

**EVOSTC FY17-FY21 INVITATION FOR PROPOSALS  
FY21 (YEAR 10) CONTINUING PROJECT PROPOSAL SUMMARY PAGE**

**Project Number and Title**

Gulf Watch Alaska: Lingering Oil Component Project

**21200114-P** Long-term Monitoring of Lingering Oil in Prince William Sound

**Primary Investigator(s) and Affiliation(s)**

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**Project Abstract**

Oil from the *Exxon Valdez* remains sequestered under beaches throughout the spill area. This lingering oil, as it is known, has been a source of concern for the federal and state government and the public for over 30 years. In 2015 the United States and State of Alaska governments advised the federal district court they would not be filing for additional damages based on the presence of lingering oil and the “reopener claim.” In their joint status report, the Governments noted that, although the Governments would not pursue the additional claim, “[the *Exxon Valdez* Oil Spill Trustee] Council (EVOSTC) and its member agencies have discretion to consider and proceed with actions to reduce residual oil in the Spill area. . . .” In subsequent Council meetings, the Trustees noted their commitment to continuing lingering oil monitoring to ensure that the oil is not bioavailable or creating damage to the spill area habitat and its resources. Subsequent Councils requested EVOSTC staff develop a lingering oil monitoring project to address targeted areas to effectively monitor the presence and condition of lingering *Exxon Valdez* oil spill oil.

This project was developed in coordination with EVOSTC staff to provide a sensible monitoring program that continues past efforts. Past monitoring projects began with an initial assessment in 2001 where over 9,000 pits were excavated to estimate how much oil remained on beaches in Prince William Sound. Results from this survey showed oil was lingering in the environment longer than expected and not changing in its chemical composition or “weathering”. Additional surveys were conducted from 2003-2015 to determine the oil’s extent and to refine model estimates. Recommendations from these surveys were to continue monitoring these known sites periodically on a 5-year cycle to maintain the oil chemistry time series and evaluate any change. This project fulfills those recommendations and has become an important case study in the long-term impacts of oil spills.

This project proposes a low-cost presence/absence approach to monitoring that can be combined with previously Council-funded modeling efforts to provide managers with up to date information on where oil is located and its potential to cause injury. COVID-19 mandate restrictions prevented this project from conducting the field survey in summer of 2020 and has been postponed until summer of 2021. The principal investigators are not changing project objectives or requesting additional funding, simply shifting tasks into FY21.

**EVOSTC Funding Requested\* (must include 9% GA)**

FY17	FY18	FY19	FY20	FY21	TOTAL
N/A	N/A	N/A	\$52,200	\$13,100	\$65,300

**Non-EVOSTC Funds to be used, please include source and amount per source: (see Section 6C for details)**

FY17	FY18	FY19	FY20	FY21	TOTAL
N/A	N/A	N/A	\$11,200	\$11,200	\$22,400

## 1. PROJECT EXECUTIVE SUMMARY

This was a new project funded in FY20 but builds on previous lingering oil projects funded by the *Exxon Valdez* Oil Spill Trustee Council (EVOSTC). Gulf Watch Alaska (GWA) project 16120114-S was a 5-year project initiated in 2012 and culminated in 2016. The overall goal of this lingering oil project was to extend previous efforts to track *Exxon Valdez* oil (EVO) occurrence and chemical composition in Prince William Sound (PWS). Previous EVOSTC-funded studies (projects 02543, 040585, 050620, 070801, and 12120117) had demonstrated that, on some beaches, subsurface oil persisted in a relatively unweathered state longer than expected with an unknown long-term fate.

COVID-19 federal and state mandates prohibited the lingering oil field sampling component of this project planned for summer of 2020. Principal investigators (PIs) were unable to acquire charter vessels, receive travel approvals, and ensure safe working conditions for staff going to PWS. The survey work will be conducted in the summer of 2021 with moderate impacts to the project and no compromising of the quality of samples being collected.

