DRAFT 1/6/10

Official Rcd 11.21.02

Exxon Valdez Oil Spill Trustee Council

441 W. 5th Ave., Suite 500 • Anchorage, AK 99501-2340 • 907 278 8012 • fax 907 276 7178

AGENDA
EXXON VALDEZ OIL SPILL TRUSTEE COUNCIL
January 13, 2010, 1:00 p.m. – 2:30 p.m.
Anchorage, Alaska

Trustee Council Members:

DANIEL S. SULLIVAN
Attorney General
Alaska Department of Law

LARRY HARTIG
Commissioner
Alaska Department of Environmental Conservation

DENBY S. LLOYD
Commissioner
Alaska Department of Fish and Game

CRAIG O'CONNOR
Special Counsel
National Oceanic & Atmospheric Administration
U.S. Department of Commerce

KIM ELTON
Senior Advisor to the Secretary for Alaska Affairs
Office of the Secretary
U.S. Department of the Interior

JOE MEADE
Forest Supervisor
Forest Service
U.S. Department of Agriculture

Meeting in Anchorage, Trustee Council Office 441 West 5th Avenue, Suite 500
Teleconference number: 800.315.6338. Code: 8205
State Chair: ___________

1. Call to Order – 1:00 p.m.

2.	Consent Agenda - Approval of Agenda* - Approval of Meeting Notes* November 18, 2009	
3.	Public comment – 1:10 p.m. (3 minutes per person)	
4.	Executive Director's Report	Elise Hsieh, Executive Director
5.	Public Advisory Committee - 2010-2012 Charter Modification*	Doug Mutter DOI, Designated Federal Officer
6.	NOAA Lingering Oil Report	Craig O'Connor, NOAA Trustee
7.	NEPA Notice of Intent	Laurel Jennings, NOAA
8.	Habitat - Ouzinkie Nomination* - Small Parcel Nominations*	Carol Fries, ADNR
9.	Executive Session, as needed	

Adjourn – by 2:30 p.m.

* Indicates action items

Nov 18 TC Mtg Notes

DRAFT 1/5/10

Exxon Valdez Oil Spill Trustee Council

441 W. 5th Ave., Suite 500 • Anchorage, AK 99501-2340 • 907 278 8012 • fax 907 276 7178

TRUSTEE COUNCIL MEETING NOTES

Anchorage, Alaska

November 18, 2009

Chaired by: Craig O'Connor
Trustee Council Member

Trustee Council Members Present:

Steve Zemke, USFS *
Kim Elton, US DOI ****
• Craig O'Connor, NOAA **

Craig Tillery, ADOL ***
Denby Lloyd, ADF&G
Larry Hartig, ADEC

• Chair
* Steve Zemke alternate for Joe Meade
** Craig O'Connor alternate for James Balsiger
*** Craig Tillery alternate for Daniel Sullivan
**** Doug Mutter alternate for Kim Elton 9:45 to 10:30 a.m.

The meeting convened at 9:37 a.m., November 18, 2009 in Anchorage at the EVOS Conference Room.

1. Approval of the Agenda

APPROVED MOTION: Motion to approve the November 18, 2009. AGENDA

Motion by Hartig, second by Zemke

2. Approval of August 31, 2009 meeting notes

APPROVED MOTION: Motion to approve the August 31, 2009 meeting notes.

Motion by Hartig, second by Tillery

Public Advisory Committee (PAC) comments: Stacy Studebaker, PAC Chair,

Public comment opened at 9:55 a.m.

Four public comments were offered: Patience Andersen -Faulkner, Jennifer Gibbins, John French, and Nancy Bird

Public comment closed at 10:15 a.m.

3. Remodel to reduce lease space

APPROVED MOTION: Motion to authorize expenditure up to $30,000 plus applicable GA and project management fees for project 10100100 administrative budget to remodel leased office space to reduce its square footage and authorization to negotiate the lease extension through FFY 2013.

Motion by Lloyd, second by Zemke

4. NEPA Update

APPROVED MOTION: Motion to approve $50,000 plus GA and applicable fees in support of public outreach regarding Trustee deliberations and concurrent NEPA update.

Motion by Lloyd, second by Zemke

5. Lingering Oil Status Report

APPROVED MOTION: Motion to approve $25,000 plus GA and applicable fees to produce a NOAA summary of the lingering oil studies to date, and with the understanding that NOAA will work with other state and federal agencies in preparing the report.

