Patterns and Processes of Population Change in Selected Nearshore Vertebrate Predators

Project Number:	030423
Restoration Category:	Research and Monitoring
Proposers:	Jim Bodkin, Dan Esler, Brenda Ballachey
Lead Trustee Agency:	DOI--USGS
Cooperating Agencies:	
Alaska SeaLife Center:	No
Project Duration:	5th year, 5-year project
Cost FY 03:	$216,600
Cost FY 04:	$0
Geographic Area:	Prince William Sound
Injured Resource/Service:	Sea Otter, Harlequin Duck

ABSTRACT

Sea otters and harlequin ducks have not fully recovered from the EVOS, based on population-level demographic differences between oiled and unoiled areas. Further, in oiled areas, both species show elevated cytochrome P4501A, almost certainly reflecting continued exposure to oil. This project was designed to explore links between oil exposure and the lack of population recovery, with the intent of understanding constraints to full recovery of these species and the nearshore environment generally. The results also serve to monitor the progress of recovery of the species and the system. To date, the work has consisted of field components for both species, and a captive component for harlequin ducks. Proposed activities for FY03 include (1) the third and final year of harlequin duck field studies quantifying oil exposure and survival of females during winter, and (2) closeout of all project components and preparation of the final report.

INTRODUCTION

The nearshore environment of Prince William Sound (PWS) received about 40% of the oil spilled after the *Exxon Valdez* ran aground (Galt et al. 1991). Concerns about nearshore recovery and restoration resulted in a suite of studies sponsored by the *Exxon Valdez* Oil Spill Trustee Council, including the Nearshore Vertebrate Predator project (NVP). Principal findings of NVP include an apparent lack of population recovery for sea otters (*Enhydra lutris*) and harlequin ducks (*Histrionicus histrionicus*), both invertebrate feeders in the nearshore ecosystem (Bodkin et al. 1999; Esler et al. in press, Dean et al. 2000, Bodkin et al. in press). Over a three year period, harlequin ducks residing in oiled areas had poorer survival than those in unoiled areas (Esler et al. 2000a). Sea otters also experienced poor post-spill survival through 1998, based on modeling of ages-at-death (Monson et al. 2000). Further indication of increased mortality (or higher rates of emigration) of sea otters in oiled areas compared to their counterparts in unoiled areas is provided by inferences based on capture data (Bodkin et al. 1999, Bodkin et al. in press). Additionally, both species show evidence of continuing exposure to hydrocarbons, based on elevations of the biomarker cytochrome P4501A (CYP1A), in oiled areas (Ballachey et al. 1999). Increases in CYP1A are not explained by background or natural hydrocarbon sources, as these were found to be negligible in intertidal areas of PWS (Short and Babcock 1996), nor by area differences in PCB contamination (Trust et al. 2000; USFWS unpub. data), leaving continued exposure to residual *Exxon Valdez* oil as the most plausible explanation. Residual oil is still stranded in intertidal areas of PWS (Babcock et al. 1996; Hayes and Michel 1999).

Conceptual links have been drawn describing mechanisms by which oil exposure could have population-level demographic impacts on sea otters and harlequin ducks. However, these links, and thus the processes that may limit full recovery, remain speculative. Therefore, we propose to build on the base of knowledge gained through previous research to (1) explore the relationships between oil exposure, individual health, and demographic attributes that could have population level effects, and (2) monitor the parameters identified in previous work that are effective and statistically powerful in describing population status and lend insight into the process of recovery of sea otters and harlequin ducks, and the nearshore environment generally.

Sea Otters

The NVP study provided several lines of evidence indicating that sea otters in the most heavily oiled portions of western Prince William Sound (WPWS), at northern Knight and Naked islands, have not recovered from oil-related injury (Bodkin et al. 1999, in press; Dean et al. 2000; Monson et al. 2000). The sea otter population at northern Knight has not increased between 1993-2001 (the period for which we have aerial survey data), with numbers remaining at about half the estimated pre-spill abundance. Sea otters in oiled areas show reduced survival, relative to prespill rates (Bodkin et al. 1999; Monson et al. 2000). Levels of CYP1A were higher in sea otters from Knight Island than from unoiled areas through 2001, suggesting continued exposure to residual oil may be constraining recovery. Additionally, increased proportions of larger-sized individuals of several sea otter prey species were identified at northern Knight, consistent with reduced predation and lack of recovery of the sea otter population in that area (Dean et al. 2000).

The sea otter component of this proposal was based on previous EVOS research (93045, 95025-99025) to develop a statistically sensitive and cost-effective program that has tracked the WPWS sea otter population and nearshore ecosystem recovery, and investigated the effects of chronic oil exposure on sea otters. We are addressing the following questions: (1) are sea otters increasing in abundance in the most heavily oiled areas, and in western PWS overall ? (2) has survival of sea otters returned to pre-spill rates? And (3) are biomarkers of oil exposure and indicators of sea otter health similar in oiled and unoiled areas?

Question 1 is being addressed by aerial surveys; question 2 by a modeling effort that uses ages at death from beach-cast carcasses (Monson et al. 2000), and question 3 by capture of sea otters in WPWS in summer 2001, with sampling of blood and liver tissues. In the final year of this project, we will complete modeling efforts and data analyses, and results will be compiled for presentation in the final report and for publication.

