Project Title: Harlequin Duck Population Dynamics in Prince William Sound: Measuring Recovery

2007 Progress Report

Dan Rosenberg
Alaska Department of Fish and Game

In March 2007 we completed the 7th year of monitoring surveys since the inception of winter surveys in 1997. These surveys measure recovery by comparing changes demographic parameters within and between oiled and unoiled sites in Prince William Sound. Surveys were expanded in 2007 to compare the potential disparity of harlequin duck densities between oiled and unoiled regions over time and better estimate the number of ducks we would expect to observe in oiled areas. We resurveyed 20 oiled and 20 unoiled transects originally surveyed in March of 1972 and 1973. These 1972 and 1973 surveys are the only prespill winter data available on population abundance.

All data has been entered and is ready for mapping and analysis. Our biometrician is currently unavailable due to personal matters so data analysis has been delayed until he returns in the near future.

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 Data Policy**, adopted July 9, 2002) and reporting requirements *(Procedures for the Preparation and Distribution of Reports***, adopted June 27, 2007).

PROJECT TITLE: Harlequin Duck Population Dynamics in Prince William Sound: Measuring Recovery from the *Exxon Valdez* Oil Spill

Printed Name of PI: Dan Rosenberg

Signature of PI: _____ Date 7/27/06

Printed Name of co-PI: NA

Signature of co-PI: _____ Date _____

Printed Name of co-PI: NA

Signature of co-PI: _____ Date _____

* Available at www.evostc.state.ak.us/Policies/data.htm
** Available at www.evostc.state.ak.us/Policies/guidelines.htm

Trustee Council Use Only
Project No: ____
Date Received: ____

PROPOSAL SUMMARY PAGE
(To be filled in by proposer)

Title: Harlequin Duck Population Dynamics in Prince William Sound: Measuring Recovery from the *Exxon Valdez* Oil Spill

Project Period: October 1, 2007 – September 30, 2008

Proposer(s): Dan Rosenberg, Alaska Dept. Fish and Game
E-mail: dan.rosenberg@alaska.gov

Study Location: Prince William Sound

Abstract: This project will monitor the recovery of harlequin ducks in PWS and is directly linked to recovery objectives in the EVOS Restoration Plan. The outlook for recovery is improving, however, oil remains in the intertidal, ducks are exposed to oil, populations in oiled areas while no longer declining have not increased more than those in unoiled areas, and proportions of females in oiled areas remain lower than reference areas. This suggests a lack of full recovery. We will conduct winter boat surveys to test if harlequin ducks have recovered from the EVOS by comparing population structure and trends between oiled and unoiled treatments in four areas (2 oiled, 2 unoiled) of PWS. Similar structure and increasing trends in oiled areas, when interpreted with complimentary data, will indicate recovery status. Work will be complimentary to studies addressing lingering oil, cytochrome P450 induction, and population modeling to provide a more comprehensive assessment of recovery.

Funding:
EVOS Funding Requested: FY 08 $105.6
(must include 9%GA) $11.8
TOTAL: $117.4

Non-EVOS Funds to be Used: FY 08 $24.0

TOTAL: $141.4

Date: July, 26, 2007

(NOT TO EXCEED ONE PAGE)

Harlequin Duck Population Dynamics in Prince William Sound: Measuring Recovery from the *Exxon Valdez* Oil Spill

Exxon Valdez Oil Spill Trustee Council
FY 2008 Proposal
Injured Resources and Services

I. NEED FOR THE PROJECT

A. Statement of Problem

Harlequin duck (*Histrionicus histrionicus*) populations in Prince William Sound (PWS) have not fully recovered from the effects of 1989 *Exxon Valdez* Oil Spill (EVOS Trustee Council 2002, Integral Consulting Inc. 2006). The outlook for full recovery for harlequin ducks is improving (Rosenberg et al. 2006, Integral Consulting Inc. 2006). However, bioavailable oil remains in the intertidal (Short et al. 2004, Short et al. 2005) and ducks residing in intertidal habitats are still being exposed to this lingering oil (Ballachey et al. 2006). The lack of a population increase (Rosenberg et al. 2005, Sullivan et al. 2005) and the lower proportions of females in oiled areas (Rosenberg et al. 2005) coupled with chronic exposure (Ballachey et al. 2006) and lower female survival through 1998 (Esler et al. 2000) suggest that oil exposure and population dynamics are linked and provide strong evidence that harlequin ducks have not fully recovered from the effects of the spill.