We proposed in FY20 to examine established lingering oil beaches in PWS for the presence of oil spilled by the *Exxon Valdez* as recommended by the last lingering oil project, 16120114-S (Lindeberg et al. 2017). The presence of lingering oil was one the most important findings by the EVOSTC scientists following the *Exxon Valdez* oil spill (EVOS). On March 24, 1989 when the tanker ran aground on Bligh Reef in PWS it released at least 10,800,000 gallons of crude oil (Wolfe et al. 1994). Western PWS beaches were the hardest hit by spilled oil, affecting 783 km of shoreline (Short et al. 2004). With a combination of large-scale clean-up efforts and natural processes it was expected that remaining oil would be reduced to negligible amounts soon after the first several years of the spill (Neff et al. 1995). As the decades passed, studies funded by EVOSTC documented unanticipated long-term impacts of EVOS, one of which was the persistence of oil in the environment (Lindeberg et al. 2018, Esler et al. 2018). Lingering oil residues are patchily distributed across geologically complex shorelines, largely found in finer-grained sand and gravel beach sediments, often under an armor of cobble and boulders (Hayes and Michel 1999, Hayes et al. 2010, Nixon and Michel 2018). Estimates of oil loss-rates from these sites indicate a prolonged presence. Monitoring these beaches for the presence of oil provides the EVOSTC with up-to-date data on the extent of injury at minimal cost.

### **Past Lingering Oil Findings**

The EVOSTC has had a comprehensive legacy regarding lingering oil studies focusing on the distribution, quantity, loss rate, weathering state, and bioavailability of EVO through field studies and by developing empirical models. EVOSTC has periodically solicited reports on the status of lingering oil (Michel and Esler 2010, Michel et al. 2016, EVOSTC 2016) to help inform sponsoring EVOSTC agencies, decision makers, and the public. Results from these studies also helped guide future focus areas for research invitations (e.g., <http://www.evostc.state.ak.us/Universal/Documents/Publications/Invitations/2018Invitation.pdf>). A brief review of findings for the lingering oil focus area follows.

*Lingering oil surveys* - The first of these surveys was conducted 12 years after the spill in 2001 by the National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service's (NMFS's) Auke Bay Laboratories, which estimated a cumulative area of 11.3 ha of EVO and 55,600 kg of subsurface oil remaining in PWS (Short et al. 2004, Pella and Maselko 2007). Additional surveys conducted in 2003 and 2005 focused on determining the distribution of subsurface oil with respect to tidal elevation and the probability of encountering

oil in a heavily oiled region of PWS (Short et al. 2006, 2007). Several other surveys were conducted in 2007-08 (Michel et al. 2010) and many of these sites were revisited in 2015. In 2015, lingering EVO was present at 8 of the 9 sites and surveys revealed little evidence of change in oil mass, area, and distribution since 2001 (Lindeberg et al. 2018). If left undisturbed by natural processes or human activities, lingering oil will likely persist in the environment on a decadal or longer scale.

*Lingering oil modeling* - A comparison of survey results between 2001 and 2005 showed the likely rate of decline of oiled beach area within PWS was 3-4%/year (Short et al. 2006, 2007). Using quantitative data from past surveys, a geomorphic spatial model was developed (Michel et al. 2010, Nixon and Michel 2015) to predict where oil is likely to occur, in addition to known locations identified by field surveys. Most recent testing by Nixon and Michel (2018) that included data ranging from 2001-2015 (14,000 pit excavations), continues to support estimates and even suggests previous estimates of the initial amount of oil remaining were slightly underestimated. Model estimates changed from 0.25% to 0.6% of the originally spilled mass of oil and it is now estimated that lingering oil remains over 30 ha of intertidal area along 11.4 km of shoreline (Nixon and Michel 2018). A refined projection for the rate of decline made in 2015 found that loss rates are still 3-4% per year, but given the margin of error, loss rates could be closer to zero and undetectable (Nixon and Michel 2017, Lindeberg et al. 2018).