Harlequin Ducks

The most concerning result from NVP harlequin duck studies was the detection of significantly lower survival probabilities of adult females in oiled areas of PWS than in unoiled areas (Esler et al. 2000a). Analyses revealed that history of oil contamination was a more likely explanation for the survival difference than intrinsic differences between oiled and unoiled study areas. Further, projections of population trends using models incorporating these survival probabilities predicted declining populations on oiled areas and increasing populations on unoiled areas. This pattern was observed during Alaska Department of Fish and Game surveys (EVOSTC Project /427), suggesting that differences in survival were a likely mechanism for observed differences in population trends. Also, harlequin duck densities were lower on oiled Knight Island than on unoiled Montague Island, after accounting for intrinsic habitat differences; this is the pattern that would be predicted given high site fidelity and poorer survival on oiled areas. Finally, higher levels of CYP1A induction were detected on oiled areas.

Results from these studies led to speculation that continued exposure to oil could result in poorer survival of harlequin ducks, which in turn would result in differences in population trends and densities. There are reasonable explanations for how oil may be related to survival (see Statement of Problem below). Unfortunately, however, these links are drawn from a wide array of sources, with limited inference to wild harlequin ducks in PWS. Thus, with these 423 studies, we are exploring the relationship between oil exposure and survival using both field and captive bird approaches. These serve to examine mechanisms or processes that may continue to limit harlequin duck population recovery. These studies also monitor the most critical elements revealed in previous studies to gauge the progress of recovery.

The specific questions addressed by the harlequin duck components of this study are: (1) what is the relationship between levels of oil exposure and CYP1A induction, and what levels of oil exposure result in CYP1A values similar to those measured in PWS? (2) are there metabolic or behavioral consequences of oil exposure that could be a mechanism by which harlequin duck survival is compromised? (3) is oil exposure (as indicated by CYP1A induction) related to

survival of harlequin ducks in the wild? and (4) is contaminant exposure declining over time and, similarly, are survival rates on the oiled area improving through time? Questions 1 and 2 were addressed using captive birds at the Alaska SeaLife Center during winters 2000-01 and 2001-02. Questions 3 and 4 have been addressed by biosampling and radio telemetry work during winters 2000-01 and 2001-02, with the final required sampling proposed to occur in winter 2002-03. These studies are a continuation of work proposed and approved in Project 00423. This work will examine both the process of recovery (through understanding of the mechanisms constraining population demography) and will monitor the progress of recovery by sampling survival and CYP1A induction of wild birds starting 3 years subsequent to the last work done as part of NVP (winter 1997-98).

NEED FOR THE PROJECT

A. Statement of Problem

Sea otters and harlequin ducks occupy an invertebrate-consuming trophic level and are conspicuous components of the nearshore ecosystem. In 1995, the NVP Project was initiated to examine the status of recovery of nearshore vertebrates (including sea otters, harlequin ducks, river otters and pigeon guillemots), and to evaluate possible causes for the apparent lack of recovery. Results of the NVP project clearly suggest that complete recovery has not occurred for sea otters and harlequin ducks, and the lack of recovery may be related to continued exposure to oil. This proposed work follows up on the critical elements revealed by the NVP studies.

Sea Otters

The sea otter population in WPWS was injured as a result of the spill. Estimates of sea otter mortality due to the spill range from 750 to 2,650 individuals (Garshelis 1997, Garrott et al. 1993). A population model (Udevitz et al. 1996) predicted recovery of the WPWS sea otter population in 10 to 23 years, projecting maximum annual growth rates from 0.10-0.14. Surveys to date (1993-1998) have shown a significant increasing trend in the WPWS sea otter population, averaging about 4% per year since 1993 (power > 0.80 to detect a 1% annual change in 5 annual WPWS surveys). In contrast to the western Sound overall, at northern Knight Island sea otter numbers remain low with no sign of an increase through 2001 (Bodkin et al. 1999, Bodkin 2000; Dean et al. 2000, USGS unpublished data).

Sea otter carcasses have been recovered from beaches in WPWS since 1976, thus providing one of the few long-term baseline data sets for evaluating post-spill injury. Carcass surveys initially were not proposed as part of Project 99423. However, in 1999 we applied recently developed modeling techniques (Doak and Morris 1999) to estimation of sea otter survival rates, utilizing the distribution of otter ages-at-death as the basis for the model. The results provide compelling evidence of long-term injury from the EVOS (Monson et al. 2000). Briefly, the model involves a comparison of observed vs. predicted ages-at-death of sea otters prespill and postspill, using data from carcasses collected during 1976-98. Postspill survival of sea otters in the western Sound was poor relative to prespill rates, and by 1998, survival rates had not yet returned to

prespill values. However, survival rates of younger age otters were increasing, suggesting that conditions were normalizing. These results are consistent with other observations of sea otters in western PWS, which suggest that the population in the most heavily oiled areas has not yet recovered . Carcass collections and modeling efforts based on age-at-death data may provide one of the most efficient tools for monitoring recovery of sea otters. Additional age data are available (carcasses collected during 1999-2002) and will be incorporated into the model as part of FY03 work, providing new insight into survival rates of sea otters in WPWS.