The current status of harlequin duck populations in oiled areas of PWS is a result of the initial impacts from the spill, continued exposure to lingering oil, and other environmental stressors. Harlequin ducks occur year-round in intertidal zones of PWS (Isleib and Kessel 1973). At least 1,298 harlequin ducks (approximately 7% of the wintering population in PWS but a much higher percentage of ducks within oiled areas) were estimated to have died as a direct result of oil exposure following the *Exxon Valdez* oil spill (J. Piatt pers. comm.). Much of the *Exxon Valdez* oil was deposited in nearshore habitats where harlequin ducks reside (Galt et al 1991). The persistence of this oil (Short et al. 2004) created the potential for long-term chronic effects from continued exposure which was additive to the initial acute mortality that occurred immediately after the spill (Trust et al. 2000, Peterson 2001, Esler et al. 2002, Rosenberg et al. 2005, Ballachey et al. 2006).

Population recovery for harlequin ducks has taken much longer than anticipated at the time of the spill. Harlequin ducks are relatively long-lived birds with delayed sexual maturity and low rates of annual recruitment and dispersal. Long-term population stability depends on high adult survival coupled with a few years of successful reproduction. Population levels may change slowly. In addition, harlequin ducks are highly philopatric to breeding, molting, and wintering sites (Robertson and Goudie 1999, Robertson et al. 2000). This is an adaptive strategy in natural situations and predictable environments. It is not favorable in the face of dramatic environmental perturbations and does not favor rapid recovery or colonization of new sites. Initial high losses of adults, especially females, coupled with many years of chronic oil exposure

may result in a long recovery period. Once oil exposure abates full recovery may still take many years.

Population monitoring provides the most direct approach to assess recovery because it measures changes in abundance. This survey (the only survey specifically focused on harlequin ducks), compares sex ratios, annual recruitment, and population growth rates between oiled and unoiled areas, providing a comprehensive assessment of demographic changes. Assessing recovery for harlequin ducks is complicated by a lack of pre-spill data and temporal variation (seasonal and annual) in abundance. Continuity of post-spill surveys is important to reduce variability and improve our ability to detect smaller levels of population change between oiled and unoiled areas. This will facilitate detecting recovery in a timely manner. With time, it becomes increasingly difficult to separate continued oil effects form natural or anthropogenic factors that may affect population structure or growth rates.

To date, these surveys have been conducted sporadically. Consistent annual surveys will improve demographic estimates and reduce the potential for other large scale natural or anthropogenic influences affecting populations and compounding the difficulties in measuring recovery. This is especially important as we near recovery objectives. As exposure rates decrease for harlequin ducks (Bodkin et al. 2003), we should see recovery manifested in an increase in abundance of ducks in oiled areas (Ballachey et al. 2006).

In 2007 we added a survey component that compares 1972-1973 PWS survey data (the only winter pre-spill data for harlequin ducks in PWS) with current data for the same transects. This component was added to help us estimate whether some oiled areas did not support high densities of ducks historically or recovery is being suppressed by lingering oil. The sooner we collect additional data we can compare changes in these oiled and unoiled sites over time. This will give us additional information to assess recovery.

B. Relevance to 1994 Restoration Plan Goals and Scientific Priorities

The demographic parameters we are measuring are consistent with EVOS Trustee Council recovery objectives. This study directly assesses the recovery status of harlequin ducks in PWS and is directly linked to the recovery goals, objectives and restoration strategy for harlequin ducks in the EVOS Restoration Plan including estimates of population sizes and trajectories in the spill area and comparisons of population estimates in oiled and unoiled areas of PWS (*Exxon Valdez* Oil Spill Trustee Council 2002). Additionally, continued demographic monitoring of harlequin ducks was recommended by Integral Consulting Inc. (2006).

Two main hypotheses have been presented to explain lack of full recovery: (1) ingested oil or contaminated prey is continuing to cause higher mortality rates and/or (2) initial mortality caused significant losses to the western PWS population, which may result in a protracted recovery period. This project will help assess the recovery rate and identify constraints to recovery of harlequin ducks by providing winter population trends, comparing population structure, and providing an index of recruitment between oiled and unoiled areas. It will also provide insight into geographic differences within PWS. In the short-term it will help us understand the effects of exposure to

lingering oil and in the long-term help identify mechanisms of population change in the nearshore environment.

Information from this project will incorporated into a population model that will improve our ability to predict rates of population change and estimate the time period necessary for full recovery (EVOS Project 070816, Evaluating Harlequin Duck Population Recovery: CYP1A Monitoring and a Demographic Population Model). There are no precedents for recovery from oil spills for harlequin ducks. Harlequin duck populations have relatively low intrinsic growth rates (Goudie et al. 1994) so full recovery from initial and chronic mortality may be delayed until long after all spill effects have abated (Esler et al. 2002). While some of the demographic information for a model has been collected for PWS populations (Rosenberg and Petrula 1998, Rosenberg et al. 2005, Holland-Bartels et al.1999) and harlequin ducks in North America (Goudie et al. 1994, Robertson and Goudie 1999), long-term data on natural variation, productivity, recruitment, dispersal, and immature survival are still lacking.

