Evaluation of Yakataga Oil Seeps as Regional Background Hydrocarbon Sources in Benthic Sediments of the Exxon Valdez Spill Area

Project Number:	01599
Restoration Category:	Research and Monitoring
Proposer:	Jeffrey W. Short NMFS, Auke Bay Laboratory ABL Program Manager: Dr. Stan Rice NOAA Program Manager: Bruce Wright
Lead Trustee Agency:	NOAA
Cooperating Agencies:	U. S. Geological Survey Payne Environmental Consultants
Alaska Sea Life Center:	No
Duration:	1 year
Cost FY01:	$ 10,500 (closeout)
Geographic Area:	Gulf of Alaska
Injured Resource/Service:	Benthic Sediments

ABSTRACT

This project will evaluate fluxes of crude oil from terrestrial oil seeps and of particulate coal near Yakataga into the northern Gulf of Alaska to delineate the extent of "natural oil pollution" in the area affected by the Exxon Valdez oil spill.

INTRODUCTION

Scientists contracted by Exxon corporation have claimed that benthic coastal sediments of the northern Gulf of Alaska (GOA), including Prince William Sound (PWS), receive crude oil produced naturally by terrestrial oil seeps at Katalla and Yakataga. If true, this suggests that the marine biota of the EVOS spill area are adapted to oil pollution, thus promoting recovery of species exposed to toxic components of oil spilled from the T/V *Exxon Valdez*. Thus, fauna that show induction of cytochrome-P450 in the spill area may be responding to natural oil pollution and not to the spilled oil. A recent study by Trustee scientists casts considerable doubt on oil from Katalla as a candidate source of hydrocarbons in these sediments, hence sources near Cape Yakataga have been emphasized by the Exxon team. The study proposed here will compare hydrocarbon transport from oil seeps with coal deposits in drainages where oil seeps or particulate coal particles have been located in the Cape Yakataga area, to resolve the relative contributions from these two alternatives to benthic sediments offshore of these drainages in the GOA. Resolution of coal and sediment-bound oil will be achieved by physical separation, with less dense coal particles floated off from the more-dense inorganic fraction of sediments in a liquid of intermediate density.

NEED FOR THE PROJECT

A. Statement of Problem

Long-term toxic effects of the oil spilled by the T/V *Exxon Valdez* may be confounded by the presence of other sources of crude oil affecting the spill area. Oil seeps near Cape Yakataga continue to be promoted as significant alternative sources of crude oil in PWS. Coal from terrestrial source beds has also been verified as a hydrocarbon source. However, toxic hydrocarbons in coal are sequestered and not available biologically, consequently they are incapable of inducing molecular indicators of PAH exposure (i.e. cytochrome P450). If the terrestrial oil seeps near Cape Yakataga are shown to be negligible compared to coal beds there, then cytochrome P450 induction that continues to be observed in some non-recovered species within the spill area are more likely the result of exposure to residual oil spilled from the T/V *Exxon Valdez.*

B. Rationale

The criteria used to evaluate recovery of sediments and of biota that continue to show increased cytochrome P450 depends on the extent of background oil contamination in the affected area from sources other than the T/V *Exxon Valdez.* This project will provide much more precise criteria for these assessments. Oil from terrestrial seeps at Katalla and near Cape Yakataga was claimed to have associated with fine-grained sediments, flushed into the norther GOA, and then transported by the ACC into PWS where the sediments deposited in the calmer waters there. However, these studies ignored the possibility that terrestrial coal deposits could be a more dominant source in these areas. Although such coal deposits have been verified as dominant sources at Katalla, coal sources have not as yet been documented in the Cape Yakataga area. The oil seeps at Cape Yakataga are the last remaining plausible alternative oil sources for the

regional background hydrocarbon signature found inside PWS. If the contribution of hydrocarbons from these seeps is shown to be negligible in comparison with coal sources, then definitive criteria for recovery of benthic sediments inside PWS follows immediately, and the link between cytochrome P450 induction and exposure to residual *Exxon Valdez* oil is made much stronger.