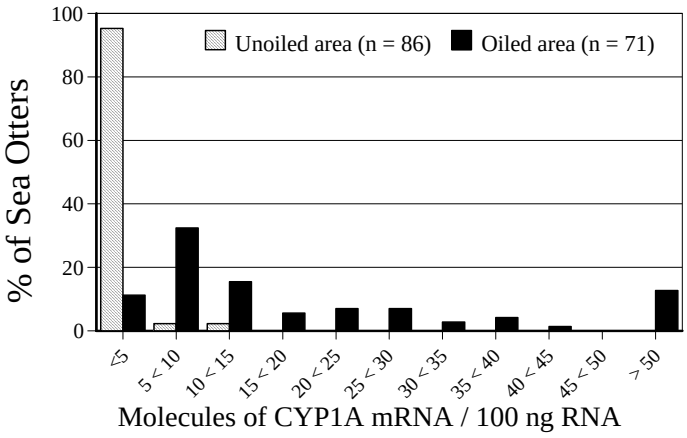


Figure 1. Measurement of cytochrome P4501A induction (RT-PCR technique) in sea otters in western Prince William Sound, 1996-98.

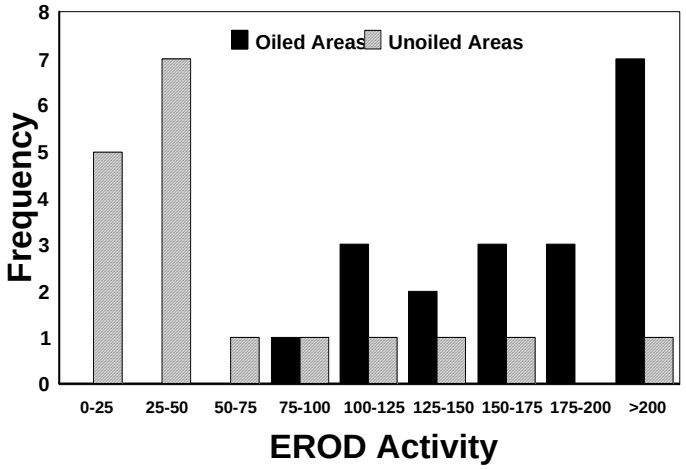
The NVP study identified elevated expression of CYP1A in 6 species that inhabit the nearshore areas of WPWS, indicating continued exposure to residual EVOS oil (Ballachey et al. 1999). Sea otters were sampled in 1996-98, and in all years, animals from Knight and Naked islands (oiled area) had elevated CYP1A, compared to those from Montague Island (unoiled area; Figure 1). Further, levels at Montague were similar to those measured in otters from a relatively clean area in southeast Alaska with no known exposure to oil or other contaminants (USGS unpub. data). In 1998, the mean value of CYP1A in the oiled study area was lower than means for 1996 or 1997, suggesting exposure to residual oil is diminishing over time. We resampled the wild sea otter population for CYP1A in summer 2001, and found that CYP1A levels in the oiled area continue to be elevated relative to the unoiled area. However, the trend to lower CYP1A levels over time continues.

These studies will be valuable in documenting extent of chronic injury and actual recovery time for the nearshore system including sea otters, and providing long-term population trend data which may be used in assessing initial damage and subsequent recovery of sea otter populations in the event of future oil spills.

Harlequin Ducks

Harlequin ducks were, and remain, particularly vulnerable to deleterious effects of the oil spill. Much of the oil from the *Exxon Valdez* was deposited in the nearshore intertidal and shallow subtidal zones (Galt et al. 1991), the coastal habitats where harlequin ducks occur. Also, Goudie and Ankney (1986) suggested that harlequins were near the lower limit of body size for sea ducks occurring in environments similar to Prince William Sound in winter. Because harlequin ducks exist close to an energetic threshold, any perturbation (e.g., an oil spill) that either affects health or condition directly (via toxic effects or increased metabolic costs) or indirectly (via food abundance) could have significant consequences for the population.

Also, among ducks, sea duck life histori
Harlequin ducks typically defer reprodu
in reproduction, and are long-lived (Gou
relatively low potential rates of populati
oil spill, require many years in the absen
population levels. Further, population d
particularly sensitive to variation in adul



Sea ducks have a general pattern of high
1980, Savard and Eadie 1989) and harle
molting and wintering sites (Robertson 1
in vulnerability to population effects because: (1) if residual oil spill damages exist, birds from oiled areas are vulnerable to spill effects as they return to those areas annually (i.e., these birds are affected disproportionately and are subject to cumulative effects), and (2) if dispersal and movements among areas are limited, recovery of groups of birds in oiled areas can occur only through demographic processes specific to that group (i.e., numbers are not enhanced through immigration from other areas). High site fidelity is an adaptive behavioral strategy in natural situations and predictable environments (Robertson 1997), but does not accommodate movement to undisturbed sites in the face of human-caused perturbations.