Motion by Hartig, second by Lloyd

6. Adjourn Motion to adjourn by Lloyd

Off the record 11:28 a.m.

Exec Dir's Report

State of Alaska

SUMMARY OF PERFORMANCE

RATES OF RETURN

PERIODS ENDING November 30, 2009

STATE STREET.

EVOS INVESTMENT REPORT

	MKT VAL $(T)	Month	QTR	1 Year	3 Years	5 Years
AY02 - EVOS RESEARCH INVESTMENT	93,855	3.62	5.62	23.57	-0.79	3.59
EVOSINFI - EVOS INVESTMENT FUND INDEX		*3.50*	*5.31*	*24.72*	*-0.78*	*3.64*
AY2H - EVOS HABITAT INVESTMENT FUND	30,076	3.62	5.56	23.48	-1.02	3.44
EVOSINFI - EVOS INVESTMENT FUND INDEX		*3.50*	*5.31*	*24.72*	*-0.78*	*3.64*
AY2J - EVOS KONIAG INVESTMENT FUND	42,410	3.65	5.53	23.29	-1.14	3.36
EVOSINFI - EVOS INVESTMENT FUND INDEX		*3.50*	*5.31*	*24.72*	*-0.78*	*3.64*
AY00A43 - EVOS BROAD MARKET FIXED INCO	54,293	1.38	3.15	14.00	6.09	5.53
XSL - BC AGGREGATE		*1.29*	*2.86*	*11.63*	*6.40*	*5.49*
AY00A45 - EVOS SOA INT'L EQUITY POOL	30,640	2.32	5.34	32.35	-3.82	4.42
XCB - MSCI EAFE (NET)		*2.00*	*4.58*	*37.72*	*-5.52*	*4.13*
AY00A42 - EVOS SHORT TERM POOL	2	0.07	0.32	2.82	0.70	2.00
X11 - 91 DAY T-BILL		*0.01*	*0.06*	*0.20*	*2.55*	*3.06*
AY00A46 - EVOS RUSSELL 3000 INDEX	81,406	5.70	7.27	27.33	-5.76	1.02
XF3 - RUSSELL 3000		*5.68*	*7.28*	*27.17*	*-5.93*	*0.90*

Alaska SeaLife Center

December 8, 2009

Ms. Elsie Hsieh
Executive Director, EVOSTC
441 West 5^{th} Avenue, Suite 500
Anchorage, AK 99501

Dear Director Hsieh,

<u>Re: Alaska SeaLife Center 2020 Strategic Planning Process</u>

As you know, the Alaska SeaLife Center is undergoing a significant transformation – due to changes in executive and scientific leadership over the past 18 months and due to the changing nature of our business model, we are working to reposition the Center as a key partner for community, academic, State and Federal partners in marine science and education. As part of that process, we are both evaluating the fundamentals of our operation (mission, core business focus, structure, etc.) as well as assessing opportunities that may be relevant to our future.

I have attached a short briefing on the process we are using to develop the 2020 Strategic Plan.

I would very much welcome the opportunity to chat with you directly to seek your views on the future of the Alaska SeaLife Center, and specifically seek your thoughts on the potential for working more closely with your agency as we reposition our business focus. Given the holiday schedules, I am hoping we can organize those conversations at your convenience in January. As per our recent conversations, I'd also very much welcome the chance to host a meeting of the Trust Council here at the Alaska SeaLife Center in the coming year.

Please don't hesitate to call me if you'd like further details.

Yours sincerely,

RECEIVED
DEC 09 2009
EXXON VALDEZ OIL SPILL
TRUSTEE Council

Ian M. Dutton, Ph.D.
President and CEO

Attachment

OFFICE OF THE PRESIDENT [illegible]
3[illegible] Ra[illegible]wa[illegible] Avenue • P[illegible] Box [illegible] • Sewar[illegible] A[illegible]aska 99664
Phone 907 224 6349 • Fax [illegible]
[illegible]

Alaska SeaLife Center

2020 Strategic Plan

Draft Process Outline for ASLC Staff and Partners

Context

The Alaska SeaLife Center (ASLC) has been in operation for 11 years. Over that time the Center has provided a "window to Alaska's seas" for more than a million visitors and has undertaken cutting edge research on endangered marine mammals and seabirds, in partnership with NOAA, USFWS and UAF-SFOS that has led to more than 170 scientific publications. The Center has an active and committed Board, more than 800 members and another 200 volunteers and enjoys broad community support.