Long-term data sets are needed for predictive modeling of ecological change. Harlequin ducks occur year-round in the nearshore environment, feed on benthic invertebrates, exhibit site-fidelity, are relatively long-lived, and are widely dispersed in the Gulf of Alaska. They are the only benthic feeding avian species present in abundance year-round in PWS. These characteristics make them unique among nearshore avian predators and ideal candidates for monitoring ecosystem change.

In addition to establishing population recovery from the EVOS, identifying and establishing mechanisms of population change depends on an historical knowledge of the status of the resource prior to environmental perturbations and an understanding of the inter-annual variability among years in periods of relatively little perturbations in the larger physical system. Thus, our ability to detect departures from natural variation is necessary if we are to accurately evaluate the effects of major environmental perturbations whether natural or human-caused. This requires numerous samples, distributed through space and time. We are focusing on relatively long-lived avian predators that tend to show less natural variability. With time-series data on harlequin duck abundance and distribution in concert with abiotic and biotic ecosystem changes we will improve our ability to interpret the affects of natural or man-induced processes and understand the mechanisms of population change.

Results of this work will have a direct bearing on assessing the status and outlook for this resource and help guide agency programs and policies related to public uses, including subsistence and recreational hunting, land-use practices, and wildlife viewing.

II. PROJECT DESIGN

This study will assess the recovery status of harlequin ducks in oiled areas of PWS by comparing changes in abundance (densities) and structure (sex and age ratios) between oiled and unoiled areas (treatments) since 1997. Age ratios serve as a measure of recruitment.

A. Objectives

1. Compare population structure (immature males, adult males, and females) between treatments (oiled and unoiled survey areas) from 1997 to present.

2. Compare annual changes in density between oiled and unoiled treatments from 1997 to present.

3. Compare annual changes in density and population structure *within* oiled and unoiled treatments.

4. Compare changes in densities of harlequin ducks between winters of 1972 and 1973 with winter 2007 and 2008 surveys for both oiled and unoiled areas.

5. Add to our knowledge of harlequin duck life history and provide long-term data set for population modeling.

6. Monitor numbers of Barrow's and common goldeneyes, surf, white-winged, and black scoters, red-breasted and common mergansers, and loons within the study area.

7. Integrate data with other long-term monitoring surveys to detect long-term changes in marine ecosystems

This study will test the following hypotheses:

1. Objective 1.
   H_o: The ratio of males to females; total ducks to subadult males; and breeding pairs to total ducks is the same for oiled and unoiled populations during March.

   $H_{1:}$ The ratio of males to females; total ducks to immature males; and breeding pairs to total ducks is different for oiled and unoiled populations during March.

2. Objective 2.
   Ho: The rate and direction of population change between years is the same for oiled and unoiled survey sites.

   $H_{1:}$ The rate and direction of population change between years is different for oiled and unoiled survey sites.

3. Objective 3.
   H_o: The rate and direction of population change between years is the same within oiled and unoiled survey sites.

   H_1: The rate and direction of population change between years is different within oiled and unoiled survey sites.

4. Objective 4.
To compare the potential disparity of harlequin duck densities between oiled and unoiled regions over time (1972-1973 data with our data) we will examine the ratio of average density in the following hypothesis:

H_o: No difference in density ratio exists between historical counts and contemporary resampling on the same transects.

$$\frac{\text{density}_{\text{oiled}}}{\text{density}_{\text{unoiled}}}$$

H_1: There is a difference in the density ratio between historical counts and contemporary resampling on the same transects.

5. Objective 5. No hypothesis is being tested.

6. Objective 6. No hypothesis is being tested at this time.

7. Objective 7. No hypothesis is being tested at this time.

B. Procedural and Scientific Methods

We propose to continue winter boat surveys in order to compare population trends and structure with data from seven surveys conducted from 1997–2007. We will survey oiled and unoiled areas identified in project 427 (Rosenberg and Petrula 1998) plus the additional oiled and unoiled areas added by project 407 (Rosenberg et al. 2005) and project 0759 (historical comparisons with 1972-1973 surveys – see below). This will increase statistical power to detect recovery, improve our ability to assess changes in the marine ecosystem, and quantify geographic variation within PWS. Surveys will be conducted in late-winter and follow procedures and methods in Rosenberg et al. 2005. For harlequin ducks, observations will be recorded by sex and males will be divided into two age groups using predetermined criteria (Rosenberg and Petrula 1998).

To compare the potential disparity of harlequin duck densities between oiled and unoiled regions over time we will examine the ratio of average density between historical counts conducted in March of 1972 and 1973 (Dwyer et al. 1976, reanalyzed by Klosewski and Laing 1994) and contemporary resampling of the same transects. Although the recovery goals and objectives for harlequin ducks include a return to conditions had the spill not occurred and a return to prespill population demographics (Exxon Valdez Oil Spill Trustee Council 2002), little historical demographic data exists for comparison. Surveys conducted in 1972 and 1973 are the only prespill winter data available on population abundance. In the first few years after the spill, population estimates for harlequin ducks in oiled areas were less than expected when compared with pre- to postspill trends for unoiled areas (Klosewski and Laing 1994). Similar comparisons have not been conducted since 1991 but Sullivan et al. (2005) suggests that harlequin duck populations in oiled areas have remained stable since the spill.