C. Location

The samples collected for this project will be taken from the coastal and terrestrial margin of the northern GOA between the Duktoth River drainage in the west to Icy Bay in the east. Several short coastal streams bisect the Sullivan syncline in this area and receive oil from seeps associated with the syncline. These samples will be analyzed in Juneau, AK, and in Menlo Park, CA. The benefits of the project will apply most directly to communities and to other Trustee projects in the spill area. The communities that may be directly affected include Cordova, Valdez, and Whittier.

COMMUNITY INVOLVEMENT

Communities will become informed about this project through radio and newspaper interviews responding to agency press releases, which will include communicate significant findings in non-technical language. The necessary vessel and aircraft charters will be advertized in Cordova and in Yakutat, the two communities closest to the study area, but cost will be the primary factor determining selection. Neither traditional nor local knowledge is expected to play a significant part in this project now.

PROJECT DESIGN

A. Objectives

This project has 1 objective:

1. Measure contributions of hydrocarbons from oil seeps and from terrestrial coal deposits to benthic marine sediments adjacent to the northern GOA margin from Icy Bay to the Duktoth River.

B. Methods

Water sampling will focus on 4 streams in the Cape Yakataga area, 2 of which receive oil from seeps and 2 of which do not. Three water samples will be collected from each of the two streams that receive seep oil. One 4 L water sample will be collected oil above the point of oil entry, another sample will be collected 100 m downstream of the oil-seep entry point into a stream, and a final sample will be collected just above tidal influence near the stream mouth on the GOA. Only 1 water sample will be collected from each of the streams that do not receive seep-oil. Each water sample will be partitioned into a dissolved and particulate fraction as describe by

Payne et al. (International Oil Spill Conference, 1999). Particulate material will be separated from each water sample, and then split into two subsamples. One subsample will be analyzed for PAH, and the other will be split again according to density in a high-density liquid to separate coal from inorganic rock, the density-separated samples will be analysed individually. This will permit estimation of the proportion of total PAH contributed by coal particles in the suspended particulates of these streams. The filtered water samples will also be analyzed for PAH to determine the dissolved PAH content.

Approximately 12 benthic GOA sediment samples and 5 PWS samples will be collected and analyzed for PAH to determine the extent of coal-contributed PAH to sediments across the GOA from Yakutat to PWS. Each of these sediment samples will be subjected to a high-density liquid to separate coal particles from the remainder of the sediment. Each fraction will be analyzed for alkane and polycyclic aromatic hydrocarbons (PAH; analysis at ABL), and for hydrocarbon biomarkers (analysis at USGS). These analytes will also be determined in the benthic sediment sample without brine separation to compare the hydrocarbon concentrations found in the separated samples with the original samples.

Analysis of sediment samples for PAH will follow methods described by Short et al. (American Fisheries Society Symposium 18, pp.140-148, 1996). Biomarker analysis is summarized by Carlson et al. (U.S. Geological Survey Open File Report 97-518, 1997).

By physically separating the coal particles from these sediments, the contribution estimate from this source will be quite unambiguous. Comparison of dissolved and particle-bound hydrocarbons in the water samples together with stream discharge estimates will further constrain contributions from oil seeps. Hydrocarbon pattern recognition will follow methods summarized by Short et al. (Environmental Science & Technology, Vol 33, pp. 34-42, 1999).

C. Contracts and Other Agency Assistance

The U.S. Geological Survey will cooperate with this project. Their participation is necessary because they have the expertise required to perform the brine density separations of the sediment samples, and the analysis of the samples for hydrocarbon biomarkers.

Collection and partitioning of the water samples will be contracted to Payne Environmental Consultants, who have developed the sample fractionation methodology to be used.

SCHEDULE

A. Measurable Project Tasks for FY01

FY01:

Sep 30 - Apr 15: Prepare final report and research paper reporting the results of this project in a peer-reviewed journal.

B. Project Milestones and Endpoints

Complete final report and submit manuscript for publication in peer-reviewed journal by Apr 15, 2001.

C. Completion Date

April 15, 2001

PUBLICATIONS AND REPORTS

A final report will be produced by April 15, 2001. A manuscript will be submitted for publication in peer-reviewed journal by Apr 15, 2001.

