FY14 INVITATION
PROPOSAL SUMMARY PAGE

Project Title: Long-term Monitoring: Lingering Oil - Evaluating Chronic Exposure of Harlequin Ducks to Lingering *Exxon Valdez* Oil - 12120114-Q

Project Period: October 1, 2011 – September 30, 2016

Primary Investigator(s): Daniel Esler, US Geological Survey
Co-Investigators: Brenda Ballachey, US Geological Survey.

Study Location: Prince William Sound, Alaska

Abstract: This Lingering Oil project is associated with the integrated Long-term Monitoring of Marine Conditions and Injured Resources and Services funded by the EVOSTC. Harlequin 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. A series of EVOSTC projects have examined exposure of harlequin ducks to lingering oil as a factor constraining recovery, using the cytochrome P4501A biomarker, CYP1A. Harlequin ducks showed elevated CYP1A in oiled areas from 1998 through 2011 relative to unoiled areas, which was interpreted to indicate continued exposure to residual oil over that period. Data from March 2013 indicated that CYP1A induction was similar between oiled and unoiled areas, suggesting that exposure to lingering oil had ceased by that time, 24 years after the spill. As recommended in previous iterations of this body of work, we propose to re-sample harlequin duck CYP1A in March 2014 to confirm 2013 findings and determine whether the conclusion of abatement of exposure to lingering oil is supported. This work contributes to understanding of the timeline and process of recovery of injured species, as well as the nearshore ecosystem, generally.

Estimated Budget: $121.3K
EVOSTC Funding Requested: FY14: 111.3K
(breakdown by fiscal year and must include 9% GA)

Non-EVOSTC Funds to be used: FY14: 10.0K
(breakdown by fiscal year)

Date: August 7 2013

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PROJECT PLAN

I. NEED FOR THE PROJECT

A. Statement of Problem

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 (Rosenberg and Petrula 1998, Esler et al. 2002, McKnight et al. 2006, Esler and Iverson 2010, Iverson and Esler 2010) as well as sampling to monitor ongoing exposure to lingering EVO using the cytochrome P4501A biomarker (Trust et al 2000, Esler et al. 2010, Esler et al. 2011).

As part of EVOSTC Restoration Project 070808, harlequin ducks were examined for lingering exposure to residual *Exxon Valdez* oil. This work demonstrated 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). More recent work (EVOSTC projects 11100808 and 12120114-Q) indicated that degree and incidence of elevated CYP1A in oiled areas was reduced in 2011 relative to previous years and, in 2013, there was no evidence of elevated CYP1A in oiled areas. This was the first sampling period since the spill in which no difference between oiled and unoiled areas was evident, which in turn indicated that oil exposure had ceased by 24 years after the oil spill. Additional sampling proposed here will evaluate the validity of the conclusion that harlequin ducks are no longer exposed to residual Exxon Valdez oil.

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 for general rationale and responsiveness to the Restoration Plan and associated priorities. For harlequin ducks specifically, this work represents continuation of an unprecedented evaluation of the timeline of population recovery and exposure following a catastrophic oil spill. This work is critical for confidently evaluating the duration and process of population recovery of a particularly vulnerable wildlife species.

II. PROJECT DESIGN

A. Objectives

<u>Project Concept</u>

In this study, we propose to sample harlequin ducks in PWS for biomarker assays in March 2014 to evaluate recovery status by measuring the degree of continued exposure to lingering oil. As described above, this continues a time series of quantification of CYP1A induction that started in 1998. In this instance, the primary goal is to evaluate whether findings in 2013, indicating abatement of exposure to lingering *Exxon Valdez* oil, are supported, which would lend strong

support to the conclusion that harlequin duck populations have recovered, based on the criteria for recovery of the species established by the EVOSTC.

Objective 1. Sample harlequin ducks in oiled and unoiled areas of PWS for CYP1A analyses to evaluate continuing exposure to lingering *Exxon Valdez* oil.

B. Procedural and Scientific Methods

Methods will replicate those from previous work (Trust et al. 2000, Esler et al. 2010) to facilitate time series 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, at least 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 collaborators Liz Bowen, Keith Miles, 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.

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. Also, the incidence of elevated exposure, defined as two times the average EROD activity on unoiled areas, will be compared between oiled and unoiled areas. Finally, these data will be incorporated into time series evaluations to document the timeline of exposure to lingering *Exxon Valdez* oil.

D. Description of Study Area

This project will focus on harlequin ducks in western PWS. Captures 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. These sites are those that have been sampled over the entirety of the time series of harlequin duck CYP1A data.

E. Coordination and Collaboration with Other Efforts

This project is coordinated with the Long-Term Monitoring program funded by the EVOSTC. A primary goal of the 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, a species recognized to have protracted recovery from the spill, directly supports that goal. This project will continue biomarker studies that were initiated in 1998 in western PWS, supported by the EVOSTC, and methods used will conform to those from earlier studies.

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, 2014.