C. Data Analysis and Statistical Methods

Population composition and annual changes in density will be compared to test whether harlequin duck populations in oiled and unoiled areas are exhibiting similar growth trends or the oiled (injured) population is exhibiting a different direction or rate of change (see Rosenberg et al. 2005). We will continue to test whether low reproductive success in oiled areas has resulted in changes in population age and sex structure. The proportion of first-year males to total males will be used as a measure of past reproductive success. Surveys will be used to detect changes in abundance and compare the direction and rate of change between years for the four survey areas and two treatments. Data from winter surveys in 1997, 2000–2002, 2004–5, and 2007 will be incorporated into the analysis.

Survey Coverage

Shoreline length (km) of transects will be calculated from the Alaska Department of Natural Resources PWS_ESI ARC/INFO GIS database. Shoreline length of small islands not included in the PWS_ESI ARC/INFO GIS database was calculated using the U.S. Forest Service CNFSHORE ARC/INFO GIS database. Shoreline length (km) of transects from the 1972-1973 surveys were provided by the USFWS.

Sex and Age Structure

We use a generalized logit model (natural logarithm of ratios) (Agresti 1990) to test for annual differences among study areas (WPWS, SWPWS, EPWS, MONT) and between treatment (oiled) and reference (unoiled) areas for the following sex and age ratios: (1) males to females; (2) adult males to immature males and 3) adult females to immatures (both sexes) (Rosenberg et al. 2005). Model fit was assessed using AIC and a backward elimination process. At each step a reduced model was used to test for significant year, area, or treatment effect (Agresti 1990). Such a criterion allows for optimal fitting of the data without over-parameterizing the model. The SAS model used the GLIMMIX Procedure with a binomial distribution and a logit link function. The full model is presented in Rosenberg et al. (2005).

Proc GLIMMIX also allowed us to create a more complex covariance structure that accounted for the correlation found in measuring the same transects over multiple years. This reduces the occurrence of Type I errors since the variance is more appropriately modeled and not underestimated.

Trend Analysis

Transect observations were modeled as Poisson counts weighted by the length of the transect. We standardized all counts of birds to linear densities (birds/km of shoreline surveyed) to facilitate comparisons in change in densities among regions and between treatments. Proc GLIMMIX was used, this time using a Poisson distribution with a log link function. The full model and statistical analysis is presented in Rosenberg et al. (2005).

Because the sampling scheme was not appropriate for comparing overall measures of abundance among regions we modeled the two treatments separately, including estimating difference variance components for each treatment. As in the ratio analyses, proc GLIMMIX also allowed us to account for the correlation found in measuring the same transects over multiple years. Using this model eliminates the need for a power analysis because we are directly modeling a slope instead of evaluating a sample of slopes from each transect as was previously done (Rosenberg and Petrula 1998).

Historical Comparisons

We will partition the historical transects surveyed by Dwyer et al. (1976) by treatment (oiled or unoiled). Within treatments, transects will be stratified according to harlequin duck habitat quality and oiling history. All transects within the oiled treatment that contained harlequin ducks in 1972 and 1973 and were lightly to heavily oiled by the spill (Alaska Department of Environmental Conservation) will be resurveyed and transects from the unoiled regions will be randomly selected while keeping the proportion of transects within each strata similar to transects in the oiled region. In 2007 we surveyed approximately 20 transects per treatment. These will be resurveyed in 2008. Some of these transects are subsets of our existing survey and do not require additional survey effort.

D. Description of Study Area

The proposed project will be conducted in the oil spill area of western and southwestern Prince William Sound and unoiled eastern PWS between Valdez and Cordova, western Montague Island and northern PWS from Valdez Arm to Passage Canal.

March surveys will repeat transects surveyed in /407 Harlequin Duck Recovery Monitoring (Rosenberg et al. 2006). Transects in the spill area will be located on Knight Island, Applegate Island, Culross Island, Foul Bay, Falls Bay, Crafton Island, Chenega Island, Green Island, Naked Island, and Bainbridge, Evans, Danger and Latouche islands. Surveys in unoiled areas will include portions of Hinchinbrook Island, Simpson Bay, Sheep Bay, Port Gravina, Landlocked Bay, Bligh and Busby islands, Galena Bay and Valdez Arm, and Montague Island. Additional transects necessary for historical comparisons were selected from areas throughout PWS.