PROFESSIONAL CONFERENCES

Results from this project will be presented at the Arctic Marine Oilspill Program sponsored by Environment Canada in June, 2001.

NORMAL AGENCY MANAGEMENT

If the oil spill had not occurred, neither NOAA nor USGS would be conducting this project.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

This project will complete work funded under Trustee project 290 in previous years to identify and interpret hydrocarbon signals in the oil spill region.

EXPLANATION OF CHANGES IN CONTINUING PROJECTS

The sampling design was modified in response to new information presented in reports by Exxon-sponsored scientists in fall 1999.

PROPOSED PRINCIPAL INVESTIGATOR

Jeffrey W. Short
Auke Bay Laboratory, Alaska Fisheries Science Center
National Marine Fisheries Service, NOAA
11305 Glacier Highway, Juneau, Alaska 99801-8626

Phone: (907) 789-6065
FAX: (907) 789-6094
e-mail: jeff.short@noaa.gov

PRINCIPAL INVESTIGATORS

1. Jeffrey W. Short (Sediment sample collection; PAH analysis and interpretation)

Education: M.S. (Physical Chemistry)

Relevant Experience:
1989- Present: Established and managed the hydrocarbon analysis facility at ABL to analyze hydrocarbon samples generated by the *Exxon Valdez* NRDA effort (about 20% of these samples were analyzed at ABL).
1989 - 1992: Principal Investigator, Exxon Valdez project Air/Water #3: Determination of petroleum hydrocarbons in seawater by direct chemical analysis and through the use of caged mussels deployed along the path of the oil spill.
1991 - 1996: Principal Investigator, Exxon Valdez project Subtidal #8: Development of computer-based statistical methods for global examination of sediment and mussel hydrocarbon data produced for the Exxon Valdez NRDA effort for systematic bias, and for identification of probable sources of hydrocarbons.
1996 - present: Principal Investigator, Restoration Project 290, Database Management: Discovered particulate coal on beaches near Katalla is a major source of background PAH in marine sediments of the spill area.

2. Keith A. Kvenvolden (Sediment sample collection and partitioning; hydrocarbon biomarker analysis; biomarker and geochemistry interpretation)

Education : Ph. D. (Geology)

Relevant Experience:

Group Leader, Organic Geochemistry
Branch of Pacific Marine Geology
U. S. Geological Survey
Menlo Park, CA

Over 250 peer-reviewed scientific publications on hydrocarbons in the marine environment

3. James R. Payne (Water sample collection and partitioning, interpretation of aqueous hydrocarbon results)

Education: Ph. D (Chemistry)

Relevant Experience:

Author of 4 books and 27 peer-reviewed scientific publications on effects of water-borne hydrocarbon pollutants.

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Budget Category:	Authorized FY 2000	Proposed FY 2001	PROPOSED FY 2000 TRUSTEE AGENCIES TOTALS ADEC	ADF&G	ADNR	USFS	DOI	
							$3.0	
Personnel	$24.9	$4.7						
Travel	$5.1	$1.4						
Contractual	$17.5	$2.5						
Commodities	$1.3	$1.0						
Equipment	$0.0	$0.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	$48.8	$9.6			Estimated			
General Administration	$5.0	$0.9			FY 2002			
Project Total	$53.8	$10.5			$0.0			
Full-time Equivalents (FTE)	0.3	0.0						
	Dollar amounts are shown in thousands of dollars.							
Other Resources	$0.0				$0.0	$0.0		

Comments:

Total NOAA Contribution: 10.1K Jeff Short 1 mo @ 10K
Total DOI Contribution: 6.6

FY00

Prepared: 4/13/99

Project Number: 01599
Project Title: Evaluation of Yakataga Oil Seeps as Regional Back
ground Hydrocarbon Sources in Benthic Sediments of EVOS Area

	Authorized	Proposed						

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Budget Category:	FY 2000	FY 2001
Personnel		$2.1
Travel		$1.4
Contractual		$2.5
Commodities		$1.0
Equipment		$0.0
Subtotal	$0.0	$7.0
General Administration		$0.5
Project Total	$0.0	$7.5
Full-time Equivalents (FTE)		0.0
Other Resources		

LONG RANGE FUNDING REQUIREMENTS

Estimated FY 2002
$0.0

Dollar amounts are shown in thousands of dollars.

