

**FY12 INVITATION
PROPOSAL SUMMARY PAGE**

Project Title: Long-term Monitoring: Lingering Oil - Evaluating Chronic Exposure of Harlequin Ducks and Sea Otters to Lingering *Exxon Valdez* Oil in Western Prince William Sound

Project Period: October 1, 2011 – March 31, 2013

Primary Investigator(s): Brenda Ballachey, US Geological Survey; Daniel Esler, Simon Fraser University and Pacific Wildlife Foundation

Co-Investigators: James Bodkin, Liz Bowen, Keith Miles, US Geological Survey.

Study Location: Prince William Sound, Alaska

Abstract: This project is a component of the integrated Long-term Monitoring of Marine Conditions and Injured Resources and Services submitted by McCammon et al. in spring 2011. Sea otter and sea duck populations in PWS were injured as a result of the *Exxon Valdez* oil spill, with evidence for both immediate acute mortality and longer term injury from chronic exposure to oil spilled in 1989. For both species, it appears that full recovery is not yet complete. Prior EVOSTC projects have examined continuing exposure to lingering oil as a factor constraining recovery, using biomarker assays (the cytochrome P4501A biomarker, CYP1A, to evaluate oil exposure in harlequins, and gene expression assays to evaluate exposure and health of sea otters). Harlequin ducks have continued to show elevation of CYP1A in oiled areas through 2009, suggesting exposure is still a concern; harlequin populations were resampled in spring 2011 and results of CYP1A assays on those samples are pending. For sea otters, recent studies have shown that abundance in the vicinity of northern Knight Island has not yet returned to pre-spill levels, and that otters are foraging in areas where lingering oil persists in sediments. Most recently, gene expression assays have been developed, using an array of genes to specifically quantify oil exposure and health status of sea otters. We propose to resample harlequin and sea otter populations in western PWS in 2012 to assess biomarker levels, as a continued effort to measure exposure of these nearshore residents to lingering oil and monitor the status of their recovery as injured species, and as indicators of recovery of the overall nearshore ecosystem.

Estimated Budget:

EVOSTC Funding Requested: 2012: \$204.2;

(breakdown by fiscal year and must include 9% GA)

Non-EVOSTC Funds to be used: 2012: \$70.0; *(breakdown by fiscal year)*

Date: May 31, 2011

(NOT TO EXCEED ONE PAGE)

PROJECT PLAN

I. NEED FOR THE PROJECT

A. Statement of Problem

Sea otter and sea duck populations in western PWS were injured as a result of the *Exxon Valdez* oil spill, with evidence for both immediate acute mortality and longer term injury from chronic exposure to oil spilled in 1989. A series of EVOSTC projects have addressed population demographic endpoints including abundance, habitat use, and survival rates, as well as biological sampling to monitor ongoing exposure to lingering EVO using biomarker assays (the cytochrome P4501A biomarker to evaluate oil exposure in harlequins and gene expression assays to evaluate exposure and health of sea otters).

For both sea otters and harlequin ducks, the most recent data suggest recovery is not yet complete. As part of EVOSTC Restoration Project 070808 (Nearshore Synthesis: Sea otters and sea ducks), harlequin ducks were examined for lingering exposure to residual *Exxon Valdez* oil. This work determined that harlequin ducks continued to show biomarker evidence of elevation of cytochrome P4501A in oiled areas through 2009, which was interpreted to indicate exposure to *Exxon Valdez* oil up to 20 years after the spill (Esler et al. 2010). For sea otters, recent studies (also part of Restoration Project 070808) have shown that sea otters in the vicinity of northern Knight Island have not yet returned to pre-spill abundance, and that they are foraging in intertidal areas where lingering oil persists in sediments (USGS unpublished data). Most recently, gene expression assays for sea otters have been developed, using an array of genes to specifically quantify oil exposure and health status of sea otters (Restoration Project 090841); that effort is close to final.