E. Coordination and Collaboration with Other Efforts

The results of this have and will compliment several ongoing and proposed *Exxon Valdez* Oil spill Trustee council projects including the following: 1) Quantifying Temporal Variation in Harlequin Duck Exposure to Exxon Valdez Oil, Dan Esler, Project 0777; 2) Oil Exposure in Nearshore Vertebrate Predators, Brenda Ballachey, project 0774; 3) Lingering Oil and Predators: Pathways of Exposure and Population Status, Stanley Rice, project /0620; 4) Surveys to Monitor Marine Bird Abundance in PWS, project 0751, David Irons; and 5) Evaluating Harlequin Duck Population Recovery, project 0816, Dan Esler.

This work was also heavily utilized by Integral Consulting, Inc., for Assessment of Lingering Oil and Resource Injuries from the *Exxon Valdez* Oil Spill, project 0776 and Information Synthesis

and Recovery Recommendations for Resources and Services Injured by EVOS, project 0783 and information will be incorporated in any future synthesis efforts.

ADF&G personnel will conduct all data collection and analysis. Winter surveys and contracts for vessel support for winter surveys will be coordinated with related EVOS projects.

This project will be integrated with ongoing studies and findings of past studies including project 407 Harlequin Duck Population Dynamics: Measuring Recovery from the Exxon Valdez Oil Spill. Information exchange has been ongoing with several marine bird and mammal studies.

III. SCHEDULE

A. Project Milestones

Objective 1. Compare population structure (number of breeding pairs, immature males, adult males, and females) between treatments (oiled and unoiled survey areas). To be met by April 2008.

Objective 2. Compare annual changes in density between oiled and unoiled treatments from 1997 to present. To be met by April 2008.

Objective 3. Compare annual changes in density and population structure *within* oiled and unoiled treatments. To be met by April 2008.

Objective 4. Compare changes in densities of harlequin ducks between winters of 1972 and 1973 with winter 2008 surveys for both oiled and unoiled areas. To be met by April 2008.

Objective 5. Add to our knowledge of harlequin duck life history and provide long-term data set for population modeling. To be met by October 2008 (report) and provide Population Modeler with data as needed.

Objective 6. Monitor population change in Barrow's and common goldeneyes, surf, white-winged, and black scoters, red-breasted and common mergansers, and loons. To be met by March 2008.

Objective 7. Integrate data with other long-term monitoring surveys to detect long-term changes in marine ecosystems. To be met by October 2008 (report).

This is proposed as a possible multi-year monitoring program designed to assess the recovery of an injured species. Each project objective will be assessed annually for oiled and unoiled areas then compared with each other and with data collected in subsequent years.

B. Measurable Project Tasks

FY 08, 1st quarter (October 1, 2007-December 31, 2007)

Project funding approved by Trustee Council.
Interagency coordination. Plan logistics and personnel for winter surveys. Contract for vessel support.

FY 08, 2nd quarter (January 1, 2008-March 31, 2008)

Annual Marine Science Symposium.
Hire seasonal technicians. Prepare field equipment. Finalize field logistics. Conduct winter surveys in PWS.

FY 08, 3rd quarter (April 1, 2008-June 30, 2008)

Create databases, GIS. Begin analysis of field data and report preparation. Maintain equipment.

FY 08, 4th quarter (July 1, 2008-September 30, 2008)

Finish analyses and final report/manuscripts submitted to Trustee Council Office.

V. RESPONSIVENESS TO KEY TRUSTEE COUNCIL STRATEGIES

A. Community Involvement and Traditional Ecological Knowledge (TEK)

A Traditional Ecological Knowledge report was prepared as part of EVOS Restoration Project 427 Harlequin Duck Recovery Monitoring (Rosenberg and Petrula 1998). Results of this project have been presented in Tatitlek and Chenega Bay. As we have done in the past we will coordinate when appropriate with the villages of Tatitlek, Chenega Bay, Cordova, Valdez, and Whittier on our activities and possibilities for community involvement. No funds are being requested for local hire or community involvement. We will solicit bids for contract work from local communities.

B. Resource Management Applications

The Alaska Department of Fish and Game, has a statutory mandate to manage and protect wildlife and their habitats on state and private lands for the benefit of Alaskans. Migratory bird management requires good scientific information to detect population change, prevent habitat degradation, and manage public uses of migratory birds and their habitats. Numbers of several sea duck species are declining throughout much or all of their range including Alaskan breeding populations (Goudie et al 1994, Hodges 1996). The ADF&G Statewide Waterfowl Program is responsible for adopting migratory bird hunting regulations (sport and subsistence) within the Pacific Flyway under the federal framework, and commenting on permits for mariculture and wetland, development within the nearshore environment, adjacent commercial and recreational activities, and oil spill contingency plans. This study will provide ADF&G with information to improve its management capabilities. Contact Tom Rothe or Dan Rosenberg, ADF&G.