*Composition of EVO* – Samples of oil, collected during lingering oil surveys, have been analyzed to verify the oil is EVO and evaluate its weathering state. Polycyclic aromatic hydrocarbons (PAHs) are used to identify the oil and determine its weathering state. Weathering is important to monitor because it provides an indication of the potential toxicity of the stranded oil. Subsurface oil over the decades has varied from extremely weathered to no different than 11-day-old EVO, which has been the standard oil to compare the rate of weathering once the oil stranded on the shoreline (Short et al. 2007, Venosa et al. 2010). Analysis of EVO sampled in 2015 indicated that the oil has not appreciably weathered since 2001 and still resembles the 11-day-old EVO (Lindeberg et al. 2018). As the oil eventually weathers, PAHs will be lost and attempts to identify and assess the weathering state of the oil will need to rely on biomarkers. Biomarkers, including hopanes, steranes, and diterpanes, are compounds believed to be most resistant to weathering. However, samples collected in 2015 indicate some of these compounds may have also slightly weathered (Carls et al. 2016, Lindeberg et al. 2018). Consequently, it is important to maintain samples of stranded EVO over time to better understand how biomarker concentrations change over time in situ.

### **Future Monitoring of Lingering Oil**

Recent surveys have provided a clear idea of the location (Michele et al. 2010, Nixon and Michele 2015) and the amount (Nixon et al. 2017) of sequestered oil in PWS. The former study relied on a geomorphic model and historic oil distribution to predict locations where oil is likely to be sequestered. Field studies conducted in 2015 (EVOSTC project 16120114-S) found the distribution model accurately predicted the probability of encountering oil residues on contaminated beaches (Lindeberg et al. 2018). Predictions of the amount of oil remaining in PWS by both EVOSTC and industry scientists (Short et al. 2004, Taylor and Reimer 2008, Nixon and Michele 2018) have estimated the remaining oil to represent between 0.25% to 0.6% of the initial spilled mass. The field study conducted in 2015 revisited previously surveyed sites and was unable to detect any loss in either the area contaminated by oil or the oil's mass (Lindeberg et al. 2018). Thus, the EVOSTC currently has a comprehensive understanding of where the oil is located, how much is there, and how long it will be there. In the near term the EVOSTC needs only to monitor contaminated locations to verify the presence of the oil.

Forensic analysis has been an important component to these previous surveys. Collection of oil samples to determine the oil's chemical composition was critical to identifying its weathering state and verifying its identity as EVO. The PAH compounds in crude oil degrade in a predictable pattern facilitating the identification of the source of an unknown sample (Short and Heintz 1997). This approach has been used in previous surveys to verify that sequestered oil is EVO and that it has retained its toxic potential. Ultimately, PAH will be lost from the oil sequestered on PWS beaches along with the potential for verifying the source of the oil. More recent developments in oil forensics have developed the use of petroleum biomarkers including triterpene, hopane, and sterane isomers to identify source oils (Wang et al. 2016). These biomarkers are highly refractory and are the result of geologic processes that formed the oil from original biological materials. Analysis of oil samples collected from locations in PWS over a 25-year period demonstrated their persistence and utility for source identification (Carls et al. 2016). That study represents one of the longest time series for monitoring biomarker persistence in the scientific record. Continued monitoring of biomarkers in PWS will be of significant value to the community of scientists studying spilled petroleum hydrocarbons.

Currently, the primary process for addressing lingering oil is the periodic monitoring conducted by EVOSTC-funded studies. During these surveys numerous pits are dug on contaminated beaches to assess the area covered by the oil, estimate the mass remaining, and collect oil samples. These estimates are expensive because they require that a large number of pits be dug. Moreover, there is the danger of mobilizing excavated oil and altering the natural weathering process during excavation. For these reasons, surveys that have a high density of pit excavations or a high frequency of visitation are not recommended, maintaining minimal impacts to the oiled beaches. We propose to maintain the current survey schedule (once every 5 years) but minimize survey objectives so that the EVOSTC can maintain a current inventory of contaminated beaches, while minimizing the potential for disturbance. This project is part of the GWA lingering oil component as it has been in the past (FY12-16) and will allow for future related projects in the long-term. We anticipate acquiring partners in the near future to carry out biomarker analyses and soliciting funds from EVOSTC in FY21.