B. Relevance to 1994 Restoration Plan Goals and Scientific Priorities

Please see pages 2-4 of the integrated proposal titled “Long-Term Monitoring of Marine Conditions and Injured Resources and Services,” submitted by McCammon et al. in spring 2011.

II. PROJECT DESIGN

A. Objectives

Project Concept

In this study, we propose to resample harlequin ducks and sea otters in PWS for biomarker assays to evaluate recovery status of these species by measuring the degree of continued exposure to lingering oil, health and condition. Harlequin ducks were sampled in March 2011 (EVOS Restoration Project 11100808). If the 2011 results show no significant difference between oiled and unoiled areas in expression of CYP1A, then we request funding to resample harlequins in 2012 to confirm that exposure has ceased. Alternatively, if we see a continued difference between areas in the 2011 sampling, then we request that the next sampling of harlequin ducks be deferred until 2013, to continue the schedule of sampling every 2 years since 2005. Sea otters were last sampled in 2008, and we request funding to resample in 2012.

Objective 1. Harlequin duck sampling in oiled and unoiled areas of PWS, for CYP1A analyses, to evaluate continuing exposure to lingering oil of ducks captured in oiled areas.

Objective 2. Sea otter sampling in oiled and unoiled areas of PWS, for gene expression assay, to evaluate continuing exposure and health of sea otters captured in oiled areas.

B. Procedural and Scientific Methods

Harlequin ducks: Methods will replicate those from previous work (Trust et al. 2000, Esler et al. 2010) to facilitate comparisons. In brief, we will capture harlequin ducks in several areas that were oiled during the *Exxon Valdez* oil spill, including Bay of Isles, Herring Bay, Crafton Island, Lower Passage, and Green Island, as well as at nearby unoiled northwestern Montague Island. In each area, 20 harlequin ducks will have small (< 0.5g) liver biopsies taken while under general anesthesia. Biopsies will be frozen in liquid nitrogen immediately and will be maintained in a frozen state until laboratory analysis at UC Davis by co-PI Keith Miles (and collaborators Jack Henderson and Barry Wilson). CYP1A induction will be determined by measuring hepatic 7-ethoxyresorufin-*O*-deethylase (EROD) activity, which is a catalytic function principally of hydrocarbon-inducible CYP1A enzymes.

Sea otters: Methods will replicate those used in 2008 (EVOSTC Project 090841). Sea otters will be captured in areas that were heavily oiled during the 1989 EVOS (primarily in Bay of Isles, Lower Passage and Herring Bay), and at nearby Montague Island to provide a reference sample from an unoiled area (15 per area). In addition, we will capture otters (n=15) in eastern PWS, to provide a second reference sample. Sea otters will be sedated and blood collected from the jugular vein into Paxgene tubes, and tubes shipped to UC Davis for gene expression assays by co-PIs L. Bowen and K. Miles. A panel of 12 genes will be quantified, including genes identified in ongoing sea otter studies as showing variation across oiled and unoiled areas within PWS, following the methods and data analytical approach currently being developed by Bowen and Miles (USGS unpublished data).

C. Data Analysis and Statistical Methods

For harlequin ducks, data analysis will follow that of Esler et al. (2010) and will evaluate average differences in EROD between oiled and unoiled areas, accounting for any effects of age, sex, or mass. Further, the latest data will be compared with results from previous years to assess whether or not a temporal trend is apparent, which may clarify the process of recovery. For sea otters, data on a panel of 12 genes will be analyzed by multivariate methods currently being developed by Miles and Bowen as part of EVOSTC Project 090841, and being applied to samples collected in 2006 and 2008. The sea otter data collected in 2012 also will be compared with previous years sampling to assess temporal trends that may be present.

D. Description of Study Area

This project will focus on harlequin ducks and sea otters in western PWS. Capture of harlequins will target birds in Bay of Isles, Herring Bay, Crafton Island, Lower Passage, and Green Island (all areas that were oiled in 1989), and at nearby unoiled northwestern Montague Island to provide a reference sample. Sea otters will be caught in areas around northern Knight Island, primarily in Bay of Isles, Lower Passage and Herring Bay, and at nearby Montague Island to

provide an unoiled reference sample. In addition, we will capture otters in eastern PWS, to provide a second reference sample.

