ATTACHMENT C  EVOSTC Annual Project Report Form

Form Rev. 10.3.14

1. Program Number:  See, Reporting Policy at III (C) (1).
   15120114-S

2. Project Title:  See, Reporting Policy at III (C) (2).

   Long-term Monitoring: Lingering Oil - Extending the Tracking of oil levels and weathering (PAH composition) in PWS through time

3. Principal Investigator(s) Names:  See, Reporting Policy at III (C) (3).

   Mark Carls, Mandy Lindeberg

4. Time Period Covered by the Report:  See, Reporting Policy at III (C) (4).

   February 1, 2015 - January 31, 2016

5. Date of Report:  See, Reporting Policy at III (C) (5).

   March 1, 2016

6. Project Website (if applicable):  See, Reporting Policy at III (C) (6).

   http://www.gulfwatchalaska.org/monitoring/lingering-oil/lingering-oil-weathering-and-tracking/

7. Summary of Work Performed:  See, Reporting Policy at III (C) (7).

   Key Findings:
   ● A new forensic biomarker model provides more source information than the standard Nordtest approach.
   ● *Exxon Valdez* oil was definitively identifiable with biomarkers in sequestered oil from 1989 to 2015.
   ● Biomarker concentrations initially increased as the oil lost volatile components.
   ● Biomarker concentrations generally declined thereafter; rates varied within and among beaches.
   ● Differential biomarker weathering was observed.
   ● Biomarkers generally weathered less loss in the Gulf of Alaska (except Cape Gull) than in Prince William Sound.
   ● Polynuclear aromatic hydrocarbon (PAH) weathering patterns were similar, though the process was more rapid for these smaller molecules.
   ● Current PAH loss rates are low, demonstrating oil deposits are no longer a threat for organisms that live outside of beach sediment.
   ● PAH and alkane loss rates decreased with molecular mass; this is controlled by thermodynamics.

   Appendix A (see accompanying pdf document) contains three draft papers in support of these observations. Chapter X reviews PAHs and alkanes across multiple sites in Prince William Sound (PWS) and the Gulf of Alaska from the year of the spill (1989) through the most recent
Field sampling has been completed to determine the quantity and weathering state of oil on 9 PWS beaches. We proposed 10 sites would be sampled but due to higher charter and fuel costs the survey was reduced by one day. Samples have been processed and quantified. A report is being drafted. Preliminary results are:

- The total mass of oil varied from 0 to 3,600 kg per beach; no oil was discovered at Evans Island (EV039A) and one of the Eleanor Island beaches contained the most oil (EL056C; Figure 1). Proportionate oiling ranged from 0 (EV039A) to 40% (EL056C) overall based on the number of oiled pits or 0 to 30% when based on oiled area (Table 1).

- The amount of oiling was consistent with previous estimates; in general the proportion oiled remains the same (Figure 2). The percent oil discovered increased in one beach (EL058B), declined in another (EV039A) and remained constant in the others. This variance is likely simply statistical noise; on average the amount of oil remaining is roughly the same.

- Polynuclear aromatic hydrocarbons (PAHs) were not discovered in passive samplers deployed on one beach in 2015; total PAH concentrations were low and modeling revealed no oil. Concentrations in field samples were about the same as in blanks. In sharp contrast, samplers deployed in 2002 in Herring Bay acquired orders of magnitude greater total PAH concentrations and they were petrogenic.

Table 1. Estimates of oil remaining in Prince William Sound beaches in 2015; % oiling is calculated on an area basis (pit area / total area) and % oil is based on the number of oiled pits divided by the total number of pits on that beach. Mmodel is the predicted %oil by a model (Nixon and Michel 2015).

