENCES

We will present our results at two scientific meetings.

December 2002:	Present an oral or poster presentation describing our major findings related to salmon-climate interactions over the last 4000 years at the American Geophysical Union Fall meeting.
August 2003:	Present oral or poster presentation at the Ecological Society of America meetings (location uncertain at this time).

EXPLANATION OF CHANGES IN THE CONTINUING PROJECT

We seek supplemental funding for the second year of the project to expand our work in the Kenai River watershed. With the anticipation of the development of the GEM project ***Nutrient cycling in the Kenai River Watershed: Detecting and understanding marine-terrestrial linkages in watersheds***, we have selected three additional lakes to core there. ^{15}N records from these additional lakes (Hidden, Skilak, and a yet unchosen control lake) will greatly expand our knowledge of long-term salmon variability and nutrient cycling on the Kenai Peninsula. Skilak Lake is a key sockeye nursery lake within the Kenai River system. Because it is a glacial lake, the responses of its sockeye population to changes in climate and to historical changes in fishing activity are likely to be different from clear water systems (e.g., Karluk or Upper Russian Lake). Hidden Lake is a lower elevation, clear water lake, with much different spawning limitations and nutrient elemental ratios than Upper Russian Lake. Studies of these three contrasting lake systems, and their responses to climatic changes, will enhance our knowledge of the politically contentious, economically valuable, and biologically complex watershed of the Kenai River. We request supplemental funding for coring, dating, and laboratory analyses of ^{15}N and lake productivity proxies for three additional lake systems during the second year of our current EVOS project. Writing up the results of our project will extend into FY2004.

PRINCIPAL INVESTIGATORS (see curricula vitae below)

Daniel H. Mann
Institute of Arctic Biology
Irving 1 Building
University of Alaska
Fairbanks, AK 99775
(907) 474-2419 or 455-6249
dmann@mosquitonet.com
fax: 474-6979

Bruce P. Finney
Institute of Marine Sciences
University of Alaska
Fairbanks, AK 99775
(907) 474-7124
finney@ims.uaf.edu

DIVISION OF LABOR BETWEEN PRINCIPAL INVESTIGATORS

Dr. Mann will supervise most of the fieldwork and oversee core sampling and sedimentological descriptions in the laboratory. He will also take the lead in synthesizing Holocene climatic records for detailed comparisons with the salmon proxy records obtained in our project.

Dr. Finney will direct laboratory analyses at UAF, supervise the chronometric analyses done at other laboratories, and provide the fisheries and oceanographic expertise in the manuscripts summarizing the results of our project.

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FY 03 *EXXON VALDEZ* TRUSTEE COUNCIL PROJECT BUDGET
October 1, 2002 - September 30, 2003

Budget Category:	Authorized FY 02	Proposed FY 03						
Personnel	$0.0							
Travel	$0.0							
Contractual	$82.3	$84.9						
Commodities	$0.0							
Equipment	$0.0	$0.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	$82.3	$84.9	Estimated FY 04					
General Administration	$5.8	$7.6						
Project Total	$88.1	$92.5	$24.9					
Full-time Equivalents (FTE)	3.0	3.0						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments:

FY03

Project Number: 030649
Project Title: Reconstructing Sockeye Salmon Populations
Name: D.H. Mann and B.P. Finney

FY 03 *EXXON VALDEZ* TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2002 - September 30, 2003

Budget Category:	Authorized FY 02	Proposed FY 03					
Personnel	$29.1	$31.0					
Travel	$4.5	$5.8					
Contractual	$26.2	$28.0					
Commodities	$6.0	$3.1					
Equipment	$0.0	$0.0	LONG RANGE FUNDING REQUIREMENTS				
Subtotal	$65.8	$67.9	Estimated FY 04				
Indirect	$16.5	$17.0					
Project Total	$82.3	$84.9	$24.9				
Full-time Equivalents (FTE)	0.3	0.3					
	Dollar amounts are shown in thousands of dollars.						
Other Resources							

Comments:

1) The indirect rate is 25% as negotiated between the EVOS Trustee Council and the University of Alaska

2) Travel includes airfare from Fairbanks to study lakes and to scientific meetings in Anchorage and in Lower 48 States. We are uncertain what cities in the Lower 48 because the locations of some national meetings changes year-to-year.

3) The increased amount of our 2003 budget reflects the expansion of our project to include three new lake systems in the Kenai River watershed. These additions are detailed in the proposal's text. If the Trustees do not approve the expansion of this project, the original 2003 budget for this project was $18.8.

4) Our estimated costs in FY 04 cover personnel, communications, travel to a scientific meeting for one investigator (1.6) and two trips from Fairbanks to Anchorage for the Annual EVOS Workshop (1.4).

FY03

Prepared:4-12-02

Project Number: 03649
Project Title: Reconstructing Sockeye Salmon Populations
Name: D.H. Mann and B.P. Finney

FY 03 *EXXON VALDEZ* TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2002 - September 30, 2003

Personnel Costs:			Months	Monthly		
Name	Position Description		Budgeted	Costs	Overtime	
Mann	PI		2.0	9.1		
Finney	co-PI		1.0	7.3		
Krumhardt	Technician		1.0	5.5		
	Subtotal		4.0	21.9	0.0	
					Personnel Total	

Travel Costs:	Ticket	Round	Total	Daily	
Description	Price	Trips	Days	Per Diem	
Fairbanks to Anchorage	0.3	4	5	0.1	
Fairbanks to Hidden, Skilak Lakes, and control lake	0.5	3	2	0.5	
Fairbanks to Lower 48 city for nat'l meeting re. climate change & fisher	0.8	1	4	0.2	
				Travel Total	

FY03

Project Number: 03649
Project Title: Reconstructing Sockeye Salmon Populations
Name: D.H. Mann and B.P. Finney

Prepared:

FY 03 *EXXON VALDEZ* TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2002 - September 30, 2003

Contractual Costs:	
Description	
Laboratory analyses of N and C isotopes AMS-radiocarbon dating, 20 samples (10 per lake) @ $500/each 210Pb analyses, three profiles @ $2000/each boat charter fees from UAF pickup truck and trailer mileage charges from UAF @ $0.40/mile x 800 miles	
Contractual Total	

Commodities Costs:	
Description	
Materials for maintaining lake corer Laboratory glassware, plastic vials, microscope slides, etc. Publications (maximum allowable contribution towards page costs per project) Communications and copy center	
Commodities Total	

FY03

Prepared:4-12-02

Project Number: 03649
Project Title: Reconstructing Sockeye Salmon Populations
Name: D.H. Mann and B.P. Finney

FY 03 *EXXON VALDEZ* TRUSTEE COUNCIL PROJECT BUDGET
October 1, 2002 - September 30, 2003

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

Existing Equipment Usage: Description	Number of Units	

FY03

Prepared:4-12-02

Project Number: Project Number: 03649
Project Title: Reconstructing Sockeye Salmon Populations
Name: D.H. Mann and B.P. Finney