V. PUBLICATIONS AND REPORTS

A final report will be presented by October 2008. Publications will be prepared for peer-review journals in lieu of final report when possible and will depend upon the duration of the project.

VI. LITERATURE CITED

Agresti, A. 1990. Categorical Data Analysis. John Wiley & Sons. NY 557 pp.

Ballachey, B.E., J.L. Bodkin, and D. Irons. 2006. Oil exposure biomarkers and population trends of Prince William Sound marine vertebrates (Restoration Project //0774). Draft Final Rept. U.S. Geological Survey, Alaska Science Center, Anchorage, Alaska.

Bodkin, J.L., B.E. Ballachey, D. Esler, and T. Dean. 2003. Patterns and processes of population change in selected nearshore vertebrate predators, Exxon Valdez Oil Spill Restoration Project Final Report (Restoration Project 030423), US Geological Survey, Alaska Science Center, Anchorage, Alaska.

Dwyer, T.J., M.E. Isleib, and J. L. Haddock. 1976. Marine bird populations in Prince William Sound, Alaska. Unpubl. Rep. U.S. Fish and Wildl. Serv., Anchorage. 21pp.

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(3):839-847.

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.

Exxon Valdez Oil Spill Trustee Council. 2002. *Exxon Valdez* Oil Spill Restoration Plan. Update on Injured Resources & Services. August 2002. Anchorage. 29pp.

Galt, J. A., W. J. Lehr, and D. L. Payton. 1991. Fate and transport of the Exxon Valdez oil spill. Environmental Science and Technology 25: 202–209.

Goudie, R. I., S. Breault, B. Conant, A. V. Kondratyev, M. R. Petersen, and K. Vermeer. 1994. The status of sea ducks in the North Pacific rim: toward their conservation and management. Trans. 59th N. Amer. Wildl. Natur. Resour. Conf.:27-49.

Hodges, J.I., King J.G., Conant, B., Hanson, H.A. 1996. Aerial surveys of waterbirds in Alaska 1957-94: Population trends and observer variability. Information and Technology Report 4. USDI, Nat'l Biological Service U.S. Fish and Wildlife Service.

Holland-Bartels, L. 1999. Mechanisms of impact and potential recovery of nearshore vertebrate predators. *Exxon Valdez* Oil Spill Restoration Project Draft Final Report (Restoration Project 98025), Alaska Biological Science Center, Anchorage, Alaska.

Integral Consulting Inc. 2006. Information synthesis and recovery recommendations for resources and services injured by the Exxon Valdez oil spill, Exxon Valdez Oil Spill Restoration Project Final Report (Restoration Project 060783), Integral Consulting Inc., Mercer Island, Washington.

Isleib, M.E. and B. Kessel. 1973. Birds of the North Gulf Coast and Prince William Sound, Alaska. Biol. Pap. Univ. Alaska No. 14. 149 pp.

Klosiewski, S. P., and K. K. Laing. 1994. Marine bird populations of Prince William Sound, Alaska, before and after the *Exxon Valdez* oil spill. EVOS Bird Study No. 2. U.S. Fish and Wildl. Serv., Anchorage. 85pp.

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

Robertson, G.J., and R.I. Goudie. 1999. Harlequin Duck (*Histrionicus histrionicus*). *In* The Birds of North America, No. 466. A. Poole and F. Gill, eds. The Birds of North America, Inc., Philadelphia, PA.

Robertson, G.J., F. Cooke, R.I. Goudie, and Sean Boyd. 2000. Spacing patterns, mating systems, and winter philopatry in harlequin ducks. The Auk 117(2):299-307.

Rosenberg, D.H. and M.J. Petrula. 1998. Status of Harlequin Duck Populations in Prince William Sound, Alaska., after the *Exxon Valdez* Oil Spill, 1995-1997. *Exxon Valdez* Oil Spill Restoration Project Final Report (Restoration Project 97427), Alaska Department of Fish and Game, Division of Wildlife Conservation, Anchorage, Alaska.

Rosenberg, D. H., M. J. Petrula, D. D. Hill, and A. M. Christ. 2005. Harlequin duck population dynamics: measuring recovery from the *Exxon Valdez* oil spill. *Exxon Valdez* Oil Spill Restoration Project Final Report (Restoration Project 407). Alaska Department of Fish and Game, Division of Wildlife Conservation, Anchorage, Alaska.

Short, J.W, M.R. Lindeberg, P.M. Harris, J.M. Maselko, J.J. Pella, and S.D. Rice. 2004. Estimate of oil persisting on the beaches of Prince William Sound 12 years after the Exxon Valdez oil spill. Environmental Science and Technology, vol 38, no. 1, pp 19-25.

Short, J.W., M. Lindeberg, S.D. Rice, C. Sloan, P. Hodson, C. Khan, and K. Springman. 2005. Lingering EVOS remains the dominant source of CYP1A inducers in PWS. Abstract. Society for Environmental Toxicology and Chemistry. 26th Annual Meeting. Baltimore, MD.