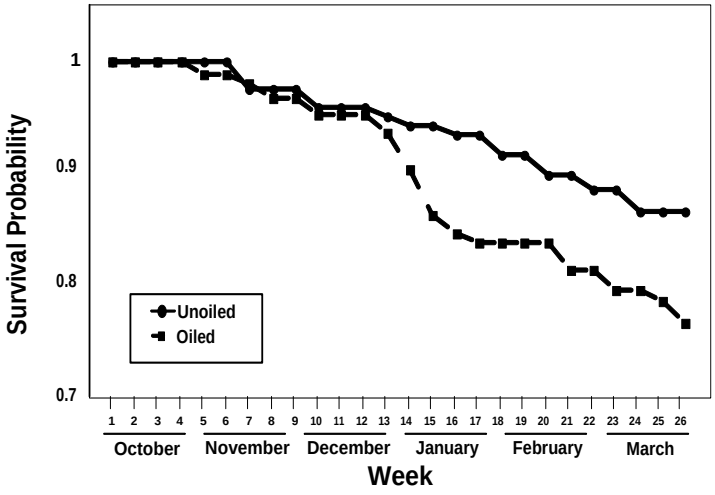


Figure 2. Survival probabilities of harlequin ducks.

Evidence from recent studies (NVP and /427) suggests that, as might be predicted from their vulnerability, harlequin duck populations have not fully recovered and, in fact, continue to suffer deleterious effects from the oil spill. Over the course of 3 winters, survival probabilities differed between oiled and unoiled areas (Figure 2). Survival probabilities were high, and similar between areas, in fall. However, survival diverged between areas during mid-winter, presumably the period during which conditions are most difficult for harlequin ducks. Also, differences in CYP1A induction were detected between populations from oiled and unoiled areas (Figure 3; Trust et al. 2000), although this was measured on different birds than those for which survival data were collected. Further, body mass during winter showed a slight, negative relationship with CYP1A level.

One can speculate on mechanisms by which continued exposure to oil could be related to differences in survival probabilities. Most lab studies have shown that mallards are tolerant of internal ingestion of oil, with toxic effects not evident until very high doses. These studies have been used to suggest that harlequin ducks should, similarly, be unaffected by residual Exxon Valdez oil (Stubblefield et al. 1995, Boehm et al. 1996). However, other studies have found that,

with addition of other stressors such as cold temperatures, oiled ducks in the lab suffered considerably higher mortality than unoiled (Holmes et al. 1978, 1979). This seems to be a much more appropriate analog for wild harlequin ducks. Particularly given their vulnerability to spill effects and hypothesized existence near an energetic threshold, harlequin ducks may not be able to handle additive effects of the oil spill, even if relatively small.

To fully understand the process of harlequin duck population recovery from the oil spill, it is important to address these speculated links between oil exposure and survival probabilities, and subsequently population trends. The research proposed here was designed to explore these potential mechanisms constraining population recovery through field studies of winter survival and CYP1A induction and captive studies of metabolic, behavioral and CYP1A responses to controlled oil exposure. Further, because of their susceptibility to spill effects and high site fidelity, harlequin ducks are an ideal species for monitoring recovery of the nearshore environment.

Figure 3. Comparison of CYP1A induction (hepatic EROD activity) in harlequin ducks from Prince William Sound.

B. Rationale/Link to Restoration

Sea otter and harlequin duck restoration requires assessments of population recovery status and definition of impediments to recovery. For harlequins and sea otters, the proposed work incorporates monitoring activities which, given the "baseline" data collected in NVP and other post-spill studies, will allow us to gauge recovery status. Additionally, the research components proposed herein represent a comprehensive approach to understanding the factors that affect population dynamics and definition of critical bottlenecks to recovery. Without an understanding of the underlying processes that dictate population change, we can not prescribe specific activities to enhance recovery. The project directly addresses the restoration objectives both by examining the processes affecting recovery and by monitoring the progress of recovery, including survival rates and contaminant exposure.

Sea Otters

Recovery of sea otters will be complete when population size returns to estimated pre-spill abundance, and there is no further evidence of continuing exposure to residual oil. Sea otter restoration requires an understanding of population status and the processes affecting changes in population status. Continued monitoring of sea otter distribution, abundance, survival rates and prey populations in WPWS will provide insight into recovery and improve future recovery models, and potentially allow us to document the actual recovery time for the nearshore system, including sea otters. A further benefit of these project components is provision of long-term population trend data and monitoring tools which may be used in assessing initial damage and subsequent recovery of sea otter populations in the event of future oil spills.

Harlequin Ducks

Harlequin duck restoration will be complete when densities have recovered to prespill levels and birds no longer show evidence of oil contamination. Poor survival in oiled areas is the most plausible cause for lack of recovery to prespill densities; restoration requires an understanding of the factors that affect survival rates, in particular the effects of oil exposure. The restoration objectives for harlequin ducks are addressed both by examining the processes affecting recovery and by monitoring the progress of recovery, in particular contaminant exposure.

C. Location

Studies will be conducted in PWS. Specific study sites for the sea otter components were northern Knight Island and Port Chalmers/Stockdale at Montague Island, as used in the NVP project. Harlequin duck study sites also are those used in previous NVP work: unoiled Montague Island and oiled Green Island, Crafton Island, Main Bay and Foul Bay. Field components will be coordinated with recent findings from NOAA Auke Bay Lab describing oil persistence on beaches. Captive studies were done at the Alaska SeaLife Center in Seward. Communities affected by the project include Chenega, Whittier, Cordova and Seward.

COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE

The project will continue to inform and coordinate our community involvement activities, including the collection of indigenous knowledge with Dr. Henry Huntington, TEK specialist Chugach Regional Resources Commission and Hugh Short, Community Coordinator, EVOS Restoration Office. We will continue to solicit advice from the above parties and gather information on TEK through local community facilitators and residents. Efforts have and will continue to be made throughout the restoration process to participate in and provide public involvement in the design and implementation of this project. Information gathered from this project will be shared with local communities. Project staff has and will continue to present information to local communities or prepare articles or photographs for Trustee Council publications. Boat and air charter contracts, and other services will be contracted from local sources when possible.

PROJECT DESIGN

A. Objectives

Sea Otters

1. Summarize findings from this project and present as journal publications and a final EVOSTC report. At least two publications are anticipated: one on survival rates through 2002, and a second on CYP1A values and liver histopathologies.

Harlequin Ducks

1. Estimate winter survival rates of harlequin ducks in relation to area (history of oil contamination) and indices of oil exposure (CYP1A induction).

2. Monitor progress of harlequin duck population recovery via tracking of survival rates and CYP1A induction in oiled and unoiled areas.

3. Summarize findings from this project and present as journal publications and a final EVOSTC report.

B. Methods

Our 423 studies employed field studies on sea otters, and both field studies and experimental work with harlequin ducks. This combination of approaches addressed the need for controlled work to look explicitly at the effects of oil exposure on hypothesized mechanisms of mortality and field work to document the relevance of those mechanisms under wild conditions. The final data collection necessary for completion of the project is a third winter of survival and oil exposure data for harlequin ducks. Given the need for strong inference for understanding effects of oil exposure, this last year is critical for meeting project goals.

Sea Otters

All field activities under this project have been completed. Close-out efforts for FY03 will include modeling to assess survival rates, additional examination of liver samples for histopathological alterations, data analyses and compilation of results into reports and publications.

Harlequin Ducks

Field Studies

The key data for harlequin duck field studies are paired CYP1A and survival data, which will allow for explicit tests of the hypothesis that mortality and oil exposure are related in wild harlequin ducks. We intend to collect survival and exposure data from 50 birds in each of 3

years by capturing them during early winter, conducting surgeries to both implant transmitters and biopsy livers, and monitoring subsequent winter survival. These types of data have been successfully collected during NVP studies.
This research requires capture of flighted harlequin ducks during early winter, after they have been on wintering sites long enough to be potentially exposed to residual oil, yet before the mid-winter period when survival probabilities diverged during NVP studies (Figure 3). The mid-winter period is presumably the time of greatest stress and thus the period when oil spill effects would be most likely to be expressed as differences in survival probabilities. The interval between capture and the critical mid-winter period must allow for at least a 2-week censor period to ensure that survival data are not biased by effects of capture, handling, or surgery (Esler et al. 2000b; Mulcahy and Esler 1999). Thus, we propose capturing birds during a 3-week period in November to generate both survival data and exposure data from the same individuals.

We will use floating mist nets (Kaiser et al. 1995) to catch flying birds in oiled (Knight Island, Green Island, Crafton Island, Main Bay, Foul Bay) and unoiled (Montague Island) study areas. Use of the same study areas as the NVP project allows for direct comparisons of results. The floating mist net capture technique was used successfully during NVP studies. However, this technique does not allow handling of as many birds as molt drives, so age cohorts used in survival estimation will not be as restricted as in NVP studies, which included only after-third-year females. We will radio females of all age classes; age parameters will be included in all analyses to account for any survival differences due to these effects. Captured birds will be banded with uniquely coded USFWS bands, aged by bursal probing (Mather and Esler 1999), and sexed by plumage characteristics.

To estimate survival probabilities of harlequin ducks, we will use implantable radio transmitters with external antennas (Korschgen et al. 1996). Implanted transmitters have been successfully used in waterfowl studies (e.g., Olsen et al. 1992, Haramis et al. 1993), and an increasing body of literature suggests that radio transmitters implanted into wild waterfowl are less disruptive than external methods of attachment, based on differences in survival or return rates (Ward and Flint 1995, Dzus and Clark 1996), behavior (Pietz et al. 1993), and reproductive rates (Pietz et al. 1993, Rotella et al. 1993, Ward and Flint 1995, Paquette et al. 1997), especially for diving ducks (Korschgen et al. 1984). NVP studies (Esler et al. 2000b) demonstrated that recapture probabilities of radio-marked harlequin ducks were not lower than unradioed individuals. Surgeries will be conducted by certified veterinarians experienced in avian implant surgeries, following procedures outlined in Alaska Biological Science Center, USGS Biological Resources Division standard protocol. Transmitters will weigh approximately 18g, which is < 3% of the body mass of the smallest wintering female harlequin ducks captured during NVP studies. Transmitters will be equipped with mortality sensors; the pulse rate will change from 45 to 90 beats per minute when a mortality is indicated. Mortality status will be confirmed by either carcass recovery or detection of signals from upland habitats, which are not used by harlequin ducks during nonbreeding periods.