E. Coordination and Collaboration with Other Efforts

This project is coordinated with the proposed Long-Term Monitoring study submitted to the EVOSTC in spring 2011 by McCammon et al. A primary goal of the proposed monitoring effort is to evaluate the recovery status of resources in PWS that were injured by the EVOS, and measuring biochemical indices of exposure in harlequin ducks and sea otters, two species recognized to have protracted recovery from the spill, directly supports that goal. This project will continue the biomarker studies that were initiated in 1996 in western PWS, supported by the EVOSTC. Methods used will conform to those from earlier studies (for harlequins, back to 1996; for sea otters, new methodologies were applied in 2006). The project will coordinate with and complement studies concurrently proposed by NOAA ABL to continue tracking oil levels in intertidal sediments.

III. SCHEDULE

A. Project Milestones

Objective 1. Harlequin duck sampling in oiled and unoiled areas of PWS, for CYP1A analyses, to evaluate continuing exposure to lingering oil of ducks captured in oiled areas.

To be met by March 31, 2013, assuming captures go ahead in 2012. Otherwise, if captures are deferred until 2013, to be met by March 31, 2014. Schedule for captures will depend on 2011 results, pending.

Objective 2. Sea otter sampling in oiled and unoiled areas of PWS, for gene expression assay, to evaluate continuing exposure and health of sea otters captured in oiled areas.

To be met by March 31, 2013, assuming captures go ahead in spring 2012 (anticipated schedule).

Measurable Project Tasks

FFY 11, 2nd quarter (January 1, 2011-March 31, 2011)

Project funding approved by Trustee Council

FFY 11, 3rd quarter & 4th quarter (April 1, 2011-September 30, 2011)

Finalize proposals and budgets

FFY 12, 1st quarter (October 1, 2011-December 31, 2011)

Planning for spring captures (harlequins and sea otters)

Potential meeting of LTM PI's, Anchorage

FFY 12, 2nd quarter (January 1, 2012-March 31, 2012)

January: Annual Marine Science Symposium, Anchorage

March: Harlequin duck capture, PWS

FFY 12, 3rd quarter (April 1, 2012-June 30, 2012)

May: Sea otter capture, PWS

Sample analyses, harlequins

FFY 12, 4th quarter (July 1, 2012-September 30, 2012)

Sample analyses, sea otters

Data analysis, harlequins

FFY 13, 1st quarter (October 1, 2012-December 31, 2012)

Complete sample and data analyses, initiate reports

Potential meeting of LTM PI's, Anchorage

FFY 1, 2nd quarter (January 1, 2013-March 31, 2013)

Complete reports, submit to EVOSTC

January: Annual Marine Science Symposium, Anchorage

Note: *the above schedule assumes that captures of harlequins and sea otters will be done in 2012 and not deferred until 2013.*

References:

- Esler, D., K.A. Trust, B.E. Ballachey, S.A. Iverson, T.L. Lewis, D.J. Rizzolo, D.M. Mulcahy, A.K. Miles, B.R. Woodin, J.J. Stegeman, J.D. Henderson, and B.W. Wilson. 2010. Cytochrome P4501A biomarker indication of oil exposure in harlequin ducks up to 20 years after the Exxon Valdez oil spill. *Environmental Toxicology and Chemistry* 29:1138-1145.
- 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.