Sullivan, K.M., A.E. McKnight, D.B. Irons, S.W. Stephensen, and S. Howlin. 2005. Marine bird and sea otter population abundance of Prince William Sound, Alaska: trends following the T/V *Exxon Valdez* oil spill, 1989-2004. *Exxon Valdez* Oil Spill Restoration Project Annual Report (Restoration Project 04159), U. S. Fish and Wildlife Service, Anchorage, Alaska.

Trust, K.A., Esler, D., Woodin, B.R. and Stegeman, J.J. 2000. Cytochrome P450 1A induction in sea ducks inhabiting nearshore areas of Prince William Sound, Alaska. Marine Pollution Bulletin 40(5):397-403.

Harlequin Duck Population Dynamics in Prince William Sound: Measuring Recovery

Budget Justification FY08

FY08: Total Request $105.8 (not incl. Gen. Admin).

Personnel Costs: Amount Requested $61.4

This increase of $20.3K from 2007 reflects the contribution to salaries provided by the ADF&G Waterfowl Program in 2007 to cover project planning, some mobilization and demobilization costs, survey time, and report preparation and writing, and attendance at conferences and meetings. All of these cannot be covered in 2008. In 2008 the state will continue to provide up to 2 months salary for the Principal Investigator and 0.5 months for a WBI. To survey the proposed study area requires a window of 21 days using at minimum 4 observers. This requires two new hires. At minimum, one of these employees is necessary for mobilization, demobilization, and data entry. While conducting surveys at sea, state labor contracts require supplemental sea duty and hazard pay (reflected in overtime). In addition negotiated contracts have increased salary costs by 4-7% in 2008. Our payroll is also charged a leave/holiday allocation that amounted to 16% of salaries in 2007.

Travel Costs: Amount Requested $0.6

Travel costs are minimal. We need to get personnel, boats, and equipment to Whittier and leave vehicles and boat trailers in Whittier. Because of the duration of the project we will split the survey into 2 periods, returning to Anchorage in the interim. Although the Whittier tunnel is a state facility, the state agencies are charged a toll for trucks and boat trailers and the City of Whittier charges for parking, boat launching, and boat mooring.

Contractual Costs: Amount Requested $37.6

The majority of this is for vessel support during the survey. Short daylight and winter weather preclude the efficient and safe use of a field camp. Therefore it is necessary to charter a larger vessel to provide housing and tow skiffs when necessary in inclement weather to make travel safer and more efficient. Costs are based on past bids that vary from year to year and the number of days it takes to complete the survey. Now that we surveyed new transects in 2007 we found it necessary to add an additional charter day for 2008. Weather delays also are factored in to the estimates. Fuel costs and inflation have increased charter costs and due to the uncertainty of charter boat availability costs may vary greatly for similar vessels at certain times of year.

In 2007 we spent over $7.0K in boat maintenance not charged to EVOS Trustee Council. Equipment is depreciating and outboard motors are now 10 years old. One skiff was purchased in 1989 at the time of the spill. We have never had to postpone or delay

surveys due to mechanical problems. Boat and motor maintenance is necessary for safe and efficient operation. Honda recommends a complete tune-up every 200 hours (about the amount we put on each motor during a survey). The minimum cost is $250 per motor – we have three motors. Shop labor is at minimum $90/hour.

One of our boats and motors is provided in-kind by ADF&G.

Air Charter costs are based on floatplane access (206) from either Anchorage or Cordova depending upon the location and situation. This includes changes in field crew if needed, emergency evacuation, and emergency delivery of boat parts or survey equipment.

Commodities Costs: Amount Requested $3.6

The biggest costs are for boat fuel, purchased in Whittier and boat parts. Boat fuel is based on the amount used in 2007 surveys for 2 skiffs operating for over 200 hours each in a 21-day period. Fuel costs are estimated a year in advance. Many parts need to be replaced annually and/or require spare parts in case of failure during the field season. It would be costly and inefficient to return to town in the middle of a survey to buy parts so we need to be prepared. Part costs have increased. Safety is also a factor. Harlequin duck surveys are conducted in rocky nearshore areas and prop damage is not uncommon. Boat propellers alone cost over $100 each and we require a minimum of 5 extra propellers.

Equipment Costs: Amount Requested $2.4

All observations are recorded by GPS and GPS navigation is essential for safe and efficient operation during our surveys. We are requesting money for weatherproof GPS Chartplotters (for use in open skiffs) with programmed nautical charts to record locations of all observations and track our routes on transect. In our 8th year of surveys, this is the first equipment we have requested from the EVOS Trustee Council since 1997. Our current GPS units have depreciated with use and the screens are difficult to observe. They will serve as backups to new units. Newer units can interface with field computers for automating data recording.