*Relevance to the invitation for proposals* - This project proposal addresses the EVOSTC lingering oil focus area. The EVOSTC continues to be accountable for monitoring oil-contaminated beaches despite evidence that the sequestered oil is not bioavailable. Oil sequestered on the beaches has not weathered substantially since it made landfall (Lindeberg et al. 2018) and therefore retains potential toxicity. So long as the oil remains on the beaches the EVOSTC needs to keep the public apprised of the status of lingering oil. Twenty-five plus years of knowledge gained by funding lingering oil studies has established the EVOSTC as a leading authority and resource for oil spill research. The long-term time series datasets accumulated by EVOSTC-funded projects have proven to be important for oil spills around the world (e.g., citations in environmental impact statements, Hebei Spirit reports, and Deep Water Horizon court cases).

## 2. PROJECT STATUS OF SCHEDULED ACCOMPLISHMENTS

### A. Project Milestones and Tasks

Table 1. This table breaks down project milestones and task progress by fiscal year and quarter, beginning February 1, 2017. C = completed, X = planned or not completed, V = cancelled due to COVID-19, P = partially completed, due to constraints of COVID-19. Fiscal year quarters: 1 = Feb 1 – April 30; 2 = May 1 – July 31; 3 = Aug. 1 – Oct. 31; 4 = Nov. 1 – Jan. 31.

Milestone/Task	FY17				FY18				FY19				FY20				FY21			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
<b>1: Field Work</b>																				
Secure funding													C							
Contracts/Supplies															X					
Travel arrangements																	X			
Survey cruise																	X			
<b>2: Data Analysis</b>																				
Data analysis																		X		
Data public																				X
<b>3: Deliverables</b>																				
Attend/brief GWA PI meeting																			X	
FY21 Work Plan															C					
2021 AMMS presentation																				X
GWA website –LO project																X				
Draft final report																				X
Reviews																				X
Submit final draft report																				X

### B. Explanation for not completing any planned milestones and tasks

The majority of tasks have been deferred to FY21 due to COVID-19. The project PIs believe it will be a tight timeline in FY21, but all objectives and tasks will be completed as outlined in Table 1. Delivery of the final report may be delayed.

### C. Justification for new milestones/tasks

There are no new milestones or tasks. The project's original objectives, milestones, and tasks remain the same.

## 3. PROJECT COORDINATION AND COLLABORATION

### A. Within an EVOSTC-funded Program

#### Gulf Watch Alaska

This project falls under a Lingering Oil component of the GWA program (originally in FY12-16) and continues monitoring conducted by project 16120114-S. Results from the lingering oil survey will be presented at the joint GWA/Herring Research and Monitoring (HRM) annual PI meetings. The Nearshore

component of GWA historically has been closely linked with the Lingering Oil component, given that lingering oil occurs in nearshore habitats and affects nearshore species. Data collected by the Nearshore component are relevant for understanding ecosystem recovery with respect to the presence of lingering oil. In particular, the Nearshore component monitors mussels for the presence of a broad suite of contaminants including PAH.

#### Herring Research and Monitoring

Currently there is one other project associated with lingering oil research that has recently moved under the Herring Research and Monitoring program. The project is titled Immunological Expressions of PAH Exposure in Fish (EVOSTC project 20170115) and the PI is Andrew Whitehead. This project is looking to interrogate the genome structure and genome function of PWS fish to test hypotheses about the causes and consequences of the PWS herring population collapse, by revealing ecological, evolutionary, and genetic mechanisms governing the demographic trajectory of PWS fish over the past ~30 years. These results coupled with previous survey results have the potential to be highly valuable for assessing long-term impacts of persistent EVO.

Findings from the summer survey and encounters of oil from the monitoring sites will be provide to the Herring Research and Monitoring program manager.

#### Data Management

This project will coordinate with the data management program by submitting data and preparing metadata for publication on the Gulf of Alaska Data Portal and DataONE within the timeframes required.

#### **B. With Other EVOSTC-funded Projects**

This project will coordinate with other EVOSTC-funded projects as appropriate by providing data, discussing the relevance and interpretation of data, and collaborating on reports and publications.

#### **C. With Trustee or Management Agencies**

Interested state, federal, and non-governmental organizations (NGOs) would benefit from the information provided by continued monitoring. Lingering EVO persisting in the spill area has ramifications for agencies and NGOs related to their mandates (e.g., National Park Service, Regional Citizens' Advisory Councils, Oil Spill Recovery Institute, Alaska Department of Health and Human Services, and Alaska State Parks). The report would bring awareness about the long-term outcomes of the EVOS and the lessons learned that could be incorporated into their operational plans in the region and wherever oil spills may occur.

