GEM PROPOSAL SIGNATURE FORM

THIS FORM MUST BE SIGNED BY THE PROPOSED PRINCIPAL INVESTIGATOR AND SUBMITTED ALONG WITH THE PROPOSAL. If the proposal has more than one investigator, this form must be signed by at least one of the investigators, and that investigator will ensure that Trustee Council requirements are followed. Proposals will not be reviewed until this signed form is received by the Trustee Council Office.

By submission of this proposal, I agree to abide by the Trustee Council's data policy (*Trustee Council/GEM Data Policy**, adopted July 9, 2002) and reporting requirements *(Procedures for the Preparation and Distribution of Reports***, adopted July 9, 2002).

PROJECT TITLE: Lingering oil and sea otters: Pathways of exposure and recovery status

Printed Name of PI: __Brenda Ballachey_____

Signature of PI: _____ Date _____

Printed Name of co-PI: ___James L. Bodkin_____

Signature of co-PI: _____ Date _____

* Available at http://www.oilspill.state.ak.us/pdf/admin/datapolicy.pdf
** Available at http://www.oilspill.state.ak.us/pdf/admin/reportguidelines.pdf

Trustee Council Use Only
Project No: __040775_____
Date Received: _____

GEM PROPOSAL SUMMARY PAGE

Project Title:	Lingering oil and sea otters: Pathways of exposure and recovery status (continuation of work in project 040620)
Project Period:	FY 05- FY 06
Proposer(s):	Brenda E. Ballachey and James L. Bodkin, Alaska Science Center, USGS, 1011 E. Tudor Road, Anchorage, Alaska, 99503 (907) 786-3550
Study Location:	Prince William Sound

Abstract: Some of the strongest evidence of continuing effects of lingering oil from the *Exxon Valdez* spill comes from long term monitoring of sea otter populations and their exposure to hydrocarbons. Sea otters in heavily oiled areas of western PWS had not recovered as of 2003. Through 2002, sea otters continue to exhibit elevated levels of the cytochrome P4501A biomarker in areas where lingering oil deposits are most prominent. In 2002/03, sea otters at northern Knight Island were instrumented with radiotransmitters and time-depth recorders. Ongoing monitoring of these individuals is quantifying home ranges relative to known intertidal lingering oil deposits, and when the dive data are retrieved and analyzed, we will link foraging behaviors of individual sea otters to oiled shorelines, and relate patterns of habitat use to individual variation in cytochrome levels. For FY2005, we propose to conduct surveys of population size and distribution, continue to monitor instrumented sea otters to obtain habitat use and survival information, and obtain an additional sample of cytochrome P4501A. This will allow evaluation of continuing exposure to residual oil, population trends, and the status of recovery of sea otters in western PWS.

Funding:				
EVOS Funding Requested:	FY 04	$ 20,500	
	FY 05	$ 126,900	
	FY 06	$ 0	TOTAL: 147,400
Non-EVOS Funds to be Used:	FY 04	$ 4,400	
	FY 05	$ 38,000	
	FY 06	$ 0	TOTAL: 42,400

Note: Closeout $ in the amount of 32.7K has already been approved as part of Project 040620.

Date: 13 April 2004

GEM RESEARCH PLAN

Lingering oil and sea otters: Pathways of exposure and recovery status

Brenda Ballachey and Jim Bodkin
U.S. Geological Survey
Alaska Science Center

I. NEED FOR THE PROJECT

A. Statement of Problem

Lingering oil from the *Exxon Valdez* oil spill persists in intertidal habitats in western Prince William Sound, and is particularly evident in those bays and passages where oiling was most severe in 1989. Further, evidence throughout the nearshore trophic web indicates an invertebrate pathway of exposure to upper trophic levels, including sea otters and sea ducks, with chronic effects resulting in delayed ecosystem recovery (Dean et al. 2000, Trust et al. 2000, Esler et al. 2000, Fukuyama et al. 2001, Bodkin et al. 2002, Esler et al. 2002). Studies conducted in 2001-2003 (EVOS projects 02585 and 030620) have documented the extent of residual oiling throughout the western Sound and the bioavailability of the oil to predators and their prey populations. Aerial surveys of sea otter abundance through 2003 fail to demonstrate population recovery in heavily oiled areas, and the biomarker of exposure to aromatic hydrocarbons, cytochrome P4501A (CYP1A), remains elevated among sea otters where recovery has not occurred (Bodkin et al. 2002), at least through 2002. Radio-telemetry studies initiated in 2002-03 (EVOS project 030620) have documented home ranges and areas of use by sea otters in three heavily oiled locations in western Prince William Sound: 1) Herring Bay, 2) Bay of Isles, and 3) Lower Passage (Figure 1). Although relocations provide reasonable estimates of home ranges, inferring use of particular habitats (such as oiled shorelines) within those home ranges remains problematic because observation time encompasses such a small percentage (estimated at about .01-.02%) of the total time an individual occurs within its home range. Additionally, strong individual variation in foraging behavior, including diet and depth (Estes et al. 2003), likely contributes to variation in exposure to lingering oil among individuals. In 2003, we captured and sampled CYP1A in those sea otters instrumented with radios in 2002 and instrumented an additional sample of 20 individuals with time-depth–recorders (TDR's) as part of the USGS base sea otter research program. TDR's will provide continuous dive depth information on each individual for about 360 days, allowing identification of intertidal foraging, particularly in relation to known home ranges and shorelines serving as repositories for residual *Exxon Valdez* oil. Monitoring of sea otters instrumented with radio transmitters through 2004-2005 will provide an additional year of data on individual habitat use and survival that will be used to determine the cause for a lack of sea otter recovery at heavily oiled northern Knight Island. Additionally, in conjunction with a sampling in 2005 of several species of nearshore fishes and birds (proposed as a separate project), a 2005 sample of CYP1A in sea otters will provide for a comprehensive evaluation of exposure to lingering oil among resident nearshore vertebrates.

B. Relevance to GEM Program Goals and Scientific Priorities

Recovery of the Prince William Sound ecosystem from the *Exxon Valdez* oil spill may not be considered complete until individuals are no longer exposed to spilled oil and when populations reach pre-spill levels of abundance. Clearly, sea otters have not attained these recovery goals. The proposed work will allow continued evaluation of the state of the affected sea otter populations, through continued estimates of sea otter population size and quantification of a biomarker of hydrocarbon exposure. The results of the biomarker component of this study will be interpreted with results from two other studies proposed for FY05 (Ballachey, Bodkin, Irons, Rice et al), to obtain an integrated view of biomarker expression in a suite of nearshore vertebrates and the extent of continuing exposure to lingering oil. Further, the proposed collaborative effort will identify those nearshore habitats that may be responsible for providing exposure to lingering oil and, therefore, where restoration efforts may be of greatest potential benefit to nearshore species as a group. The proposed work directly addresses items contained in the 2004-5 invitation for proposals pertaining to population data, foraging activities, and hydrocarbon exposure of sea otters in oiled areas.