Why costs not being fully covered by ADF&G.

The Alaska Department of Fish and Game, has a statutory mandate to manage and protect wildlife and their habitats on state and private lands for the benefit of Alaskans. The ADF&G Statewide Waterfowl Program has very limited funds to fulfill the obligations of this mandate and funds will not be increased in 2008. Limited staffing and funding precludes ADF&G from undertaking these surveys as part of normal operations and in the past ADF&G has not conducted marine bird surveys in PWS as part of its normal waterfowl management functions nor responded to oil spills.

ADF&G is offering to partner to study the effects of lingering oil from the EVOS by providing in-kind contributions of s boats, vehicles, office equipment and supplies, and filed sampling equipment. In addition ADF&G is covering some salary costs.

2007 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2007 - September 30, 2008

Budget Category:	Authorized FY 2007	Proposed FY 2008
Personnel	$41.1	$61.4
Travel	$0.4	$0.6
Contractual	$35.3	$37.6
Commodities	$2.7	$3.6
Equipment	$0.0	$2.4
Subtotal	$79.5	$105.6
General Administration	$7.2	$11.8
Project Total	$88.1	$117.4
Full-time Equivalents (FTE)	0.4	0.5

LONG RANGE FUNDING REQUIREMENTS					
Estimated FY 2009					
$120.0					

Dollar amounts are shown in thousands of dollars.

Other Resources			$24.1					

Comments:

Reformatted the spreadsheet so that headers are at the bottom of each page. Corrected the G&A for FY 07 authorized. Budget Justification and Proposal Summary page are accurate.

Personnel costs increased in 2008 because in 2007 Fish and Game (waterfowl program) provided salary for PI (2 mo.) and WBII (0.5 mo.) and WB 1 (1.0 mo.). The waterfowl program cannot contribute the same level of funding in 2008.

Addiitonal costs in 2008 are based on actual expenditures in 2007 plus allowances for inflation with the exception of equipment requests which are new for 2008. The waterfowl program budget contributed to contractual and commodity expenses in 2007 which lowered Trustee Council costs but these cannot be funded by the waterfowl program in 2008. This is the first equipment we have requested from the Trustee Council since 1997.

FY08

Prepared: 26 July 2007

Project Number: 080759
Project Title: Harlequin Duck Population Dynamics in PWS
Agency: Alaska Department of Fish and Game

2007 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 2007 - September 30, 2008

Personnel Costs:		GS/Range/ Step	Months Budgeted	Monthly Costs	Overtime	
Name	Position Description					
D. Rosenberg	WBIII, Principal Investigator	18L	1.0	9.4	4.8	
Mike Petrula	WBII, survey and data analysis	16 J	1.0	7.5	5.0	
Doug Hill	WB1	14F	2.3	6.4	4.0	
Fish and Game Tech III	Wildlife Tech III	11G	0.8	5.9	2.7	
Aaron Christ	Biometrician	20D	1.0	8.6	0.0	
	Subtotal		6.1	37.8	16.5	
					Personnel Total	

Travel Costs:	Ticket Price	Round Trips	Total Days	Daily Per Diem	
Description					
Whittier parking, 2 vehicles- 21 days					
Whittier Toll - 2 vehicles and trailers		4			
				Travel Total	

FY08

Project Number: 080759
Project Title: Harlequin Duck Population Dynamics in PWS
Agency: Alaska Department of Fish and Game

2007 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 2007 - September 30, 2008

Contractual Costs:	
Description	
Boat and outboard motor repair and maintenance Air charter for field support 4 hrs @ $400/hr Launch fee, Trailer and boat moorage Whittier Vessel support for March surveys 21 days @1500/day	
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	
Commodities Costs:	
Description	
Boat fuel 530 gallons @ $3.50/gal Boat supplies- replacement parts, props, fuel lines, fuel filters, water filters, battery, absorbent rags, oil, emergency provisions Field survey supplies- rite-in-rain notebooks/paper, nautical charts, batteries,	
Commodities Total	

FY08

Project Number: 080759
Project Title: Harlequin Duck Population Dynamics in PWS
Agency: Alaska Department of Fish and Game

Prepared: 26 July 2007

2007 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2007 - September 30, 2008

New Equipment Purchases:		Number of Units	Unit Price	
Description				
2	GPS Chartplotters	2	1.2	
Those purchases associated with replacement equipment should be indicated by placement of an R.			**New Equipment Total**	

Existing Equipment Usage:	Number of Units	
Description		
19 ft.rigid hull inflatable	1	
17 ft. Boston Whaler	1	
10x40 binoculars	4	
Image Stabilized binoculars	2	
Spotting Scopes	2	
Survival Suits	4	
Outboard Motors/various hp	5	
GPS	2	
Marine VHF radios	4	
Trucks	2	
Personal locator beacons	2	
Exposure Suits	4	

FY08

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