However, because of the small local and overall State population and limited options for revenue generation in Alaska, the Center has always struggled to secure stable long term funding. Over the past eight years, annual Federal appropriations for research and education have enabled the Center to generate sufficient funding to operate and maintain the facility, but that funding stream has declined by 75% in the past three years and is not expected to be replenished at former levels. Additionally, with a changeover in both executive and scientific leadership over the past two years, the Center is clearly poised to move in new directions. *But what should these new directions be? And what is the business model that should underpin future operations?*

What is our Goal?

In a nutshell, we are developing a 10 year roadmap for the Alaska SeaLife Center – an articulation of our long term vision for success and a series of rolling implementation plans (3 year time frames) that will make that vision a reality.

What Does a 2020 Strategic Plan Contain?

This will be determined by the stakeholders and working groups, but it is likely that the actual written plan will be a relatively short (~10 page) document that will include:

- Updated ASLC Mission
- Proposed Governance Structure (Board, Scientific Advisory Committee (SAC), etc.)
- Core Business Foci with three and ten year outcomes defined
- Business model to underpin the Core Business Foci (funding and allocation mechanisms)
- Key Partnerships with industry, government, academia, NGOs and community
- Links to other relevant material (e.g., building master plan)

The plan will be supported by working reports such as a SWOT (Strengths, Weaknesses, Opportunities and Strengths) analysis, benchmarking (e.g., how do we compare with like facilities) and thematic (e.g., industry and university linkage options) reports and risk and business analyses. The plan will be launched together with the first Triennial Rolling Implementation Plan – an intermediate document that guides the Board and Senior Management Team to achieve key strategic outcomes in the first three years (2011-13) and which guides annual budgets.

Who Will be Involved?

We plan to "cast a wide net" to ensure that all current and potential stakeholders in the Center have adequate opportunity to give input and feedback as the plan develops. For efficiency, the plan will be guided by a small core planning group, comprising two Board members, a SAC representative, three senior management team members and one external/independent representative.

How will Staff and Partners be Involved?

The core group will convene a range of meetings of staff and other stakeholders over the period December 2009 to March 2010. Each meeting will be designed to contribute knowledge or review options and will feed into the core working group's iterative process of plan assembly.

What is the Time Frame?

We plan to complete the final draft plan by mid 2010 (ready for May Board meeting) so that we can use the plan to guide the 2010-11 budget as well as near-term fundraising, staffing, Board development, infrastructure investment, partnerships, and other key organizational priorities. This timeline is tight, and will therefore require the core group to communicate efficiently with a diverse range of groups.

How Can you Engage?

Please respond quickly to any call for input or meetings that are convened to seek information or obtain feedback. The success of the plan will depend on all Center staff and partners understanding why we made specific choices and why certain priorities are being pursued, and so we encourage you to track relevant communications and respond appropriately.

Questions/Inputs?

If you have any questions or suggestions, please contact Nancy Anderson, the ASLC Executive Assistant and Communications Coordinator for the process – nancy_anderson@alaskasealife.org

PAC Aug 26
Mtg Summary

Meeting Summary D R A F T

A. GROUP: *Exxon Valdez* Oil Spill (EVOS) Public Advisory Committee (PAC)

B. DATE/TIME: August 26, 2009

C. LOCATION: Anchorage, Alaska

D. MEMBERS IN ATTENDANCE: (T = via teleconference)

Name	Principal Interest
Torie Baker (T)	Marine Transportation
Jason Brune	Public-at-Large
Gary Fandrei (T)	Aquaculture/Mariculture
Jennifer Gibbins (T)	Conservation/Environmental
John French (T)	Regional Monitoring
Amanda Bauer (T)	Commercial Tourism
Stacy Studebaker (T)	Recreation Users
Bill Rosetti (T)	Science/Technical
Larry Evanoff (T)	Native Landowners

E. NOT PRESENT:

Name	Principal Interest
Patience Andersen Faulkner	Subsistence
Kurt Eilo	Sport Hunting/Fishing
Vacant	Tribal Government
Vacant	Commercial Fishing
Vacant	Local Government
Vacant	Public-at-Large