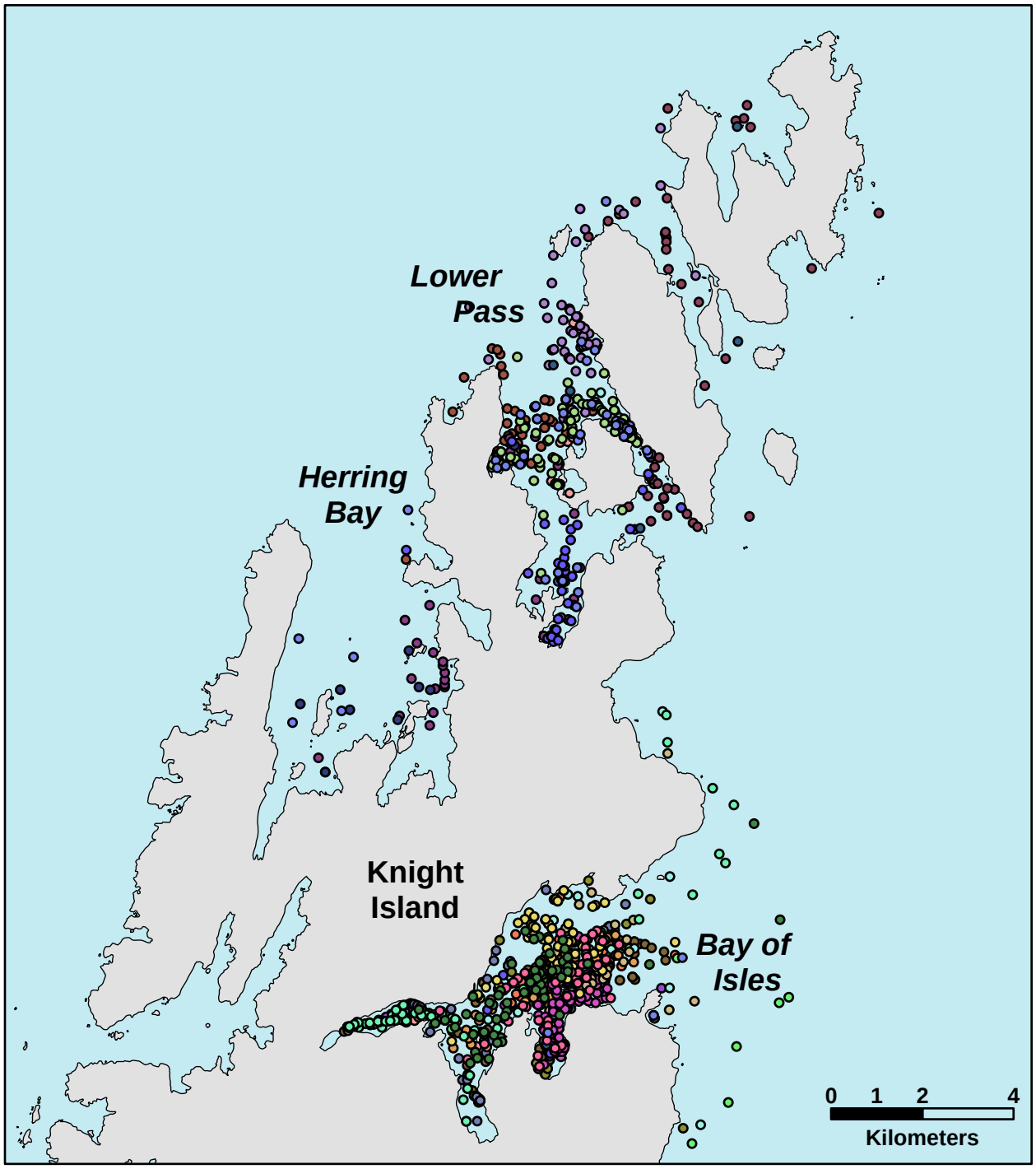

Figure 1. Locations of 27 individual sea otters instrumented with radio transmitters at Knight Island in July 2002. Each color represents an individual and not all re-sights are observable in the figure due to overlap. The number of relocations ranges from 26-142 per individual

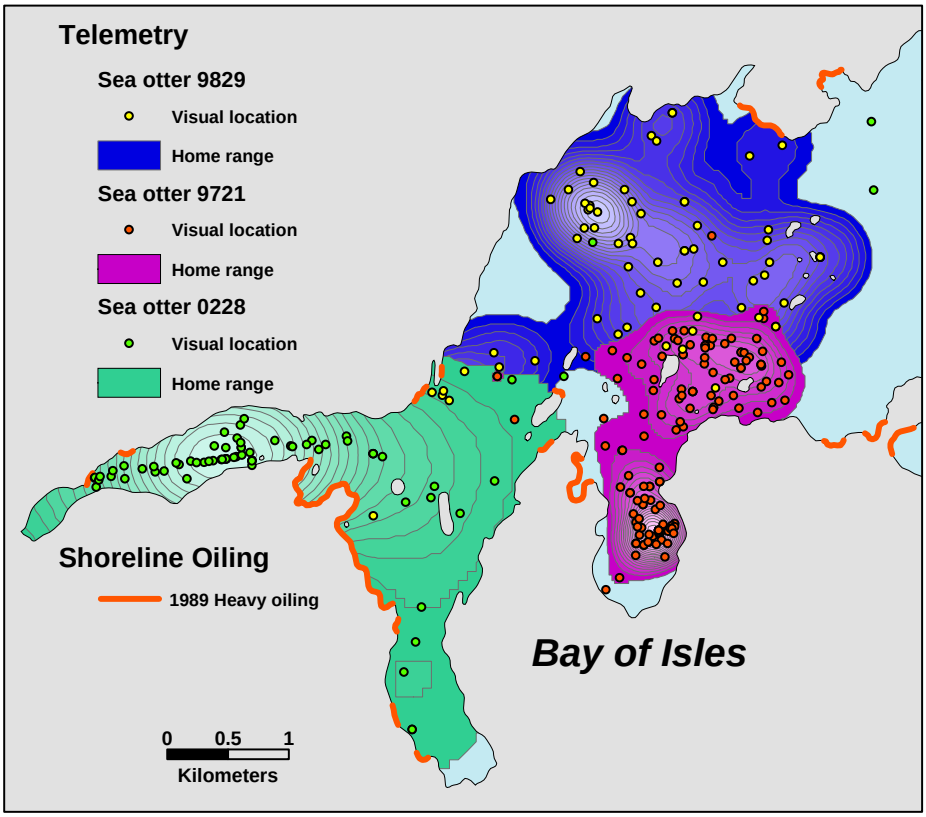

Figure 2. Kernal home ranges of three individual male sea otters in Bay of Isles and the proximity of home ranges and activity centers to known heavily oiled shorelines in 1989. Completion of the mapping of oiled shoreline habitats in 2003 will allow similar analyses with contemporary oiled habitats. Preliminary analyses indicate not all individuals are equally exposed to lingering oil.

II. PROJECT DESIGN

A. Objectives

Objective 1. Conduct an aerial survey of sea otters in western Prince William Sound, including the heavily oiled areas of the northern Knight Island Archipelago.

H_o: Sea otter population size in western Prince William Sound, or the northern Knight Island Archipelago, does not differ in 2005 from prior years.

Estimates of sea otter population size provide perhaps our best measure of the current status of sea otter populations affected by the *Exxon Valdez* oil spill. Standardized surveys have demonstrated an increase in western Prince William Sound (Figure 2), yet fail to demonstrate any increase in population size in the heavily oiled area of northern Knight Island since 1993

(Figure 3). Continued surveys likely will provide our most direct measure of population recovery.

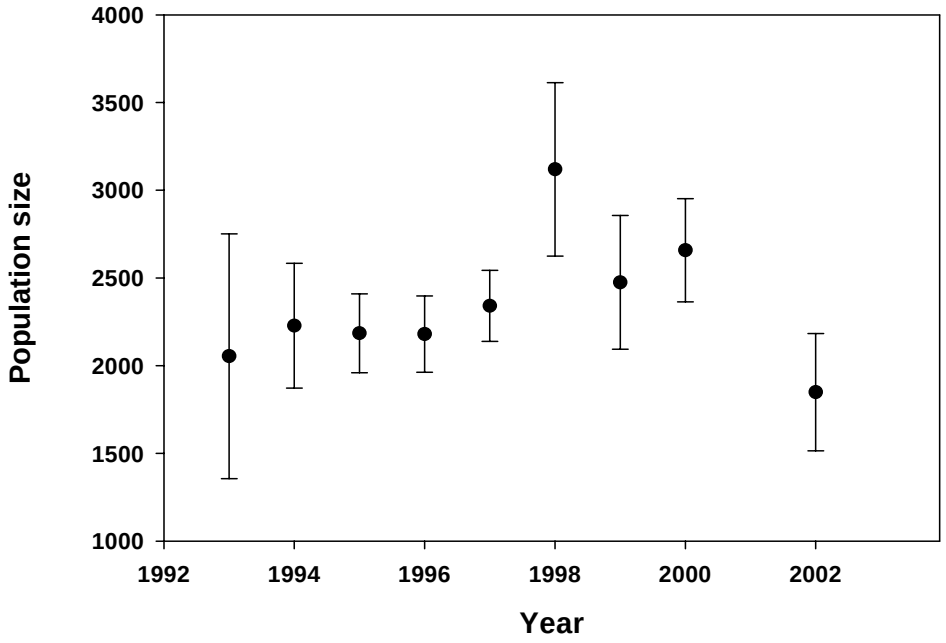

Figure 2. Western Prince William Sound sea otter population size estimates (± se), 1993-2002 (except 2001).

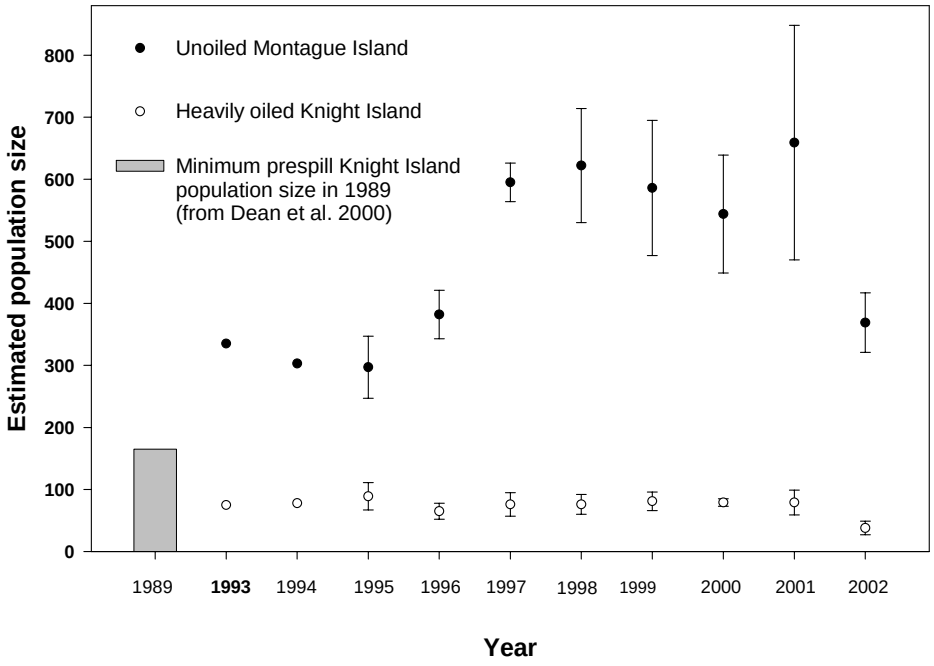

Figure 3. Sea otter population size estimates from unoiled Montague and heavily oiled Knight Island, Prince William Sound, AK, 1989-2002.