Measurable Project Tasks

FFY 14, 1st quarter (October 1, 2013-December 31, 2014)
Plan for March captures
Arrange lab analysis of samples
Attend meeting of LTM PI's, Anchorage

FFY 14, 2nd quarter (January 1, 2014-March 31, 2014)
Attend Annual Marine Science Symposium, Anchorage
Harlequin duck capture, PWS

FFY 14, 3rd quarter (April 1, 2014-June 30, 2014)
Shipping and laboratory analyses of harlequin duck liver biopsies

FFY 14, 4th quarter (July 1, 2014-September 30, 2014)
Analysis of laboratory data of EROD activity of harlequin ducks

FFY 15, 1st quarter (October 1, 2014-December 31, 2015)
Complete sample and data analyses, prepare reports and submit to EVOSTC
Attend meeting of LTM PI's, Anchorage

FFY 15, 2nd quarter (January 1, 2015-March 31, 2015)
Attend Annual Marine Science Symposium, Anchorage

References:

Esler, D., T. D. Bowman, K. 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. Marine Ecology Progress Series 241: 271-286.

Esler, D., and S. A. Iverson. 2010. Female harlequin duck winter survival 11 to 14 years after the *Exxon Valdez* oil spill. Journal of Wildlife Management 74:471-478.

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.

Esler, D., B. E. Ballachey, K. A. Trust, S. A. Iverson, J. A. Reed, A. K. Miles, J. D. Henderson, B. W. Wilson, B. R. Woodin, J. R. Stegeman, M. McAdie, and D. M. Mulcahy. 2011. Cytochrome P4501A biomarker indication of the timeline of chronic exposure of Barrow's goldeneye to residual *Exxon Valdez* oil. Marine Pollution Bulletin 62:609-614.

Iverson, S. A., and D. Esler. 2010. Harlequin duck population dynamics following the 1989 Exxon Valdez oil spill: assessing injury and projecting a timeline to recovery. Ecological Applications 20:1993-2006.

McKnight, A., K. M. Sullivan, D. B. Irons, S. W. Stephensen, and S. Howlin. 2006. Marine bird and sea otter population abundance of Prince William Sound, Alaska: trends following the *T/V Exxon Valdez* oil spill, 1989-2005. *Exxon Valdez* Oil Spill Restoration Project Final Report (Restoration Projects 040159/050751), U.S. Fish and Wildlife Service, Anchorage, Alaska.

Rosenberg D. H. and M. J. Petrula. 1998. Status of harlequin ducks in Prince William Sound, Alaska after the *Exxon Valdez* oil spill, 1995-1997. *Exxon Valdez* oil spill restoration project final report, No. 97427. Alaska Department of Fish and Game, Division of Wildlife Conservation, Anchorage, Alaska.

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

Budget Category:	Proposed FY 12	Proposed FY 13	Proposed FY 14	Proposed FY 15	Proposed FY 16	TOTAL PROPOSED	Actual Cumulative
Personnel			$54.0			$54.0	
Travel			$3.1			$3.1	
Contractual			$38.0			$38.0	
Supplies			$7.0			$7.0	
Equipment			$0.0			$0.0	
Indirect Costs (will vary by proposer)	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	
SUBTOTAL	$0.0	$0.0	$102.1	$0.0	$0.0	$102.1	
General Administration (9% of subtotal)	$0.0	$0.0	$9.2	$0.0	$0.0	$9.2	N/A
PROJECT TOTAL	$0.0	$0.0	$111.3	$0.0	$0.0	$111.3	
Other Resources (Cost Share Funds)	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	

COMMENTS: USGS in-kind contributions include use of field gear and other resources, estimated at $10K.

Personnel Costs:		Months	Monthly		Personnel
Name	Project Title	Budgeted	Costs	Overtime	Sum
Dan Esler, Principal Investigator	Harlequin Duck Exposure to Lingering Oil	2.0	10.0		20.0
Brenda Ballachey, Research Physiologist	Harlequin Duck Exposure to Lingering Oil	1.0	10.0		10.0
Lead Technician - TBN	Harlequin Duck Exposure to Lingering Oil	2.0	4.0		8.0
Field Technicians (2) - TBN	Harlequin Duck Exposure to Lingering Oil	2.0	3.0		6.0
Veterinarian - TBN	Harlequin Duck Exposure to Lingering Oil	1.0	10.0		10.0
					0.0
			Subtotal	0.0	
				Personnel Total	$54.0

Travel Costs:	Ticket	Round	Total	Daily	Travel
Description	Price	Trips	Days	Per Diem	Sum
Continental U.S./Canada to ANC round trip	1.0	2	28	0.0	2.1
Miscellaneous (accomodation, tunnel fees, parking, etc)			1	1.0	1.0
					0.0
				Travel Total	$3.1

FY14

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Team Leader: Dan Esler
Agency: USGS

FORM 3B
PERSONNEL & TRAVEL DETAIL

Contractual Costs:	Contract
Description	Sum
Lab analysis of liver samples (USGS-WERC/UCDavis) - 50 @ $200	10.0
Vessel charter (14 days @ $2000)	28.0
If a component of the project will be performed under contract, the 4A and 4B forms are required. **Contractual Total**	$38.0

Supplies Costs:	Supplies
Description	Sum
Capture gear purchase and maintenance	5.0
Gear and sample shipping	2.0
Supplies Total	$7.0

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FORM 3B
CONTRACTUAL & Supplies

FY14

Team Leader: Dan Esler
Agency: USGS

CONTRACTUAL & Supplies
DETAIL

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

Existing Equipment Usage: Description	Number of Units	Inventory Agency

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FORM 3B
EQUIPMENT DETAIL