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Project No: 10100808

Date Received: 2-17-10

**PROPOSAL SUMMARY PAGE**

Project Title: Nearshore Synthesis: Sea otters and sea ducks, FY10 Amendment

Project Period: February 27, 2010 to May 30, 2010

Proposer(s): Brenda Ballachey and Dan Monson, USGS Alaska Science Center

Study Location: Prince William Sound, Alaska

Abstract: This is an amendment to project 070808-090808, Sea otter status and nearshore synthesis, to update the sea otter population model with four years of more recent data. Population models have been utilized for sea otters to evaluate causes underlying a lack of recovery of populations in western Prince William Sound. Data for the models include ages at death (based on recovery of otter carcasses), ages of live animals (based on captured otters), and abundance estimates from aerial surveys. Initial modeling efforts used age-at-death data collected from 1976-1998; later efforts have involved more complex models and have included data sets collected through 2005. Overall, results suggest continued depression of survival rates through 2005, relative to prespill survival. We now have 4 years of more recent data, and have noted an increase in sea otter abundance at northern Knight Island since 2007. We propose to update the models with the 2006-2009 data, to determine if sea otter survival rates are returning to prespill patterns, and to elucidate the factors related to the *sink* and *source* populations that would explain the recent increase in otter numbers.

Funding: EVOS Funding Requested: FY 10 \$ 15.9 K  
(must include 9%GA)

TOTAL: \$15.9 K

Non-EVOS Funds to be Used: FY 10 \$

**TOTAL: \$11.5 K**

Date: February 16, 2010

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# PROJECT PLAN

## I. NEED FOR THE PROJECT

### A. Statement of Problem

Sea otters suffered heavy losses from the direct effects of the *Exxon Valdez* oil spill (EVOS), with an estimated several thousand animals dying within a few months of the spill. Subsequently, based on various post-spill studies, the potential for long-term chronic effects on sea otters and other nearshore species became evident. For sea otters, population models have provided one approach to evaluating chronic injury.

Initially, Monson et al. (2000) used simple population models fit to the age distributions of beach cast sea otters to examine post-spill survival rates. This analysis suggested that through 1998, survival rates in the western Prince William Sound (PWS) population had generally declined since the *EVOS* and that these declines were stratified by age and time since the spill. In more recent efforts, the population models were updated by using the age distribution and survey data through 2005 in conjunction with time-varying *source-sink* population models to estimate the number of sea otters at risk and potentially lost due to chronic effects from the spill. With the *source-sink* model dynamics, a portion of the western PWS population is constrained to have a stable or declining population trajectory (the “*sink*” population, which is that part of the population with deleterious oil spill effects and declining numbers), and the remaining western PWS population is considered to be the “*source*”.

In the more recent modeling work (Monson 2009), the most supportable models suggest continued depression of survival rates for the *sink* population, with numbers stable from 1990 to 2005 at approximately 350 individuals. Total chronic loss estimates include nearly 600 animals attributable to direct mortality with another 400 lost from reduced reproductive potential. However, there also were reasonably supportable models that indicate the *sink* population has declined through time with initially over 600 individuals at risk, but dropping below 100 individuals by 1995 and below 10 by 2001. Model-averaged predictions also indicate the *source* population would be growing at ~16% per year if not for loss of emigrants to the *sink* population, and the *sink* population would be declining at ~14% per year if not for the addition of immigrants from the *source*.

We now have 4 additional years of data that can be incorporated into updated models. Ages-at-death (based on recovery of otter carcasses), and ages of live animals (based on data from captured otters), are available for 2006-2008, and aerial survey data of population abundance for 2007-2009. Further, the aerial survey results from 2007-2009 indicate that sea otter abundance in the most heavily oiled areas of western PWS is now increasing, which is a distinct change from previous years. We propose to rerun the population models to determine the effects of incorporating the most recent years of data (2006-2009); to see if the sea otter survival rate is returning to a prespill pattern, and to elucidate the factors related to the *sink* and *source* populations that would explain the recent increase in otter numbers.

### B. Relevance to 1994 Restoration Plan Goals and Scientific Priorities

The work being proposed in this amendment to project 070808 – 090808 will update our knowledge of the status of recovery of sea otters in Prince William Sound following the 1989 oil spill with data

collected through 2009. Recovery of the PWS ecosystem from the *Exxon Valdez* oil spill may not be considered complete until individual animals are no longer exposed to lingering oil from the spill, and when populations reach pre-spill levels of abundance.

## **II. PROJECT DESIGN**

### **A. Objectives**

Objective: Update population models developed by D. Monson (2009) to include the most recent sea otter data sets from 2006-2009, collected under EVOS projects 050775 and 070808 – 090808.