## **4. PROJECT DESIGN**

### **A. Overall Project Objectives**

#### *1. Maintain surveillance of lingering oil*

We propose a “presence/absence” approach to monitoring known patches of lingering oil. Beaches with moderately and heavily oiled residues will be sampled to determine if oil continues to persist by re-digging pits on beaches known to be contaminated in 2015. This approach minimizes costs and any potential for mobilizing lingering oil deposits or changing its natural state. If a large number of re-dug pits across sites are devoid of oil residues, then a more detailed approach will be warranted on future surveys. The goal of the surveys proposed here is to determine if oil can be found in locations where oil

has been previously found. Therefore, sampling procedures are not intended to provide estimates of the probability of encountering oil or the area or mass of retained oil.

2. *Collect and archive biomarkers for future analysis*

Samples of oiled residues will be collected from each site targeting the heaviest oil from visual classification. A control sample, no visible oil, will also be taken from each site.

**B. Changes to Project Design and Objectives**

Due to COVID-19 mandate restrictions fieldwork for this project has been postponed until the summer of 2021. There are other no changes to the project design or objectives.

**5. PROJECT PERSONNEL – CHANGES AND UPDATES**

There are no changes or updates to project personnel.

**6. PROJECT BUDGET**

**A. Budget Forms (See GWA FY20 Budget Workbook)**

Please see project budget forms compiled for the program. A copy of the project summary budget sheet is shown below.

**EXXON VALDEZ OIL SPILL TRUSTEE COUNCIL  
PROJECT BUDGET PROPOSAL AND REPORTING FORM**

Budget Category:	Proposed FY 17	Proposed FY 18	Proposed FY 19	Proposed FY 20	Proposed FY 21	TOTAL PROPOSED	ACTUAL CUMULATIVE
Personnel	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0	
Travel	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0	
Contractual	\$0.0	\$0.0	\$0.0	\$46.5	\$12.0	\$58.5	
Commodities	\$0.0	\$0.0	\$0.0	\$1.4	\$0.0	\$1.4	
Equipment	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0	
<b>SUBTOTAL</b>	<b>\$0.0</b>	<b>\$0.0</b>	<b>\$0.0</b>	<b>\$47.9</b>	<b>\$12.0</b>	<b>\$59.9</b>	<b>\$0.0</b>
General Administration (9% of subtotal)	\$0.0	\$0.0	\$0.0	\$4.3	\$1.1	\$5.4	N/A
<b>PROJECT TOTAL</b>	<b>\$0.0</b>	<b>\$0.0</b>	<b>\$0.0</b>	<b>\$52.2</b>	<b>\$13.1</b>	<b>\$65.3</b>	
Other Resources (Cost Share Funds)	\$0.0	\$0.0	\$0.0	\$11.2	\$11.2	\$22.4	

**B. Changes from Original Project Proposal**

Since COVID-19 mandates prohibited the project from conducting field sampling during summer 2020, funds for this project will be rolled over into FY21 and the lingering oil survey will occur during the summer of 2021. FY20 funds for the NOAA PI to travel (\$1.4K) were cancelled so we are requesting those funds to be reallocated to supplies (see yellow highlights in summary budget table, Section 6.A).

**C. Sources of Additional Project Funding**

There are no sources of additional project funding.

**7. FY17-20 PROJECT PUBLICATIONS AND PRODUCTS**

Publications

N/A

Published and updated datasets

N/A

## Presentations

N/A

## Outreach

N/A

## **8. LITERATURE CITED**

- Carls, M.G., L. Holland, G.V. Irvine, D.H. Mann, and M.R. Lindeberg. 2016. Biomarkers as tracers of *Exxon Valdez* oil. Report to the *Exxon Valdez* Oil Spill Trustee Council, National Oceanic and Atmospheric Administration, Juneau, AK.
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- Nixon, Z., and J. Michel. 2017. A review of distribution and quantity of lingering subsurface oil from the *Exxon Valdez* oil spill. *Deep-Sea Research Part II*. DOI:10.1016/j.dsr2.2017.07.009.
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