Objective 2. Measure Cytochrome P4501A values in a sample of sea otters from previously oiled Knight Island and unoiled Montague Island

H_o: Cytochrome P450 values do not differ among previously oiled and unoiled habitats,

H_o: Cytochrome P450 values do not vary over time.

Measurement of CYP1A in sea otters from heavily oiled Knight Island compared to unoiled Montague Island have demonstrated significant exposure to aromatic hydrocarbons at Knight Island; significant differences between the two areas have persisted through summer 2002 (Figure 4). However, over time the magnitude of the difference between areas has been diminishing, suggesting gradual recovery (Ballachey et al. 2001b, Bodkin et al. 2002, USGS unpub. Data, Bodkin et al 2003). If differences between Knight Island and baseline extend through 2005, we will use these data to project a predicted point in time where biomarker values at Knight may attain the background levels measured at Montague Island.

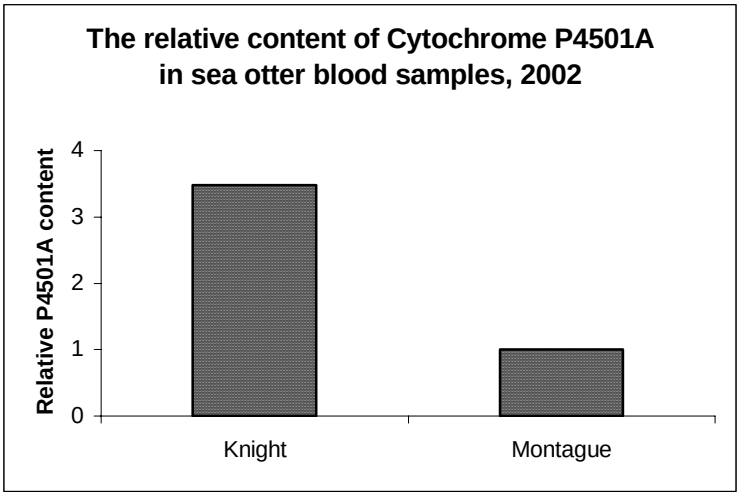

Figure 4. Relative cytochrome P4501A (CYP1A) content of blood lymphocytes from sea otters at oiled northern Knight Island and unoiled Montague Island, July 2002. (Note: mRNA for CYP1A quantified using real time PCR, and expressed in graph as CYP1A mRNA relative to mRNA for the housekeeping gene 18SrRNA).

Objective 3. Estimate habitat use and annual survival rates in a sample of sea otters from previously oiled Knight Island.

H_o: Habitat use relative to oiled habitats does not vary among individual sea otters

H_o: Annual survival rates of adult sea otters from previously oiled habitats do not differ from expected adult survival rates

Sea otters were instrumented with radio transmitters (2002-03) and TDRs (2003) allowing us to monitor their patterns of habitat use and to estimate annual survival rates. CYP1A was also measured in these individuals (some otters have multiple CYP1A

measurements over several years). A continued year of monitoring these sea otters will improve our estimate of survival rates in the oiled area and our understanding of variation among individuals in habitat use and hoe that relates to CYP1A levels.

B. Procedural and Scientific Methods

Objective 1. Aerial Surveys

We will continue to use previously developed aerial survey techniques which employ standardized strip transect counts along survey lines, and intensive search units (ISU's) to estimate a correction factor for each survey (Bodkin and Udevitz 1999). We will conduct a single survey of the entire western Sound in 2005. We will also conduct replicate surveys (3-5 replications per survey) of the heavily oiled northern Knight Island study site (previously sampled in the Nearshore Vertebrate Predators project and projects 02423 and 030620). Results of proposed surveys provide unbiased estimates of population size and density. Proportional standard errors of past surveys in Prince William Sound range from 0.09-0.18

Objective 2. Monitor Exposure to Lingering Oil

Elevations in CYP1A in sea otters captured at northern Knight Island do not appear to be due to background or natural hydrocarbon sources, as these were found to be negligible in intertidal areas of Prince William Sound (Short and Babcock 1996), nor to differential contamination of areas by PCBs (Trust et al. 2000; USGS unpub. data). Continued exposure to residual *Exxon Valdez* oil is the most plausible explanation for CYP1A elevations. Residual oil is still stranded in intertidal areas of Prince William Sound (Short et al 2003, Babcock et al. 1996, Brodersen et al. 1999, Carls et al. 2001, Hayes and Michel 1999), providing a continuing potential source of contamination. However, the locations where sea otters may be acquiring continuing exposure to residual oil remained largely unknown until 2001/2002. With the data now available on distribution and abundance of lingering oil, we can identify those locations where sea otters and sea ducks are most likely acquiring their continued exposure, and prioritize areas for restoration. Further, we can evaluate relations between exposure of those individuals, based on their foraging locations and depths, their health and their subsequent survival.

As in past years, the CYP1A biomarker will be measured using peripheral mononuclear blood cells collected by jugular venipuncture (Ballachey et al. 2001a). The cells are isolated from the blood in the field, cryopreserved in liquid nitrogen, and subsequently shipped to Purdue University for analyses in the laboratory of Dr. Paul Snyder. Previous assays of CYP1A on the blood cells have been done with a reverse transcriptase PCR assay (Snyder et al 2001). However, with the 2002 and 2003 samples, we are examining the utility of an improved (and potentially more sensitive) molecular assay, using real-time PCR. If we demonstrate a high correlation between CYP1A induction measured by the two assays, subsequent analyses on the 2004 samples will utilize only the real-time PCR method. However, if the correlation is not high, all samples will be assayed by the reverse transcriptase methods to assure comparability with data collected in previous years.

In addition to sampling blood for the CYP1A biomarker, we routinely collect blood and ship it to Quest Laboratories (Portland, OR) for hematology and clinical chemistry panels, which provide a general picture of animal health as well as supplementary data on liver and kidney function. We will also collect a small (approximately 2 mm) liver biopsy that will be fixed in formalin and examined histologically for abnormalities in the liver cells.

The proposed research will provide a means to relate observed levels of CYP1A induction and liver histopathology in sea otters from heavily oiled areas of northern Knight Island to locations and depths where those individuals forage. Although essentially all sea otters sampled at Knight show at least a low level of induction, only a small proportion exhibit relatively high CYP1A levels. Thus, it appears likely that exposure may vary across individuals, with only a small proportion of the animals using areas where oil is persistent, as opposed to all animals using all habitats equitably. This research also provides the opportunity to relate the abundance and behavior of sea otters to the proximity of lingering oil. Once sea otter density, foraging depths, and oil exposure history can be tied to known patches of lingering oil, direct restoration measures and locations can be identified and prioritized.

Objective 3. Estimate oiled habitat use and annual survival rates from sea otters at previously oiled Knight Island

In 2002 and 2003 we instrumented a sample of sea otters at Knight Island to determine the use of habitats known to contain lingering oil and to estimate annual survival rates. The radio transmitters deployed in 2003 will continue to function through July 2005. Continued monitoring of these individuals will provide additional information on the degree to which oiled intertidal areas are utilized and provide an additional estimate of annual survival.

Individuals will be relocated at approximately 10 day intervals from July 2004-July 2005. Relocations will be obtained from single engine aircraft flying at 500' altitude and 70 mph. Each relocation will include the date, time and a location with not less than 400 meters accuracy. Each relocation will be plotted on a map in the field and later digitized into a GIS coverage (ARC View). Each radio transmitter incorporates a thermal sensor that reduces the transmission pulse rate by 50% upon reaching a temperature of approximately 85 degrees Fahrenheit. This sensor allows for rapid detection of mortality and facilitates recovery of fresh carcasses suitable for necropsy.

C. Data Analysis and Statistical Methods

Aerial survey data will be collected and analyzed following procedures described in detail in Bodkin and Udevitz (1999). The observer, pilot, and plane will be the same as in prior years (1994-2002).

Blood and Liver Cytochrome P4501A

CYP1A data on a subset of sea otters will be obtained by both the reverse transcriptase and the real-time PCR assays. If there is a high correlation between the two methods, further analyses will be by the real-time PCR technique, and data from previous years will be transformed so that

all years are comparable. An ANOVA will be conducted on the full data set (2 areas: northern Knight and Montague; 7 years: 1996-98, 2001-2004). Additionally, based on a regression analysis (CYP1A values by year), we will predict the point in time when CYP1A values, and exposure to aromatic hydrocarbons, will return to background levels at northern Knight Island.

Habitat use and survival

Relocation data will be analyzed with the animal movement extension to ARC-View GIS using kernel home range estimation. Minimum, maximum, and mean distances to known oiled shorelines for each individual will be calculated and related to CYP1A measures using regression analysis.

Survival estimates will be based on a Kaplan-Meier analysis (Kaplan and Meier 1958). The analysis estimates survival throughout the study based on the number of otters at risk and the number of otters that died during each time period. The time origin for the survival analysis will be the date of capture with time intervals approximately equal to the length of time between otter relocations. Survival estimates will be compared to estimates from other locations using similar methods.