### **B. Procedural and Scientific Methods**

Modeling methodologies will be similar to those described and reviewed previously, in project 070808, for sea otter population modeling efforts. Briefly, we will use time-varying, age-specific demographic models to predict changes in sea otter survival rates in, and abundance of, the *source* and *sink* sub-populations.

### **C. Data Analysis and Statistical Methods**

We will fit these models by perturbing survival rates away from pre-spill values and predicting (1) the age distribution of sea otters dying in the *sink* population each year following the spill, (2) the age distribution of female sea otters living in the *sink* population each year, and (3) the yearly total size of the western PWS population (*source* + *sink* population). In order to identify the most likely ways in which the spill has influenced the demography of the spill-affected population (Doak and Morris 1999, Tinker et al. 2006), likelihood values will be calculated based on the difference between these predictions and their corresponding observed values (Burnham and Anderson 2002). Data sets collected on sea otters in western PWS through 2009 will be incorporated.

### **D. Description of Study Area**

The study area is western PWS.

### **E. Coordination and Collaboration with Other Efforts**

This amendment is a collaboration with and augmentation to EVOS project 070808 – 090808, Sea otter status and nearshore synthesis.

## **III. SCHEDULE**

### **A. Project Milestones**

- Update sea otter population model with 2006-2008 data on ages of living sea otters and ages at death, and 2006-2009 aerial survey data on sea otter population abundance in western PWS.  
*To be met by March 15, 2010*

- Revise draft report for EVOS project 070808 - 090808 to include updated analyses.  
*To be met by May 1, 2010*

## **B. Measurable Project Tasks**

### **FY 10, 2nd quarter (January 1, 2010 -- March 31, 2010)**

*February 26: Project funding approved by Trustee Council  
TOMLAB software purchased and installed; input and complete data computations  
Analyze results for population modeling and age-at-death distributions*

### **FY 10, 3rd quarter (March 31, 2010 -- June 30, 2010)**

*Amend draft Final Report (Journal manuscript) with updated data analyses  
May 1, 2010: Submit draft Final Report to Trustee Council*

*Revise Final Report within 90 days following receipt of peer review comments*

## **IV. RESPONSIVENESS TO KEY TRUSTEE COUNCIL STRATEGIES**

### **A. Community Involvement and Traditional Ecological Knowledge (TEK)**

The work proposed is an amendment to project 070808. The community involvement section of that proposal states that the Principal Investigators will be available to interact with communities in meetings to explain and discuss ongoing restoration projects.

### **B. Resource Management Applications**

The results of the work in this proposal will be included with the sea otter status and nearshore synthesis report of project 070808 – 090808. This report will provide managers with additional information to make decisions regarding progress toward recovery of sea otter and sea duck populations, and intertidal communities at northern Knight Island. Results will also facilitate understanding risk factors, including exposure to lingering oil, which may have been contributing to delayed rates of recovery, and will identify locations of specific shoreline habitats where populations of marine mammals, birds and fishes have incurred exposure to lingering oil and which may be suitable for direct restoration actions. The combined results of the proposed work will allow managers to better evaluate the current state of progress toward recovery in the nearshore ecosystem in PWS and to identify specific locations that may be most suitable for and result in the most direct benefit in achieving restoration objectives.

## **V. PUBLICATIONS AND REPORTS**

## Proposed Budget, FY10

Dr. Monson salary, 1.5 month @ \$7400/ month.....	\$11.1 K
TOMLAB software .....	\$ 3.5 K
9% Agency G.A. ....	<u>\$ 1.3 K</u>
Total.....	\$15.9 K

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- Monson, Daniel H. 2009. Sea otters (*Enhydra lutris*) and Steller sea lions (*Eumetopias jubatus*) in the North Pacific : evaluating mortality patterns and assessing population status at multiple time scales. Ph.D. Dissertation. University of California Santa Cruz. 207 pp.
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December 2009

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**Phone:** (907) 786-7161**Fax:** (907) 786-7150**Email:** [dmonson@usgs.gov](mailto:dmonson@usgs.gov)**Education**

Ph.D.	2009	University of California Santa Cruz, Santa Cruz, CA	Ecology and Evolutionary Biology
M.S.	1995	University of California Santa Cruz, Santa Cruz, CA	Marine Science
B.S.	1983	Luther College Decorah, IA	Biology

**Areas of Specialization and/or Research Interests**

Retrospective and historical data analysis, nearshore ecology of marine systems; predator/prey dynamics; mammalian reproductive biology/ecology; marine food web dynamics and marine mammal foraging ecology; population biology.

**Publications**

Monson, D. H. 2009. Sea otters (*Enhydra lutris*) and Steller sea lions (*Eumetopias jubatus*) in the North Pacific: Evaluating mortality patterns and assessing population status at multiple time scales. Ph.D. Dissertation, Dept. of Ecology and Evolutionary Biology, University of California, Santa Cruz. 223 pp.

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