We will conduct radio telemetry flights at approximately weekly intervals from the capture and marking period through the end of March. Survival data entry and general description will follow procedures outlined in Pollock et al. (1989a, 1989b), as modified by Bunck et al. (1995).

We will examine effects of area, season, and CYP 1A on survival by comparing AIC_c values (Burnham and Anderson 1998) among models with different combinations of these effects. The AIC_c indicates the most parsimonious model by balancing the goodness-of-fit of each model (from the maximum likelihood) with the number of parameters to be estimated. Under this approach, the model with the lowest AIC_c indicates the combination of parameters that are best supported by the data, which we will interpret as the factors related to variation in survival. Survival estimates and variances will be calculated by iterative solution of the likelihood using program MARK (White and Burnham 1999).

CYP1A induction will be measured by EROD activity. Small liver biopsies (approximately 0.1 g) will be surgically removed and immediately frozen in a liquid nitrogen shipper. EROD activity analyses will be conducted in a contracted lab following standard procedures (Trust et al. 2000). Plumage swabs and plucked feathers will be used to assess presence of external oil.

C. Cooperating Agencies, Contracts, and Other Agency Assistance

USGS-BRD personnel will be responsible for directing and conducting sea otter and harlequin duck studies. A contract will be established with Dr. Dan Esler for the harlequin duck components.

SCHEDULE

A. Measurable Project Tasks for FY03

Sea Otters

October 02-Nov. 04: Data compilation, analysis, publication preparation, and final report.

Harlequin Ducks

November:	Capture harlequin ducks for field studies of survival and CYP1A induction.
Nov-March:	Monitor radioed birds for survival study.
October 02-Nov 04:	Data compilation, analysis, publication preparation, and final report.

B. Project Milestones and Endpoints

This is a projected five-year research and monitoring program (initiated FY99, with completion of all objectives by FY03; see below) designed to assess the recovery of two injured species. Project objectives will be assessed annually. At the end of each year results will be compared

with the restoration goals to assess whether recovery has occurred. The reporting schedule is described below, and is consistent with EVOS Trustee Council guidelines.

Sea Otters

FY03: Complete analysis, prepare final report and manuscript preparation

Harlequin Ducks

FY03: Conduct final winter of field studies, complete analysis, prepare final report and manuscript preparation.

C. Completion Date

All project objectives will be met by the end of FY03.

PUBLICATIONS AND REPORTS

A final report will be prepared at the end of the proposed work, with a delivery date of no later than 30 November 2003. Publications will be prepared for peer-review journals.

PROFESSIONAL CONFERENCES

D. Esler attendance at 2003 American Ornithologists Union meeting, date and location to be determined. B. Ballachey attendance at Carnivores 2002, a conference on carnivore biology and conservation (includes 2 sessions devoted to sea otter biology), Monterey, CA, November 2002.

NORMAL AGENCY MANAGEMENT

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

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

As described in the Introduction, this research relies on incorporation of data and results from other Trustee sponsored research, including projects /025, /427 and 02585. Equipment and commodities purchased under /025 will be used to conduct the proposed research and data collection and analysis will follow previously established protocols and standards. Additionally, in conjunction with NOAA Auke Bay Laboratory scientists, we (JLB, BEB) are submitting a new FY03 project proposal titled "Lingering Oil: Identifying Linkages Among Contaminated Habitat, Prey and Predators", which continues investigation of links between exposure to oil and lack of recovery in sea otters.

EXPLANATION OF CHANGES IN CONTINUING PROJECTS

In 1998, the EVOS Trustee Council first approved funding for Restoration Project 99423, "Patterns and Processes of Population Change in Sea Otters", an extension of the NVP project. The objectives of the project included sea otter aerial surveys of PWS, replicate surveys of sea otters at Knight and Montague Islands and sampling of sea urchin populations. In 1999, the Trustee Council approved the addition of harlequin duck studies to 00423 with the revised project title "Patterns and Processes of Change in Selected Nearshore Vertebrates". Those studies included relating harlequin survival to oil exposure and captive studies to assess responses to controlled oil exposure. In February 2000, the Trustee Council approved an amendment to 00423, to fund carcass recovery surveys in WPWS, to collect data on sea otter ages at death for estimation of survival rates. The work proposed for FY03 in this document follows directly from the work approved through the original proposals and amendments.

PROPOSED PRINCIPAL INVESTIGATORS

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PRINCIPAL INVESTIGATOR QUALIFICATIONS

Jim Bodkin is a Research Wildlife Biologist and team leader for coastal ecosystem studies in Alaska for the USGS Alaska Science Center. He has over 40 peer-reviewed scientific publications and directs an active coastal marine research program. He has studied and published on sea otter foraging ecology and community structuring since 1988 and has been principal investigator for sea otter survey methods development. He earned a M.S. from California State Polytechnic University in 1986.