**EXXON VALDEZ OIL SPILL TRUSTEE COUNCIL
DETAILED BUDGET FORM FY 12-FY16**

Budget Category:	Proposed FY 12	Proposed FY 13	Proposed FY 14	Proposed FY 15	Proposed FY 16	TOTAL PROPOSED
Personnel	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0
Travel	\$10.0	\$0.0	\$0.0	\$0.0	\$0.0	\$10.0
Contractual	\$141.9	\$0.0	\$0.0	\$0.0	\$0.0	\$141.9
Commodities	\$35.5	\$0.0	\$0.0	\$0.0	\$0.0	\$35.5
Equipment	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0
Indirect Costs (<i>will vary by proposer</i>)	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
SUBTOTAL	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
General Administration (9% of subtotal)	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
PROJECT TOTAL	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
Other Resources (Cost Share Funds)		\$0.0	\$0.0	\$0.0	\$0.0	\$0.0

COMMENTS: NOTE!!!! One year of capture/sampling is planned for harlequin ducks (HADU) and one year for sea otters (SEOT). HADU capture year depends on sample analysis currently in progress, so work will be conducted in 2012 OR in 2013. We're adding values to this budget worksheet for only 1 year (2012), but work might end up being conducted in a different year (2013). SEOT capture dates are not anticipated to vary from planned. Cost Share Funds include (a) USGS staff for sea otter capture logistics, capture, sample prep and shipping, and data analysis: approximately 70K; (b) USGS equipment for sea otter captures, and (c) USGS laboratory facilities for EROD and gene expression analyses. Donated funds include the sea otter veterinarian's time (travel and supplies will be covered under this project).

FY12-16

**Program Title: HADU & SEOT Lingering Oil
Team Leader: Esler & Ballachey
Agency: USGS**

SUMMARY

**EXXON VALDEZ OIL SPILL TRUSTEE COUNCIL
DETAILED BUDGET FORM FY 12-FY16**

Budget Category:	Proposed FY 12	Proposed FY 13	Proposed FY 14	Proposed FY 15	Proposed FY 16	TOTAL PROPOSED
Personnel	\$0.0	\$0.0				\$0.0
Travel	\$10.0	\$0.0				\$10.0
Contractual	\$141.9	\$0.0				\$141.9
Commodities	\$35.5	\$0.0				\$35.5
Equipment	\$0.0	\$0.0				\$0.0
SUBTOTAL	\$187.4	\$0.0	\$0.0	\$0.0	\$0.0	\$187.4
General Administration (9% of subtotal)	\$16.9	\$0.0	\$0.0	\$0.0	\$0.0	\$16.9
PROJECT TOTAL	\$204.2	\$0.0	\$0.0	\$0.0	\$0.0	\$204.2
All amounts are in thousands of dollars.						
Other Resources (Cost Share Funds)	\$70.0	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0

COMMENTS: NOTE!!!! One year of capture/sampling is planned for harlequin ducks (HADU) and one year for sea otters (SEOT). HADU capture year depends on sample analysis currently in progress, so work will be conducted in 2012 OR in 2013. We're adding values to this budget worksheet for only 1 year (2012), but work might end up being conducted in a different year (2013). SEOT capture dates are not anticipated to vary from planned. Cost Share Funds include (a) USGS staff for sea otter capture logistics, capture, sample prep and shipping, and data analysis: approximately 70K; (b) USGS equipment for sea otter captures, and (c) USGS laboratory facilities for EROD and gene expression analyses. Donated funds include the sea otter veterinarian's time (travel and supplies will be covered under this project).

FY12-16

Program Title: HADU & SEOT Lingering Oil
Team Leader: Esler & Ballachey
Agency: USGS

**FORM 4A
TRUSTEE AGENCY
SUMMARY**

**EXXON VALDEZ OIL SPILL TRUSTEE COUNCIL
DETAILED BUDGET FORM FY 12-FY16**

Personnel Costs:		Months Budgeted	Monthly Costs	Overtime	Personnel Sum
Name	Project Title				
					0.00
					0.00
					0.00
					0.00
					0.00
					0.00
					0.00
					0.00
					0.00
					0.00
					0.00
					0.00
					0.00
		Subtotal	0.0	0.0	
Personnel Total					0.00