<table>
<thead>
<tr>
<th>SiteCode</th>
<th>Location</th>
<th>Segment</th>
<th>Length</th>
<th>Site Area</th>
<th>Oil Area</th>
<th>%Oiling</th>
<th>% oil</th>
<th>Est. based on n pits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Eleanor Is.</td>
<td>EL056C</td>
<td>90</td>
<td>13,212</td>
<td>3,898</td>
<td>29.5%</td>
<td>40%</td>
<td>&gt;30%</td>
</tr>
<tr>
<td>2</td>
<td>Eleanor Is.</td>
<td>EL058B</td>
<td>51</td>
<td>9,372</td>
<td>1,698</td>
<td>18.1%</td>
<td>30%</td>
<td>&gt;30%</td>
</tr>
<tr>
<td>3</td>
<td>Evans Is.</td>
<td>EV039A</td>
<td>109</td>
<td>26,716</td>
<td>0</td>
<td>0.0%</td>
<td>0%</td>
<td>1-5%</td>
</tr>
<tr>
<td>4</td>
<td>Greens Is.</td>
<td>GR103B</td>
<td>100</td>
<td>20,742</td>
<td>802</td>
<td>3.9%</td>
<td>10%</td>
<td>1-5%</td>
</tr>
<tr>
<td>5</td>
<td>Herring Bay</td>
<td>KN0114A</td>
<td>68</td>
<td>13,605</td>
<td>1,855</td>
<td>13.6%</td>
<td>23%</td>
<td>&gt;30%</td>
</tr>
<tr>
<td>6</td>
<td>Herring Bay</td>
<td>KN0300A-2</td>
<td>52</td>
<td>11,135</td>
<td>267</td>
<td>2.4%</td>
<td>3%</td>
<td>1-5%</td>
</tr>
<tr>
<td>7</td>
<td>Knight Island</td>
<td>KN0506A</td>
<td>50</td>
<td>9,171</td>
<td>13</td>
<td>0.1%</td>
<td>3%</td>
<td>0-1%</td>
</tr>
<tr>
<td>8</td>
<td>Sleepy Bay</td>
<td>LA018A-1</td>
<td>100</td>
<td>15,722</td>
<td>71</td>
<td>0.5%</td>
<td>4%</td>
<td>5-15%</td>
</tr>
<tr>
<td>9</td>
<td>Smith Is.</td>
<td>SM006B</td>
<td>100</td>
<td>28,014</td>
<td>2,504</td>
<td>8.9%</td>
<td>22%</td>
<td>&gt;30%</td>
</tr>
</tbody>
</table>
Figure 1. Total oil mass per beach surveyed in Prince William Sound summer of 2015.

Project Status for year 4:

<table>
<thead>
<tr>
<th>Deliverable/Milestone</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Objective 1: field work</td>
<td>Field work is complete.</td>
</tr>
<tr>
<td>Objective 2: supplemental analyses</td>
<td>No supplemental analyses have been requested by other Gulf Watch researchers.</td>
</tr>
<tr>
<td>Objective 3: hydrocarbon database</td>
<td>Maintenance of the hydrocarbon database is up to date through 2015 and available on Ocean Workspace/public.</td>
</tr>
<tr>
<td>Objective 4: Reporting</td>
<td>Reports have been submitted as required and publications have been published and drafted.</td>
</tr>
</tbody>
</table>

8. **Coordination/Collaboration:** See, Reporting Policy at III (C) (8).

We continued collaboration with the Prince William Sound Regional Citizens’ Advisory Council on long-term environmental monitoring, an Alaska Department of Fish and Game bird study (outside PWS), and hydrocarbon contamination in Cordova Harbor (Ivy Patton, Environmental Coordinator Native Village of Eyak).

9. **Information and Data Transfer:** See, Reporting Policy at III (C) (9).

Publications and Reports:


Carls MG, Vanderhoof L, Shaufler L. Submitted. Carbonate cycling in a north temperate fjord.

Carls MG, Larry Holland, Corey Fugate, and Mandy Lindeberg. In prep. Review of PAH and alkane retention in sediment oiled by the Exxon Valdez.


**Presentations and outreach:**


**Meeting attendance:**


November 2015, Gulf Watch Alaska annual principal investigator meeting, Anchorage: Mandy Lindeberg, Ron Heintz.

**Data and Metadata:**

Ocean Workspace now has:
• 2015 update of the hydrocarbon database and supporting documentation (e.g legacy or data dictionary pdf, macro for filtering GCMS output, and updated metadata). All reports and publications on biomarkers and Exxon Valdez oil analyses are based on data in the hydrocarbon database.

• A file on gravimetric samples (raw data for calculating mass of oil in pits) from the summer survey has been added.

• A chain of custody file of all samples collected during the lingering oil survey.

• Site photos from the Prince William Sound lingering oil survey have also be uploaded with metadata file.

10. Response to EVOSTC Review, Recommendations and Comments: See, Reporting Policy at III (C) (10).

There were no recent comments for this project from EVOS reviews.

11. Budget: See, Reporting Policy at III (C) (11).

Please see provided program work book.

Our overall budget expenditures are on target with the proposed expenditures. The majority of remaining funds are encumbered in a contract and all funds will be exhausted by the end of the fiscal year.