Dan Esler is a University Research Associate with Simon Fraser University in British Columbia. He has conducted waterfowl research in arctic and subarctic regions of Alaska and Russia for the past 12 years. Since 1995 he has served as project leader for harlequin duck studies as part of the EVOSTC-sponsored Nearshore Vertebrate Predator project. He earned a M.S. from Texas A&M University in 1988 and a Ph.D. from Oregon State University in 2000. He has authored over 25 peer-reviewed journal publications and numerous reports and presentations addressing research and issues in waterbird conservation.

Brenda Ballachey is a Research Physiologist at the USGS Alaska Science Center in Anchorage. She was Project Leader for sea otter NRDA studies from 1990 through 1996, and has been involved in all aspects of post-spill research on sea otters, including the Nearshore Vertebrate Predator (NVP) project, with primary responsibilities for examining effects of residual oil on biomarkers and health of sea otters and other NVP study species. She has authored numerous peer-reviewed journal publications, reports and presentations. She received her M.S. in 1980 at Colorado State University, and Ph.D. in 1985 Oregon State University.

KEY COOPERATORS

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LITERATURE CITED

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2003 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2002 - September 30, 2003

Budget Category:	Authorized FY 2002	Proposed FY 2003	PROPOSED FY 2003 TRUSTEE AGENCIES TOTALS					
			ADEC	ADF&G	ADNR	USFS	DOI	NO
							$216.2	
Personnel	$66.2	$38.6						
Travel	$3.9	$1.3						
Contractual	$223.5	$153.3						
Commodities	$10.5	$5.5						
Equipment	$0.0	$0.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	$304.1	$198.7				Estimated		
General Administration	$25.6	$17.9				FY 2004		
Project Total	$329.7	$216.6				$0.0		
Full-time Equivalents (FTE)	1.0	0.5						
	Dollar amounts are shown in thousands of dollars.							
Other Resources	$0.0	$0.0			$0.0	$0.0		

Comments:

FY03

Prepared:4/8/02

Project Number: 03423
Project Title: Pattern and Process of Population Change in Selected Nearshore Vertebrates
Lead Agency: DOI--USGS

2003 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2002 - September 30, 2003

Budget Category:	Authorized FY 2002	Proposed FY 2003
Personnel	$55.7	$28.1
Travel	$3.9	$1.3
Contractual	$223.5	$153.3
Commodities	$10.5	$5.5
Equipment	$0.0	$0.0
Subtotal	$293.6	$188.2
General Administration	$24.0	$16.9
Project Total	$317.6	$205.1
Full-time Equivalents (FTE)	0.9	0.4

LONG RANGE FUNDING REQUIREMENTS

Estimated FY 2004
$0.0

Dollar amounts are shown in thousands of dollars.

Other Resources

Comments:

FY03

Prepared: 4/8/02

Project Number: 03423
Project Title: Pattern and Process of Population Change in Selected Nearshore Vertebrates
Agency: DOI--USGS

2003 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2002 - September 30, 2003

Personnel Costs:		GS/Range/	Months	Monthly		Propos
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 2(
J. Bodkin (so)	Research Wildlife Biologist	GS 13-4	1.5	7.2		1(
D. Monson (so)	Research Wildlife Biologist	GS 9-02	1.0	4.2		4
B. Ballachey (so)	Research Physiologist	GS 12-4	1.0	7.2		7
						(
						(
						(
D. Mulcahy (hd)	Veterinarian	GS 13	0.8	7.4		5
						(
						(
						(
						(
						(
	Subtotal		4.3	26.0	0.0	
					Personnel Total	$28

Travel Costs:	Ticket	Round	Total	Daily	Propos
Description	Price	Trips	Days	Per Diem	FY 2(
B. Ballachey Scientific Conference					1
					(
					(
					(
					(
					(
					(
					(
					(
					(
					(
				Travel Total	$1

FY03

Prepared: 4/8/02

Project Number: 03423
Project Title: Pattern and Process of Population Change in Selected Nearshore Vertebrates
Agency: DOI-USGS

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

Contractual Costs:	Propos
Description	FY 2(
4A Linkage Simon Fraser University (hd)	13(
Oregon State University - graduate student support (hd)	1
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$15

Commodities Costs:	Propos
Description	FY 2(
Preparation and Page costs towards 2 manuscripts (so); limited to 1K per project	1
Ballachey: P450 values in sea otters and relation to animal health	
Bodkin/Modson: mortality patterns of sea otters	
Vet supplies (hd)	4
Commodities Total	$

FY03

Project Number: 03423
Project Title: Pattern and Process of Population Change in Selected Nearshore Vertebrates
Agency: DOI--USGS

Prepared: 4/8/02

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

New Equipment Purchases:	Number	Unit	Propos
Description	of Units	Price	FY 2(
			(
			(
			(
			(
			(
			(
			(
			(
			(
			(
			(
			(
Those purchases associated with replacement equipment should be indicated by placement of an R	**New Equipment Total**		$(

Existing Equipment Usage:	Number	Invent
Description	of Units	Ager

FY03

Prepared: 4/8/02

Project Number: 02423
Project Title: Pattern and Process of Population Change in Selected Nearshore Vertebrates
Agency: DOI-USGS

2003 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2002 - September 30, 2003

Budget Category:	Authorized FY 2002	Proposed FY 2003
Personnel	$10.5	$10.5
Travel	$0.0	$0.0
Contractual	$0.0	$0.0
Commodities	$0.0	$0.0
Equipment	$0.0	$0.0
Subtotal	$10.5	$10.5
General Administration	$1.6	$1.0
Project Total	$12.1	$11.5
Full-time Equivalents (FTE)	0.1	0.1
Other Resources		

LONG RANGE FUNDING REQUIREMENTS					
		Estimated FY 2004			
		$0.0			
Dollar amounts are shown in thousands of dollars.					