Travel Costs:	Ticket Price	Round Trips	Total Days	Daily Per Diem	Travel Sum
Description					
SEOT: lingering oil: Seattle to Whittier, 2 people	1.0	2	42	0.1	4.10
SEOT: lingering oil: Anchorage to Whittier, 4 people	0.0	4	84	0.0	1.26
SEOT: lingering oil: San Jose to Whittier, 1 person	2.0	1	21	0.1	3.05
SEOT: lingering oil: misc travel costs (GOV fuel, tunnel tickets, parking)					1.60
					0.00
					0.00
					0.00
					0.00
					0.00
					0.00
Travel Total					10.01

FY12

**Program Title: HADU & SEOT Lingering Oil
Team Leader: Esler & Ballachey
Agency: USGS**

**FORM 4B
PERSONNEL & TRAVEL
DETAIL**

**EXXON VALDEZ OIL SPILL TRUSTEE COUNCIL
DETAILED BUDGET FORM FY 12-FY16**

New Equipment Purchases: Description	Number of Units	Unit Price	Equipment Sum
			0.00
			0.00
			0.00
			0.00
			0.00
			0.00
			0.00
			0.00
			0.00
			0.00
			0.00
			0.00
			0.00
			0.00
			0.00
New Equipment Total			0.00

Existing Equipment Usage: Description	Number of Units	Inventory Agency
SEOT: Lingering Oil: 25 ft Boston Whaler for sea otter capture		USGS
SEOT: Lingering Oil: assorted inflatable skiffs for sea otter capture		USGS
SEOT: Lingering Oil: diver rebreather units and/or tangle nets for sea otter capture		USGS
SEOT: Lingering Oil: Questar spotting scopes & binoculars & Garmin GPS units for sea otter capture		USGS
HADU: lingering oil: EROD analytical equipment		USGS

FY12

**Program Title: HADU & SEOT Lingering Oil
Team Leader: Esler & Ballachey
Agency: USGS**

**FORM 4B
EQUIPMENT DETAIL**

**EXXON VALDEZ OIL SPILL TRUSTEE COUNCIL
DETAILED BUDGET FORM FY 12-FY16**

Personnel Costs:		Months Budgeted	Monthly Costs	Overtime	Personnel Sum
Name	Project Title				
					0.00
					0.00
					0.00
					0.00
					0.00
					0.00
					0.00
					0.00
					0.00
					0.00
					0.00
					0.00
		Subtotal	0.0	0.0	
Personnel Total					0.00

Travel Costs:	Ticket Price	Round Trips	Total Days	Daily Per Diem	Travel Sum
Description					
					0.00
					0.00
					0.00
					0.00
					0.00
					0.00
					0.00
					0.00
					0.00
					0.00
					0.00
Travel Total					0.00

FY13

**Program Title: HADU & SEOT Lingering Oil
Team Leader: Esler & Ballachey
Agency: USGS**

**FORM 4B
PERSONNEL & TRAVEL
DETAIL**

**EXXON VALDEZ OIL SPILL TRUSTEE COUNCIL
DETAILED BUDGET FORM FY 12-FY16**

Personnel Costs:		Months Budgeted	Monthly Costs	Overtime	Personnel Sum
Name	Project Title				
					0.00
					0.00
					0.00
					0.00
					0.00
					0.00
					0.00
					0.00
					0.00
					0.00
					0.00
					0.00
		Subtotal	0.0	0.0	
					Personnel Total
					0.00

Travel Costs:	Ticket Price	Round Trips	Total Days	Daily Per Diem	Travel Sum
Description					
					0.00
					0.00
					0.00
					0.00
					0.00
					0.00
					0.00
					0.00
					0.00
					0.00
					0.00
					0.00
					Travel Total
					0.00

FY13

**Program Title: HADU & SEOT Lingering Oil Team
Leader: Esler & Ballachey
Agency: Pacific Wildlife Foundation (Dr. Esler)**

**FORM 4B
PERSONNEL & TRAVEL
DETAIL**