D. Description of Study Area

The aerial surveys will be conducted in western Prince William Sound, with intensive replicate surveys at northern Knight Island. Sampling of oiled and unoiled shoreline segments for the abundance and behaviors of sea otters will be conducted at northern Knight Island. Oiled and unoiled shoreline segments identified from project 02585 and 030620 (NOAA and USGS) will serve as the foundation for our study design relating sea otter home ranges and foraging depths to oil exposure histories and potential use of oiled shorelines. Capture and relocations have been centered in Lower Passage (60.501, -148.667) and Bay of Isles (60.400, -148.667) at northern Knight Island, although relocations of some individuals have been recorded up to 24 km away from their capture location. Locations of observations will depend on animal movements and to date, all but a very few observations have been at Knight Island.

E. Coordination and Collaboration with Other Efforts

The proposed work builds on the long history of EVOS and Department of Interior study of sea otters in Prince William Sound (Nearshore Vertebrate Predator project, Doroff et al. 1994, Ballachey et al. 1994, Bodkin et al 1999, Bodkin et al 2002, Ballachey et al 2003, Monson et al 2000). Prior project numbers include 99025, 02423, 02585, 03620 and 04620. The scope of prior work includes annual sea otter population size estimates since 1993, estimates of reproduction, survival and mortality, diet, size and condition, and movements and home ranges. Assays of the CYP1A biomarker have been conducted since 1996 (no samples were collected in 1999 or 2000). The proposed work will utilize the results of NOAA (Auke Bay Laboratory) studies on the presence, distribution and abundance of oiled habitats at Northern Knight Island in 2001-2003, in terms of identifying proximity and foraging depths in relation to lingering oil. Surveys of sea otter abundance will be plotted with historic data to evaluate progress toward a recovery endpoint defined by estimated pre-spill abundance. Biomarker data will be contrasted

to data collected in the same locations, and from some of the same individuals, during the period 1996-2004. Such contrasts will allow evaluation of trends observed from 1996-2004, suggesting a decline in the magnitude of the difference between oiled and unoiled habitats. Approximately 22% of the total cost of the work proposed for FY05 will be funded by the Alaska Science Center, USGS, in the form of vessel support ($4,000) salary costs ($26,400), and facilities and equipment ($12,000).

III. SCHEDULE

A. Project Milestones

Objective 1. Aerial Surveys
Data acquisition to be completed by August 2005
Data analysis to be completed by December 2006

Objective 2. Monitor Exposure to Lingering Oil
Sample acquisition to be completed by August 2005
Laboratory and data analysis to be completed by April 2006

Objective 3. Habitat Use and Survival
Data acquisition to be completed by August 2005
Data analysis to be completed by April 2006

B. Measurable Project Tasks

FY 04, last quarter (August 1, 2004-October 1, 2004)
Initiate monitoring of instrumented individual locations

FY 05, 1st quarter (October1, 2004-January 1, 2005)
Continue monitoring of instrumented individual locations

FY 05, 2nd quarter (January 1, 2005-April 1, 2005)
Continue monitoring of instrumented individual locations

FY 05, 3rd quarter (April 1 - July 1, 2005)
Continue monitoring of instrumented individual locations

FY05, 4th quarter (July 1, 2005 – October 1, 2005)
Initiate capture of sea otters
Obtain biomarker samples

Aug-Sept. 2005 Initiate data recovery and analysis (surveys, biomarker and habitat use and survival)
Submit annual report

Oct-Dec 2005	Continue sample and data analyses
2006	Prepare and submit final report

IV. RESPONSIVENESS TO KEY TRUSTEE COUNCIL STRATEGIES

A. Community Involvement and Traditional Ecological Knowledge (TEK)

We will be available to interact with local communities in meetings to explain and discuss ongoing restoration projects (this effort coordinated with similar activities for project 030423 and 040620, and proposed new project by Ballachey, Bodkin, and Irons). Contractual arrangements have been made with Cordova Air Service (907-424-3289) in Cordova to provide aerial support for survey and radio relocations. Contractual arrangements will be sought with other members of local communities for vessel charters to support recapture and other project needs.

B. Resource Management Applications

Results of the proposed work, in conjunction with the results of work completed under projects 99025, 02423 and 03620, should provide managers with adequate information to make decisions regarding locations of specific shoreline habitats where sea otter populations are incurring exposure to lingering oil and which may be suitable for direct restoration actions. In addition, anticipated results of this work will allow managers to identify progress toward reclassification of sea otters and other nearshore resources as "recovered" from the 1989 *Exxon Valdez* oil spill.

Sea otter populations throughout the Aleutian Archipelago, the Alaska Peninsula, and as far east as Kodiak Island, have experienced declines in abundance ranging from about 50-90% since about 1985 (Estes et al. 1998). Although cause of the decline is unclear, predation is thought to be a contributing factor, at least in the Aleutians. The proposed survey effort in Western Prince William Sound will continue the longest annual sea otter population data set in Alaska and will be of benefit to the Fish and Wildlife Service, Marine Mammals Management (Rosa Meehan, 907-786-3349) who is responsible for sea otter management in Alaska.

V. PUBLICATIONS AND REPORTS

An annual progress report will be submitted to the Trustee Council on 1 September, 2005 and a final report will be submitted by 15 April, 2006. The results of the TDR work will provide new information on sea otter diving and foraging behavior that has not previously been published and will make a new contribution to the primary scientific literature. The results of the biomarker studies will provide an unprecedented view of the duration and relative magnitude of exposure to a top-level nearshore predator following a large-scale oil spill. Because the persistence of *Exxon Valdez* lingering oil was unanticipated and unprecedented, the linkage between lingering oil and pathways of exposure to higher trophic levels will also provide an original contribution to the primary literature on oil spill effects.

VI. PROFESSIONAL CONFERENCES

We anticipate the results of the proposed work will be suitable for presentation at the 2006 International Biennial meeting of the Society for Marine Mammalogy to be held in South Africa during the winter of 2005/2006. Because of the global nature of oil spills, the unanticipated magnitude and duration of EVOS effects, and the apparent susceptibility of marine mammals to such events, this will be a particularly valuable opportunity to present the results of this work. We anticipate presenting two papers at the conference, one pertaining to pathways of exposure and another on the use and interpretation of biomarkers as a tool for defining exposure to and recovery from spilled oil. Note: travel for attending conference was already approved as part of closeout for Project 040620.

References

Babcock, M. M., G. V. Irvine, P. M. Harris, J. A. Cusick, and S. D. Rice. 1996. Persistence of oiling in mussel beds three and four years after the *Exxon Valdez* oil spill. Am. Fish. Soc. Symp. 18:286-297.

Ballachey, B.E., J.L. Bodkin and A.R. DeGange. 1994. An overview of sea otter studies. *in* T. Loughlin editor. Marine mammals and the Exxon Valdez. Academic Press. San Diego, CA pages 47-59.

Ballachey, B.E., J.L. Bodkin, S. Howlin, K.A. Kloecker, D.H. Monson, A.H. Rebar and P.W. Snyder. 2001a. Hematology and serum chemistry of sea otters in oiled and unoiled areas of Prince William Sound, Alaska, from 1996-98. Appendix BIO-01 in NVP Draft Final Report (Project 95025-99025).

Ballachey, B.E., J.J. Stegeman, P.W. Snyder, G.M. Blundell, J.L. Bodkin, T.A. Dean, L. Duffy, D. Esler, G. Golet, S. Jewett, L. Holland-Bartels, A.H. Rebar, P.A. Seiser, and K.A. Trust. 2001b. Oil exposure and health of nearshore vertebrate predators in Prince William Sound following the *Exxon Valdez* oil spill. Chapter 2 *in* NVP Draft Final Report (Project 95025-99025).

Ballachey, B.E., J.L. Bodkin, S. Howlin, A.M. Doroff and A.H. Rebar. 2003. Survival of juvenile sea otters in Prince William Sound, Alaska, 1992-93. Cdn. Jnl. Zoology

Brodersen, C.C., J.W. Short, L. Holland, M.G. Carls, J. Pella, M. Larsen, and S.D.Rice. 1999. Evaluation of oil removal from beaches 8 years after the *Exxon Valdez* oil spill. Proc. 22nd Arctic and Marine Oil Spill Program, Environment Canada, Calgary, June 1999, pp. 325-336.

Bodkin, J. L. and M.S. Udevitz. 1999. An aerial survey method to estimate sea otter abundance. in: Garner, G.W., S.C. Amstrup, J.L. Laake, B.F.J. Manly, L.L. McDonald, and D.G. Robertson, (eds.) Marine mammal survey and assessment methods. Balkema Press, Netherlands pg. 13-26.

Bodkin, J.L., B.E. Ballachey, T.A. Dean, S. Jewett, L. McDonald, D. Monson, C. O'Clair, and G. VanBlaricom. 2002. Sea otter population status and the process of recovery from the *Exxon Valdez* oil spill. Marine Ecology Progress Series. 241:237-253.

Bodkin, J.L., G.E. Esslinger, and D.H. Monson. In press. Foraging depths of sea otters and implications to coastal marine communities. Marine Mammal Science.

Bodkin, J.L., B.E. Ballachey, D. Esler, and T. Dean. 2003. Patterns and Processes of Population Change in Selected Nearshore Vertebrate Predators (Restoration Project 99423-03423), US Geological Survey, Alaska Science Center, Anchorage, Alaska.