Comments:

FY00

Prepared: 4/13/99

Project Number: 01599
Project Title: Evaluation of Yakataga Oil Seeps as Regional Back-
ground Hydrocarbon Sources in Benthic Sediments of EVOS Area
Lead Agency: National Oceanic & Atmospheric

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

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 2000 - September 30, 2001

Jeff Short	Research Chemist	13/6	0.2	10.4		
	Subtotal		0.2	10.4	0.0	
					Personnel Total	

Travel Costs:	Ticket	Round	Total	Daily	
Description	Price	Trips	Days	Per Diem	
AMOP conference in Calgary, Alberta	0.8	1	2	0.3	
				Travel Total	

FY00

Prepared: 4/13/99

Project Number: 01599
Project Title: Evaluation of Yakataga Oil Seeps as Regional Back-
ground Hydrocarbon Sources in Benthic Sediments of EVOS Area

Contractual Costs:	
Description	

Payne Environmental Consultants	
When a non-trustee organization is used, the form 4A is required. ***Contractual Total***	
Commodities Costs:	
Description	
Page Charges for manuscript	
Commodities Total	

FY00

Prepared: 4/13/99

Project Number: 01599
Project Title: Evaluation of Yakataga Oil Seeps as Regional Back-
ground Hydrocarbon Sources in Benthic Sediments of EVOS Area

New Equipment Purchases:	Number of Units	Unit Price	
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		

FY00

Prepared: 4/13/99

Project Number: 01599
Project Title: Evaluation of Yakataga Oil Seeps as Regional Back-
ground Hydrocarbon Sources in Benthic Sediments of EVOS Area

Budget Category:	Authorized FY 1999	Proposed FY 2000
Personnel		$2.6

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Travel		$0.0						
Contractual		$0.0						
Commodities		$0.0						
Equipment		$0.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	$0.0	$2.6			Estimated FY 2001	Estimated FY 2002		
General Administration		$0.4						
Project Total	$0.0	$3.0						
Full-time Equivalents (FTE)		0.0						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments:
USGS Contribution: K.Kvenvolden, Group Leader Chemist, .5 mo @ 13.2K for a total USGS contribution of 6.6

FY00

Prepared: 4/13/99

Project Number: 01599
Project Title: Evaluation of Yakataga Oil Seeps as Regional Back-
ground Hydrocarbon Sources in Benthic Sediments of EVOS Area

Personnel Costs:		GS/Range/	Months	Monthly		
Name	Position Description	Step	Budgeted	Costs	Overtime	
Keith Kvenvolden	Group Leader, Organic Geochemistry	GS-14	0.2	13.2		

	Subtotal		0.2	13.2	0.0	
					Personnel Total	

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

FY00

Prepared: 4/13/99

Project Number: 01599
Project Title: Evaluation of Yakataga Oil Seeps as Regional Back-
ground Hydrocarbon Sources in Benthic Sediments of EVOS Area

Contractual Costs:	
Description	

When a non-trustee organization is used, the form 4A is required. ***Contractual Total***	
Commodities Costs:	
Description	
Commodities Total	

FY00

Prepared: 4/13/99

Project Number: 01599
Project Title: Evaluation of Yakataga Oil Seeps as Regional Back-
ground Hydrocarbon Sources in Benthic Sediments of EVOS Area

New Equipment Purchases:	Number of Units	Unit Price	
Description			

Those purchases associated with replacement equipment should be indicated by placement of an R.			***New Equipment Total***	
Existing Equipment Usage:			Number	
Description			of Units	

FY00

Prepared: 4/13/99

Project Number: 01599
Project Title: Evaluation of Yakataga Oil Seeps as Regional Back-
ground Hydrocarbon Sources in Benthic Sediments of EVOS Area