Comments:

FY03

Prepared: 4/8/02

Project Number: 03423
Project Title: Pattern and Process of Population Change in Selected Nearshore Vertebrates
Agency: DOI--FWS

2003 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2002 - September 30, 2003

Personnel Costs:		GS/Range/	Months	Monthly		Propos
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 2(
K. Trust (hd)	Biologist	GS 12	1.5	7.0		1(
						(
						(
						(
						(
						(
						(
						(
						(
						(
	Subtotal		1.5	7.0	0.0	
					Personnel Total	$1(

Travel Costs:	Ticket	Round	Total	Daily	Propos
Description	Price	Trips	Days	Per Diem	FY 2(
					(
					(
					(
					(
					(
					(
					(
					(
					(
					(
					(
				Travel Total	$(

FY03

Prepared: 4/8/02

Project Number: 03423
Project Title: Pattern and Process of Population Change in Selected Nearshore Vertebrates
Agency: DOI-FWS

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

Contractual Costs:	Propos
Description	FY 2(
	(
	(
	(
	(
	(
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$(

Commodities Costs:	Propos
Description	FY 2(
	(
	(
	(
	(
	(
Commodities Total	$(

FY03

Prepared: 4/8/02

Project Number: 03423
Project Title: Pattern and Process of Population Change in Selected Nearshore Vertebrates
Agency: DOI--FWS

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

New Equipment Purchases:	Number	Unit	Propos
Description	of Units	Price	FY 2(
			(
			(
			(
			(
			(
			(
			(
			(
			(
			(
			(
			(
Those purchases associated with replacement equipment should be indicated by placement of an R	**New Equipment Total**		$(

Existing Equipment Usage:	Number	Invent
Description	of Units	Ager

FY03

Prepared: 4/8/02

Project Number: 03423
Project Title: Pattern and Process of Population Change in Selected Nearshore Vertebrates
Agency: DOI-FWS

2003 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2002 - September 30, 2003

Budget Category:	Authorized FY 2002	Proposed FY 2003						
Personnel	$69.0	$69.0						
Travel	$6.4	$5.1						
Contractual	$68.5	$58.7						
Commodities	$17.6	$3.5						
Equipment	$0.0	$0.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	$161.5	$136.3			Estimated FY 2004			
Indirect	$0.0	$0.0						
Project Total	$161.5	$136.3						
Full-time Equivalents (FTE)	1.0	1.0						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments: SIMON FRASER UNIVERSITY

No overhead or fees are charged by the university on this contract.

FY03

Prepared: 4/8/02

Project Number: 03423
Project Title: Pattern and Process of Population Change in Selected Nearshore Vertebrates
Agency: DOI-USGS --Simon Fraser University Contract

2003 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2002 - September 30, 2003

Personnel Costs:			Months	Monthly		Propos
	Name	Position Description	Budgeted	Costs	Overtime	FY 2(
	D. Esler	University Research Associate	9.0	6.8		6
		Biological Technician	3.0	2.6		
		Subtotal	12.0	9.4	0.0	
					Personnel Total	$6(

Travel Costs:		Ticket	Round	Total	Daily	Propos
	Description	Price	Trips	Days	Per Diem	FY 2(
	Esler - Seward (hd)	0.8	2	20	0.1	3
	Field crew/gear to Whittier (winter) (hd)	0.5	1			(
	Meeting (hd)					1
					Travel Total	$(

FY03

Prepared:4/8/02

Project Number: 03423
Project Title: Pattern and Process of Population Change in Selected Nearshore Vertebrates
Agency: DOI-USGS--Simon Fraser University Contract

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

Contractual Costs:	Propos
Description	FY 2(
EROD activity - 50 @ $140 (hd)	7
Charter vessel (winter) - 21 days @ 1150 (hd)	24
Plumage swab analysis - 50 @ 100 (hd)	5
Air charter - survival monitoring - 90 hrs @ $250 (hd)	22
Contractual Total	$58

Commodities Costs:	Propos
Description	FY 2(
Winter trap maintenance (hd)	(
Miscellaneous field/office supplies (hd)	3
Commodities Total	$3

FY03

Prepared: 4/8/02

Project Number: 03423
Project Title: Pattern and Process of Population Change in Selected Nearshore Vertebrates
Agency: DOI-USGS--Simon Fraser University Contract

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

New Equipment Purchases:	Number of Units	Unit Price	Propos FY 2(
Description			
Those purchases associated with replacement equipment should be indicated by placement of an R	**New Equipment Total**		$(

Existing Equipment Usage:	Number of Units	
Description		

FY03

Prepared: 4/8/02

Project Number: 03423
Project Title: Pattern and Process of Population Change in Selected Nearshore Vertebrates
Agency: USGS--Simon Fraser University Contract