Carls, M.G., M.M. Babcock, P.M. Harris, G.V. Irvine, J.A. Cusick, and S.D. Rice. 2001. Persistence of Oiling in Mussel Beds after the *Exxon Valdez* Oil Spill, Marine Environmental Research, 51 pp. 167-190,.

Dean, T.A., J.L. Bodkin, S.C. Jewett, D.H. Monson and D. Jung. 2000. Changes in sea urchins and kelp following a reduction in sea otter density as a result of the *Exxon Valdez* oil spill. Marine Ecology Progress Series 199:281-291.

Doroff, A.M. and J.L. Bodkin. 1994. Sea otter foraging behavior and hydrocarbon levels in prey. *in* T. Loughlin, editor. Marine mammals and the Exxon Valdez. Academic Press. San Diego, CA pages 193-208.

Esler, D., T.D. Bowman, K.A. Trust, B.E. Ballachey, T.A. Dean, S. Jewett, and C. O'Clair. 2002. Harlequin duck population recovery following the *Exxon Valdez* oil spill: progress, process and constraints. Mar. Ecol. Prog. Ser. 241-271-286.

Esler, D., J. A. Schmutz, R. L. Jarvis, and D. M. Mulcahy. 2000. Winter survival of adult female harlequin ducks in relation to history of contamination by the *Exxon Valdez* oil spill. J. Wildl. Manage. 64:839-847.

Estes, J.A., M.L. Riedman, M.M. Staedler, M.T. Tinker and B.E. Lyon. 2003. Individual variation in prey selection by sea otters: patterns, causes and implications. J. Animal Ecology 72:144-155.

Fukuyama, A.K., G. Shigenaka, and R. Z. Hoff. 2001. Effects of residual *Exxon Valdez* oil on intertidal Prototheca staminea: Mortality, growth, and bioaccumulation of hydrocarbons in transplanted clams. Marine Pollution Bulletin 40: 1042-1050.

Hayes, M. O., and J. Michel. 1999. Factors determining the long-term persistence of *Exxon Valdez* oil in gravel beaches. Mar. Pollut. Bull. 38:92-101.

Irons, D. B., S. J. Kendall, W. P. Erickson, L. L. McDonald, B. K. Lance, "Nine Years After the *Exxon Valdez* Oil Spill: Effects on Marine Bird Populations in Prince William Sound, Alaska", Condor Vol. 02, pp. 723-737, 2000.

Kaplan, E. L., and Meier, P. 1958. Nonparametric estimation from incomplete observations. J. Am. Stat. Assoc. 53:457-481.

Monson, D.H., D.F. Doak, B.E. Ballachey, A. Johnson, and J.L. Bodkin. 2000. Long-term impacts of the *Exxon Valdez* oil spill on sea otters, assessed through age-dependent mortality patterns. Proc. Nat'l. Acad. Sciences, USA 97(12):6562-6567.

O'Clair, C. E., J. W. Short, and S. D. Rice. 1996. Contamination of intertidal and subtidal sediments by oil from the *Exxon Valdez* in Prince William Sound. Am. Fish. Soc. Symp. 18:61-93.

Peterson, C.H. 2001. *Exxon Valdez* oil spill in Alaska: Acute, indirect, and chronic effects on the ecosystem. Advances in Marine Biology 39: 1-103.

Short, J.W. and M.M. Babcock. 1996. Prespill and postspill concentrations of hydrocarbons in mussels and sediments in Prince William Sound. Pages 149-166 in S.D. Rice, R.B. Spies, D.A. Wolfe, and B.A. Wright, editors. Proceedings of the *Exxon Valdez* Oil Spill Symposium, American Fisheries Society Symposium 18, Bethesda, Maryland.

Short, J.W., M. R. Lindeberg, P. M. Harris, J. M. Maselko, J. J. Pela, and S. D. Rice. 2003. Estimate of oil persisting on the beaches of Prince William Sound 12 years after the *Exxon Valdez* oil spill. Environmental Science and Technology.

Snyder, P. W., T. Kondratyuk, B. E. Ballachey, and J. Vanden Heuvael. 2002. CYP1A gene expression in sea otters (Enhydra lutris): a quantitative reverse transcriptase-polymerase chain reaction to measure CYP1A mRNA in peripheral blood mononuclear cells. Appendix BIO-02.1 *in* Holland-Bartels, L.E., editor. 2002. Mechanisms of impact and potential recovery of nearshore vertebrate predators following the 1989 Exxon Valdez oil spill, volume 2. Exxon Valdez Oil Spill Restoration Project Final Report (Restoration Project 99025), U.S. Geological Survey, Alaska Biological Science Center, Anchorage, Alaska.

Trust, K. A., D. Esler, B. R. Woodin, and J. J. Stegeman. 2000. Cytochrome P450 1A induction in sea ducks inhabiting nearshore areas of Prince William Sound, Alaska. Marine Pollution Bulletin 40:397-403.

RESUME

BRENDA E. BALLACHEY
Research Physiologist
U.S. Geological Survey, Alaska Science Center
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Phone: 907/786-3480, Fax: 907/786-3636
E-mail: brenda_ballachey@usgs.gov

AREAS OF EXPERTISE

Sea otters: biochemical, physiological, population and ecological effects of oil exposure
Marine mammals: population status and indices of condition
Environmental toxicology; Biomarkers of contaminant exposure
Mammalian genetics and physiology; Quantitative genetics
Male reproduction: semen quality and relationship to fertility

EDUCATION

Oregon State University, Corvallis, Oregon - Ph.D., 1985
Major: Animal Breeding and Genetics; Minors: Genetics, Statistics
Thesis: Flow cytometric evaluation of spermatozoan viability and nuclear chromatin structure
(January 1984 to March 1985 - Relocated to South Dakota State University to conduct doctoral research)

Colorado State University, Fort Collins, Colorado - M.S., 1980
Major: Animal Sciences/Animal Breeding and Genetics
Thesis: Effect of diet and age on body composition of obese and lean mice

Colorado State University, Fort Collins, Colorado - B.S. with distinction, 1974
Major: Animal Sciences

PROFESSIONAL EXPERIENCE ***(1987 to present)***

Research Physiologist
Alaska Biological Science Center, U.S. Geological Survey, Anchorage, AK
(Formerly National Biological Service; Fish & Wildlife Service)

July 1990 to September 1996: Project leader for population status (sea otters, walrus) and sea otter oil spill studies.

October 1996 to present: Principal investigator (half-time appointment) on Exxon Valdez oil spill studies of sea otters and other vertebrate predators in coastal marine areas of Prince William Sound, Alaska.

General Biologist
Alaska Fish and Wildlife Research Center, U.S. Fish and Wildlife Service, Anchorage, AK

November 1989 to July 1990

Research on sea otters, with emphasis on studies of acute and chronic effects of the *Exxon Valdez* oil spill.

Staff Officer
Board on Agriculture, National Research Council (NRC), Washington, DC, USA

March 1987 to November 1989

Worked with Committee on Managing Global Genetic Resources to assess genetic diversity in agricultural species, including crops, livestock, forests and fisheries.

COLLABORATIONS

Purdue University, South Dakota State University, NOAA/ABL, USFWS**,** Woods Hole Oceanographic Institute, University of Alaska Fairbanks, Monterey Bay Aquarium.

AFFILIATIONS

American Association for the Advancement of Science
Society for Marine Mammalogy
Society for Environmental Toxicology and Chemistry

SELECTED PUBLICATIONS

Ballachey, B.E., J. L. Bodkin, and A. R. DeGange. 1994. An Overview of Sea Otter Studies. Chapter 3 in Marine Mammals and the *Exxon Valdez*. T.R. Loughlin, Ed. Academic Press.

Ballachey, B.E., J.L. Bodkin, S. Howlin, A.M. Doroff and A.H. Rebar. 2003. Survival of juveniles sea otters in Prince William Sound, Alaska, 1992-93. Cdn. Jnl. Zoology

Ballachey, B.E., W.D. Hohenboken, and D.P. Evenson. 1987. Heterogeneity of sperm nuclear chromatin structure and its relationship to bull fertility. Biol. Reprod. 36:915-925.

Bickham, J.W., J.A. Mazet, J. Blake, M.J. Smolen, Y. Lou, and B.E. Ballachey. 1998. Flow-cytometric determination of genotoxic effects of exposure to petroleum in mink and sea otters. Ecotoxicology 7:191-199.

Bodkin, J.L. and B.E. Ballachey. 1996. Monitoring the status of the wild sea otter population: field studies and techniques. Endangered Species Update 13(12):14-19.

Bodkin, J.L., B.E. Ballachey, T.A. Dean, S. Jewett, L. McDonald, D. Monson, C. O'Clair, and G. VanBlaricom. 2002. Recovery of sea otters in Prince William Sound following the *Exxon Valdez* oil spill. Mar. Ecol. Prog. Ser. 241:237-253.

Bodkin, J.L., B.E. Ballachey, K. Scribner and M.A. Cronin. 1999. Population demographics and genetic diversity in remnant and re-established populations of sea otters. Cons. Biol. 13:1378-1385.

Cronin, M.A., J.L. Bodkin, B.E. Ballachey, J.A. Estes and J.C. Patton. 1996. Mitochondrial DNA variation among subspecies and populations of sea otters (*Enhydra lutris*). J. Mammal. 77(2):546-557.

Esler, D., T.D. Bowman, K.A. Trust, B.E.Ballachey, T.A. Dean, S.C. Jewett and C.E. O□Clair. 2002. Harlequin duck population recovery following the *Exxon Valdez* oil spill: progress, process and constraints. Mar. Ecol. Prog. Ser. 241:271-286.

Lipscomb, T.P., R.K. Harris, A.H. Rebar, B.E. Ballachey and R.J. Haebler. 1994. Pathology of Sea Otters. Chapter16 in Marine Mammals and the *Exxon Valdez*. T.R. Loughlin, Ed. Academic Press.

Loughlin, T.R., B.E. Ballachey and B. Wright. 1996. Overview of studies to determine injury caused by the *Exxon Valdez* oil spill to marine mammals. *In* Rice, S.D., R.B. Spies, D.A. Wolfe and B.A. Wright, Eds. Proceedings of the *Exxon Valdez* Oil Spill Symposium. American Fisheries Society Symposium Number 18:798-808.

Monson, D.H., D.F. Doak, B.E. Ballachey, A. Johnson and J.L. Bodkin. 2000. Long-term impacts of the *Exxon Valdez* oil spill on sea otters assessed through age-dependent mortality patterns. Proc. Natl. Acad. Sci., USA 97:6562-6567.

Mulcahy, D.M and B.E. Ballachey. 1994. Hydrocarbon residues in sea otters. Chapter 18 in Marine mammals and the *Exxon Valdez*. T.R. Loughlin, Ed. Academic Press.

Rebar, A.H., T.P. Lipscomb, R.K. Harris and B.E. Ballachey. 1995. Clinical and clinical laboratory correlates in sea otters dying acutely in rehabilitation centers. Vet. Clin. Path. 32:346-350.

Stegeman, J.J., B. Ballachey, J. Bickham, B. Hocker, S. Kennedy, H. Thompson and D. Vethaak. 1993. Implementation of biomarker-based studies. Chapter 3 in Strategy for Biomarker Research and Application in the Assessment of Environmental Health. D.B. Peakall and L.R. Shugart, Eds. Springer-Verlag, Belgium.

Udevitz, M.S. and B.E. Ballachey. 1998. Estimating survival rates with age structure data. Jnl. Wildl. Mgmt. 62(2):779-792.

Resume: James L. Bodkin March 2004

Research Wildlife Biologist, Alaska Science Center, USGS, 1011 E. Tudor Road, Anchorage, Alaska, 99503. phone 907-786-3550, fax 907-786-3636 email, james_bodkin@usgs.gov.

Education:	1985 -MS, California Polytechnic State University, San Luis Obispo, CA. (Wildlife Biology) 1976- BS, Long Beach State University (Biology), Long Beach, CA 1972 - AS, Cypress College (Biology), Cypress, CA
Memberships:	Society for Marine Mammalogy American Society of Mammalogists Society for Conservation Biology Wildlife Society Western Society of Naturalists National Geographic Society

Responsibilities: I lead Alaska sea otter research and the marine science program for the Alaska Science Center. The mission of the Center is to provide biological information and research findings to resource managers, policymakers, and the public to support sound management of biological resources and ecosystems in Alaska and throughout the North Pacific Ocean. The Alaska sea otter project is one of two USGS sea otter research programs, the other led by James Estes, located in Santa Cruz, CA.

Responsible for designing, developing and directing multi-disciplinary research programs for studying North Pacific coastal marine ecosystems, focusing on sea otter populations and their role in structuring coastal marine communities in Alaska. Current research programs encompass three broad objectives, including, 1) designing, developing and testing methods to assess the status of sea otter populations, 2) describing processes responsible for structuring coastal marine communities, and 3) determining the status of recovery of sea otter populations affected by the 1989 Exxon Valdez oil spill in Prince William Sound, Alaska.

Scope of each of the three research programs:

Designing, developing and testing methods to assess the status of sea otter populations. Appropriate conservation and management of sea otter populations requires accurate knowledge on the status of populations relative to available resources, primarily food and space. Current projects to evaluate population status include measures of abundance (density), age and sex specific fecundity and survival, individual condition and bio-markers, and activity-time budgets. Remote sensing devices (time-depth recorders) are currently being tested as a new method to estimate time budgets.

Describing processes responsible for structuring coastal marine communities. Processes responsible for driving the structure and function of north Pacific coastal communities are complex and not well understood, yet managers of coastal resources need to understand causes of variation and change in coastal communities. Current projects include a) defining coastal marine community structure in terms of physical character, biological productivity, and species composition and abundance of algae,

macro-invertebrates, fishes, birds and mammals, and b) employing comparative and experimental methods to allow inference regarding cause of change in the coastal system.

Determine the status of recovery of sea otter populations affected by the 1989 Exxon Valdez oil spill in Prince William Sound, Alaska. Natural resources are subjected to increasing levels of anthropogenic disturbance, as exemplified by this nation's largest oil spill, the Exxon Valdez spill of 1989. Previous methods to understand the acute and chronic effects of disturbances at both species and ecosystem levels are poorly developed, often leading to uncertainty. Project objectives include developing new tools and approaches to improve our understanding of catastrophic perturbations and methods to describe the processes of how systems recover and to identify factors that can constrain system recovery.

Selected Publications:

Bodkin, J.L. 1988. Effects of kelp forest removal on associated fish assemblages in central California. Journal of Experimental Marine Biology and Ecology. 117:227-238.

Bodkin, J.L. and R. Jameson. 1991. Patterns of seabird and marine mammal carcass deposition along the central California coast, 1980-1986. Can J. Zool. 69:1149-1155.

Bodkin, J.L. and L. Browne. 1992. Molt frequency and size-class distribution in the spiny lobster (Panulirus interruptus), at San Nicolas Island, California. California Fish and Game. 78(4):136-144.

Bodkin, J.L., B.E. Ballachey, M.A. Cronin and K.T. Scribner. 1999. Population demographics and genetic diversity in remnant and re-established populations of sea otters. Conservation Biology 13(6):1278-1385.

Bodkin, J. L. and M.S. Udevitz. 1999. An aerial survey method to estimate sea otter abundance. in: Garner, G.W., S.C. Amstrup, J.L. Laake, B.F.J. Manly, L.L. McDonald, and D.G. Robertson, (eds.) Marine mammal survey and assessment methods. Balkema Press, Netherlands pg. 13-26

Bodkin, J.L., A.M. Burdin and D.A. Ryzanov. 2000. Age and sex specific mortality and population structure in sea otters. Marine Mammal Science 16(1):201-219.

Bodkin, J.L. 2001. Marine Mammals: Sea otters. Pages 2614-2621. in Steele, J. S.Thorpe and K. Turekian (eds.) Encyclopedia of Ocean Sciences. Academic Press, London UK. (invited ms)

Bodkin, J.L., B.E. Ballachey, T.A. Dean, A.K. Fukuyama, S.C. Jewett, L.M. McDonald, D.H.Monson, C.E. O'Clair and G.R. VanBlaricom. 2002. Sea otter population status and the process of recovery from the Exxon Valdez oil spill. Marine Ecology Progress Series. 241:237-253.

Peterson, C.H., S.D. Rice, J.W. Short, D. Esler, J.L. Bodkin, B.E. Ballachey, D.B. Irons. 2003. Long-term ecosystem response to the Exxon Valdez oil spill. Science 302:2082-2086.

Collaborators:
Dr B.E. Ballachey, USGS, Dr. T.A. Dean, Coastal Resource Associates, Ms A.M. Doroff, USFWS, Dr. D. Esler, Simon Fraser Univ., Dr. J.A. Estes, USGS, Dr. D.B. Irons USFWS, Dr. C.H. Peterson, Univ. North Carolina, Dr. John Piatt, Alaska Science Center, Dr S.D. Rice NOAA, Mr J.W. Short, NOAA, Dr P. Snyder, Purdue University, Ms. M. Staedler, Monterey Bay Aquarium

BUDGET JUSTIFICATION

Bodkin and Ballachey
Lingering oil and sea otters: Pathways of exposure and recovery status

Total project cost 189.9 K, for FY04 & FY05. 42.4 K provided by USGS/ASC (4.4K in FY04 and 38K in FY05). 147.4K requested from EVOSTC; 20.5K in FY04 and 126.9K in FY05. The costs not covered by the EVOS funds include salary for J. Bodkin and additional USGS staff involved in planning, logistics and capture operations. The project is not legislatively mandated, but will provide information valuable to both sea otter management (USFWS and the Alaska Sea Otter Commission) and the EVOS Trustee Council in terms of understanding sea otter population dynamics, behavioral ecology and recovery from the *Exxon Valdez* oil spill. Indirect costs have been previously arranged between the EVOS office and Trustee Agencies.

FY 2004: Amount requested 20.5K
Personnel: 6.0 K. Funds will provide the salary support necessary to monitoring objectives. USGS will be providing 4.4 K in additional salary support.
Travel: No funds requested from EVOS.
Contractual: 12.8 K total. 3.8 K is requested for aerial relocations of instrumented sea otters in August and September 2004. 9.0 K is requested for histopathology of sea duck liver samples that were collected in western PWS and at the Alaska SeaLife Center between 1996 and 2002.
Commodities: No funds requested in FY04.
Equipment: No funds requested in FY04. USGS will be providing needed equipment for monitoring (radio-tracking) purposes.

FY 2005: Amount requested $ 126.9 K.
Personnel: 30.0 K Funds will provide the additional salary support necessary to monitoring and biomarker objectives. USGS will be providing 22 K in additional salary support.
Travel: None requested from EVOS. USGS will provide field research travel costs in Alaska.
Contractual: 79.6 K total. 18.8 K is requested for aerial relocations of instrumented sea otters and 8.8K for population abundance surveys in western PWS. 27 K is requested for vessel support for capture and sampling of tissues for biomarker assays, liver endoscopies and blood chemistry, and 20 K for veterinarian and laboratory services, including analysis of biomarker samples. 5.0 K is allocated to blood analyses, including hematology and serum chemistries. 9.0 K is requested for histopathology of sea duck liver samples collected between 1996 and 2002.
Commodities: 1.5 K is requested for food and miscellaneous commodities such as tools, field notebooks, and paper. 2.7 K is requested for fuel (2 skiffs and 1 25' whaler). 1.6 K is requested to defray expenses of veterinary supplies (surgical materials, drugs, etc). USGS will provide commodities in the form of office supplies, survival gear, etc.
Equipment: 1.0 K is requested for miscellaneous radio tracking equipment such as antennas, switch boxes, and cables. USGS will be providing radio receivers for tracking purposes at a cost of 6.0 K and vessel costs of 4 K.

FY 2006 & FY 2007: no new funding is requested.
Note: 26.2 K and 6.5 K have already been approved for FY06 & 07 as part of Project 040620.

CURRENT AND PENDING SUPPORT FORM

The following information must be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: James Bodkin/Brenda	Other agencies to which this proposal has been/will be submitted: None; no other current or pending support for this research.

Support: X Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title:

Source of Support:
Total Award Amount: Total Award Period Covered:
Location of Project:
Months of Your Time Committed to the Project: FY 05 FY06 Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title:

Source of Support:
Total Award Amount: $ Total Award Period Covered:
Location of Project:
Months of Your Time Committed to the Project: FY FY 05 FY 06 Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title:

Source of Support:
Total Award Amount: $ Total Award Period Covered:
Location of Project:
Months of Your Time Committed to the Project: FY FY 06 Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title:

Source of Support:
Total Award Amount: $ Total Award Period Covered:
Location of Project:
Months of Your Time Committed to the Project: FY FY 05 FY 06 Sumr:

*If this project has previously been funded by another entity, please list and furnish information for immediately preceding funding period.

DATA MANAGEMENT

1. Study Design: See Research Plan for details.

Aerial Survey: We will continue to use previously developed aerial survey techniques which employ standardized strip transect counts along survey lines, and intensive search units (ISU's) to estimate a correction factor for each survey (Bodkin and Udevitz 1999).

CYP1A: As in past years, the CYP1A biomarker will be measured using peripheral mononuclear blood cells collected by jugular venipuncture (Ballachey et al. 2001a). Morphometric data will be collected during captures and blood samples will be analyzed for a suite of standard hematological and chemical variables.

Habitat Use: Individuals will be relocated at approximately 10 day intervals from July 2004-July 2005. In addition several intensive periods of resight data will be collected, attempting multiple resights per day and logging behaviors. TDRs will be retrieved in July 2004.

2. Criteria/Acceptable Data Quality

Aerial Survey, CYP1A, Habitat Use: The USGS Alaska Science Center's Sea Otter Project has in place a data management plan, developed from the EVOS NVP project. All data will be collected, proofed, and stored under guidelines delineated in the DM plan.

3. Metadata

a. Metalite Metadata information:
Aerial Survey, CYP1A, Habitat Use:
Identification_Information:
Citation:
Citation_Information:
Originator: USGS Alaska Science Center, James L Bodkin and Brenda E Ballachey
Publication_Date: 20060415
Title: Lingering oil and sea otters: pathways of exposure and recovery status
Geospatial_Data_Presentation_Form: map
Publication_Information:
Publication_Place: Anchorage, Alaska, United States
Publisher: USGS
Description:
Abstract: There are three main datasets that will be created by this project: aerial survey data consisting of sea otter sightings (number, group size, , activity, GIS locations); Cytochrome P4501A data consisting of sea otter capture information and results of P450 analysis of white blood cells; and habitat use data consisting locations of re-sighted VHF-implanted sea otters (VHF frequency, date, time, activity, GIS location).
Purpose: These data sets will be created to allow continued evaluation of the state of the sea otter populations affected by EVOS, through continued estimates of sea otter population size,

quantification of a biomarker of hydrocarbon exposure, and evaluation of habitat use relative to known areas of existing lingering oil.
  Time_Period_of_Content:
    Time_Period_Information:
      Range_of_Dates/Times:
        Beginning_Date: 20010401
        Ending_Date: 20050415
    Currentness_Reference: ground condition
  Status:
    Progress: Planned
    Maintenance_and_Update_Frequency: As needed
  Spatial_Domain:
    Bounding_Coordinates:
      West_Bounding_Coordinate: -147.2
      East_Bounding_Coordinate: -147.983
      North_Bounding_Coordinate: 60.75
      South_Bounding_Coordinate: 60.15
  Keywords:
    Theme:
      Theme_Keyword_Thesaurus:
      Theme_Keyword: sea otter
      Theme_Keyword: oil
      Theme_Keyword: recovery
    Place:
      Place_Keyword_Thesaurus:
      Place_Keyword: Prince William Sound
  Access_Constraints: None
  Use_Constraints: None
Spatial_Data_Organization_Information:
  Direct_Spatial_Reference_Method: Point
Distribution_Information:
  Distributor:
    Contact_Information:
      Contact_Person_Primary:
        Contact_Person: James L. Bodkin
        Contact_Organization: USGS Alaska Science Center
      Contact_Address:
        Address_Type: Mailing and Physical Address
        Address:
          Alaska Science Center
          1011 East Tudor Road
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        State_or_Province: Alaska
        Postal_Code: 99503
        Country: United States
      Contact_Voice_Telephone: 907.786.3550

Contact_Facsimile_Telephone: 907.786.3636
Contact_Electronic_Mail_Address: james_bodkin@usgs.gov
Distribution_Liability:
Metadata_Reference_Information:
Metadata_Date: 20040413
Metadata_Contact:
Contact_Information:
Contact_Person_Primary:
Contact_Person: James L. Bodkin
Contact_Organization: USGS Alaska Science Center
Contact_Address:
Address_Type: Mailing and Physical Address
Address:
Alaska Science Center
1011 East Tudor Road
City: Anchorage
State_or_Province: Alaska
Postal_Code: 99503
Country: United States
Contact_Voice_Telephone: 907.786.3550
Contact_Facsimile_Telephone: 907.786.3636
Contact_Electronic_Mail_Address: james_bodkin@usgs.gov
Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata
Metadata_Standard_Version: FGDC-STD-001-1998

b. Dataset category:
Aerial Survey: Species specific measurements, fields: INTENSIVE SEARCH UNIT, SET, TRANSECT, GROUP, ADULTS, STRIP ADULTS, CIRCLE ADULTS, PUPS, STRIP PUPS, CIRCLE PUPS, CHOP, GLARE, BEHAVIOR, DATE, OBSERVER, PERIOD, AREA, STRATUM, LENGTH, SIDE

CYP1A: Species specific measurements, fields:
P450: OTTER#, COLLDAT, CYP1Ablood, CYP1Aliver
Capture: DATE, AREA, AGECLASS, TOOTHAGE, RECORDER, OTTER NUMBER, SEX, PUP, PUP WEIGHT, PUP LENGTH, WEIGHT, LENGTH, GIRTH, LATITUDE, LONGITUDE, CAPTURE METHOD, TIME OTTER FIRST OBSERVED, CAUGHT WITH, PAW, LEFT TAG POSITION, LCOLOR, LTAG #, RIGHT TAG POSITION, RCOLOR, RTAG #, COMMENTS1, INITIAL FENTANYL DOSE, IFTIME, INITIAL VALIUM DOSE, IVTIME, SUPPLEMENTAL FENTANYL DOSE, SUPPLEMENTAL VALIUM DOSE, STIME, SUPPLEMENTAL2 FENTANYL DOSE, S2TIME, COMMENTS2, TEMPERATURE, TIME, FECAL SAMPLE COLLECTED?, TOOTH CONDITION, CANINES, INCISORS, PREMOLARS, MOLARS, MISSING, BROKEN, CANINE DIAMETER, TOOTH COLLECTED, AGE ESTIMATE, ESTIMATOR, ORAL LESIONS, BIOPSIES/SWABS, HEAD COLOR, BACULA LENGTH, COMMENTS3, BLOOD VOLUME DRAWN, DRAWTIME, QUEST DIAGNOSTICS NUMBER, NALTREXONE DOSE, NALTIME, COMMENTS4, RELEASE LOCATION, RELTIME, OBSERVERS, OTHER REMARKS

Blood: OTTER#, TREATMENT DATE, TREATMENT TIME, ANALYSIS DATE, ANALYSIS TIME, LABORATORY, WHITE BLOOD CELLS, RED BLOOD CELL COUNT, HEMOGLOBIN, HEMATOCRIT, MEAN CORPUSCULAR VOLUME, MEAN CORPUSCULAR HEMOGLOBIN, MEAN CORPUSCULAR HEMOGLOBIN CONCENTRATION, PLATELETS, SEGMENTED NEUTROPHILS, BANDS, LYMPHOCYTES, MONOCYTES, EOSINOPHILS, BASOPHILS, GLUCOSE, TOTAL PROTEIN, CREATININE, URIC ACID, CHOLESTEROL, TRIGLYCERIDES, ALKALINE PHOSPHATASE, SERUM GLUTAMIC OXALOACETIC TRANSAMINASE / ASPARTATE AMINO TRANSFERASE, SERUM GLUTAMIC PYRUVIC TRANSAMINASE / ALANINE AMINO TRANSFERASE, LACTIC DEHYDROGENASE, TOTAL BILIRUBINS, DIRECT BILIRUBIN, SODIUM, POTASSIUM, CHLORIDE, CALCIUM, PHOSPHOROUS, IRON, ALBUMIN, GLOBULIN, ALBUMIN TO GLOBULIN RATIO, BLOOD UREA NITROGEN, CORTISOL, CARBON DIOXIDE, CREATINE PHOSPHOKINASE, HAPTOGLOBIN, RED CELL WIDTH, TOTAL PROTEIN, TRIGLYCERIDES, CHOLESTEROL, HIGH DENSITY LIPOPROTEINS, VERY LOW DENSITY LIPOPROTEINS, LOW DENSITY LIPOPROTEINS, CHOLESTEROL:HIGH DENSITY LIPOPROTEINS, GAMMA GLUTAMYL TRANSFERASE, ALKALINE PHOSPHATASE

Habitat Use Species specific measurements, fields: VHF Frequency, Pup Presence, Date, Time, Easting, Northing, Accuracy, Behavior, Bout, Prey, Observer, Outlier, Comment

4. Algorithms

Aerial Survey, CYP1A, Habitat Use:
No algorithms will be utilized in this project.

5. Sample Collection, Handling, Custody, Storage

Aerial Survey and Habitat Use:
No samples are collected during these portions of the project.

CYP1A: As in past years, the CYP1A biomarker will be measured using peripheral mononuclear blood cells (PBMC) collected by jugular venipuncture (Ballachey et al. 2001a). The cells are isolated from the blood in the field, cryopreserved in liquid nitrogen, and subsequently shipped to Purdue University for analyses in the laboratory of Dr. Paul Snyder. Sample identifications are tied to the otter ID number and collection date that are located on the capture data sheets for each individual. The USGS Alaska Science Center's Sea Otter Project sample management plan is followed in documenting, inventorying, and tracking all samples. Chain of custody forms are used when shipping samples to other facilities for analysis. Surplus PBMC samples are stored at Purdue University. Surplus serum samples are stored in an ultracold freezer at USGS Alaska Science Center. Any additional samples collected during the capture are stored appropriately (frozen or preserved) at USGS Alaska Science Center.

6. Analytical Instrumentation

Aerial Survey, CYP1A, Habitat Use:
Analytical instruments will not be utilized in this project.

7. Data Reduction and Reporting

Aerial Survey: We will continue to use previously developed aerial survey data analysis techniques which use the standardized strip transect counts and intensive search units (ISU's) to estimate a correction factor for each survey (Bodkin and Udevitz 1999) in order to determine a population estimate. SAS statistical software and ArcInfo GIS software will be used.

CYP1A, Capture, and Blood: Off the shelf statistical software (e.g. SAS, SYSTAT, SigmaStat) will be used for descriptive statistics and simple between areas (oil exposed vs non-exposed) comparisons. A statistical consulting group might be contracted if the data warrant.

Habitat Use: SAS Statistical software, pre-packaged programs from the TDR manufacturer (Wildlife Computers), and ArcInfo or ArcGIS will be used to determine home ranges of VHF implanted otters as well as proportion of time spent in proximity to lingering oil. Further analyses and potential modeling have yet to be determined and will be based on results of preliminary data analysis.

***EXXON VALDEZ* OIL SPILL TRUSTEE COUNCIL**
DETAILED BUDGET FORM FY 04- FY 06

Budget Category:	Proposed FY 04	Proposed FY 05	Proposed FY 06		TOTAL PROPOSED
Personnel	$6.0	$30.0	$0.0		$36.0
Travel	$0.0	$0.0	$0.0		$0.0
Contractual	$12.8	$79.6	$0.0		$92.4
Commodities	$0.0	$5.8	$0.0		$5.8
Equipment	$0.0	$1.0	$0.0		$1.0
Subtotal	$18.8	$116.4	$0.0		$135.2
General Administration (9% of subtotal)	$1.7	$10.5	$0.0		$12.2
Project Total	$20.5	$126.9	$0.0		$147.4

Cost-share Funds:
In this box, identify non-EVOS funds or in-kind contributions used as cost-share for the work in this proposal. List the amount of funds, the source of funds, and the purpose for which the funds will be used. Do not include funds that are not directly and specifically related to the work being proposed in this proposal.

USGS Cost-Share:
Salary: Bodkin 0.5 months FY04: $4.4K, 2.5 months FY05: $22K
Vessel use FY05: $4K
Equipment and facilities, FY 05 and FY06: $12K

Total cost-share funds: $42.4K

FY 04

Prepared: April 13, 2004

Project Number: 040775
Project Title: Lingering oil and sea otters: Pathways of exposure and recovery status
Lead Agency: DOI--USGS

FORM 3A
TRUSTEE
AGENCY
SUMMARY

***EXXON VALDEZ* OIL SPILL TRUSTEE COUNCIL**
DETAILED BUDGET FORM FY 04- FY 06

Personnel Costs:		GS/Range/	Months	Monthly		Personnel
Name	Description	Step	Budgeted	Costs	Overtime	Sum
						0.0
Heather Coletti	Fishery Biologist	7 step 2	1.5	4.0		6.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		1.5	4.0	0.0	
					Personnel Total	$6.0

Travel Costs:	Ticket	Round	Total	Daily	Travel
Description	Price	Trips	Days	Per Diem	Sum
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$0.0

FY 04

Project Number: 040775
Project Title: Lingering oil and sea otters: Pathways of exposure and recovery status
Lead Agency: DOI--USGS

FORM 3B
Personnel
& Travel
DETAIL

***EXXON VALDEZ* OIL SPILL TRUSTEE COUNCIL**
DETAILED BUDGET FORM FY 04- FY 06

Contractual Costs:	Contractual Sum
Description	
Airplane contract for aerial relocations 4 @ 937.50	3.8
Histopathology of sea duck livers samples (1996-2002) 150 @ $60	9.0
If a component of the project will be performed under contract, the 4A and 4B forms are required. **Contractual Total**	$12.8

Commodities Costs:	Commodities Sum
Description	
Commodities Total	$0.0

FY 04

Project Number: 040775
Project Title: Lingering oil and sea otters: Pathways of exposure and recovery status
Lead Agency: DOI--USGS

FORM 3B
Contractual & Commodities DETAIL

New Equipment Purchases: Description	Number of Units	Unit Price	Equipment Sum
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
		New Equipment Total	$0.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency

FY 04

Project Number: 040775
Project Title: Lingering oil and sea otters: Pathways of exposure and recovery status
Lead Agency: DOI--USGS

FORM 3B
Equipment
DETAIL

Personnel Costs: Name	Description	GS/Range/ Step	Months Budgeted	Monthly Costs	Overtime	Personnel Sum

Brenda Ballachey	Research Physiologist	13 step 1	3.0	8.0		24.0
Heather Coletti	Fishery Biologist	7 step 2	1.5	4.0		6.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		4.5	12.0	0.0	
					Personnel Total	$30.0

Travel Costs:	Ticket	Round	Total	Daily	Travel
Description	Price	Trips	Days	Per Diem	Sum
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$0.0

FY 05

Project Number: 040775
Project Title: Lingering oil and sea otters: Pathways of exposure and recovery status
Lead Agency: DOI--USGS

FORM 3B
Personnel
& Travel
DETAIL

Contractual Costs:	Contractual
Description	Sum
Airplane contract for aerial relocations 20 @ 937.50	18.8
Vessel charter for recapture, and removal of instruments 15 days in July 2004 @ $1800/day	27.0

Veterinary services for instrument removal and biomarker assays	20.0
Airplane costs for aerial surveys of western PWS 40 hrs @ $220/hr	8.8
Blood analyses 40 @ $125	5.0
If a component of the project will be performed under contract, the 4A and 4B forms are required. **Contractual Total**	$79.6

Commodities Costs:	Commodities
Description	Sum
fuel	2.7
food and misc supplies	1.5
veterinarian supplies	1.6
Commodities Total	$5.8

FY 05

Project Number: 040775
Project Title: Lingering oil and sea otters: Pathways of exposure and recovery status
Lead Agency: DOI--USGS

FORM 3B
Contractual & Commodities
DETAIL

New Equipment Purchases:	Number	Unit	Equipment
Description	of Units	Price	Sum
			0.0
radio tracking equipment (antenna, cables, switches)			1.0
			0.0
			0.0

				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
			New Equipment Total	$1.0

Existing Equipment Usage:	Number of Units	Inventory Agency
Description		

FY 05

Project Number: 040775
Project Title: Lingering oil and sea otters: Pathways of exposure and recovery status
Lead Agency: DOI--USGS

FORM 3B
Equipment
DETAIL