F. OTHER PARTICIPANTS:

Name	Organization
Elise Hsieh	Interim Executive Director, Trustee Council
Doug Mutter	Designated Federal Official, U.S. Dept. of the Interior
Cherri Womac	Trustee Council Staff
Catherine Boerner	Trustee Council Staff
Rebecca Talbott	Trustee Council Staff
Michael Schlei	Trustee Council Staff
Carrie Holba	Trustee Council Staff
Renee James	Trustee Council Staff
Barat LaPorte (T)	Patton Boggs
Nancy Bird (T)	Prince William Sound Science Center (PWSSC)
Rob Campbell (T)	PWSSC
Carol Fries (T)	Alaska Department of Natural Resources (ADNR)

G. SUMMARY:

At 10:01 a.m. Stacy Studebaker, PAC Chair, opened the session with a welcome and introductions by all in attendance. Doug Mutter took roll call and confirmed that a quorum was present. The June 25, 2009, PAC meeting summary was approved.

Elise Hsieh provided the Executive Director's report. The staff have been preparing for the August 31 Trustee Council meeting. The Outreach Coordinator position will continue, appointment of the Executive Director will need to be made (rather than an interim appointment), several retreat sessions for Trustee Council members have been, or will be, held. The Restoration account is now at $91.4 million. That puts the 5% level for a spending target at $4.5 million for FY 2010. As part of the administrative budget reduction efforts, they are looking at reducing office space, and one data management position has been eliminated. She appreciates the hard work the PAC did on their Work Plan recommendations. She hopes to streamline the Work Plan review process for next year.

John French remarked that asking for PAC members to rank projects needed to be part of the general discussion and that more information on projects was probably required. Jason Brune stated that the dialog among PAC members in reviewing the Work Plan was critical, especially if projects are to be ranked. Jennifer Gibbins echoed John and Jason's comments, and added the need for more time to discuss the Work Plan.

Renee James provided an overview of the proposed FY 2010 budget (see handout) by category. The summary by category is:

- Administration: $807,319
- Data management: $152,453
- Science management: $503,688
- Public Info/Outreach: $87,350
- PAC: $37,605
- Trustee Council: $29,975
- Habitat: $109,000
- Program Support: $284,148
- ARLIS: $166,669

TOTAL: $2,173,207

The program support budget is underestimated, since we do not know yet what efforts are required to manage projects, so that number will rise.

Brune asked for the recent history and expectations for the habitat protection program. Carol Fries listed several projects pending and/or coming in soon, such as the Natives of Kodiak proposal, Old Harbor, Kenai Fjords, Lesnoi, Ouzinki, and several smaller parcels. She explained that acquired parcels are then managed by the nearest logical landowner (either State or Federal), with a conservation easement with the other non-manager government. She said the Trustee Council only pursues parcels that address restoration goals.

The group raised questions about the project management and program management elements of the budget. Mutter explained the Nesslage role in managing Natural Resource Damage Assessment and Restoration funds nationwide. Hsieh noted that some agency personnel were more heavily involved in EVOS operations than others and that different salaries resulted in different amounts in the budget. Work levels also ebb and flow. She plans to analyze the current set-up for project and program management to look for ways to make it less costly. Catherine Boerner stated that agency liaisons and project managers were not always the same people. Cherri Womac also noted that these folks attend numerous EVOS-related meetings.

Gary Fandrei asked if the audit expenses were annual. James said this year they were annual, but generally they are for a 3-year period. Torie Baker asked why USGS was involved. Several responded about the USGS biological programs and past EVOS involvement by the agency. Fandrei asked how well actual expenses tracked with those budgeted. Hsieh explained that there was usually a surplus at the end of a fiscal year. It is easier to budget for travel, for example, and not need the funds than to be short of money and have to hold a Trustee Council meeting to approve additional funds. She also said she wished to examine the costs of doing project management in-house, rather than through agency personnel.

French voiced his concern that the PAC did not have enough time to adequately evaluate and discuss in a face-to-face meeting, the projects in the draft Work Plan. A full day meeting, at least, is required. Womac noted that the number of projects being reviewed has been reduced from 100 to 40. Hsieh voiced concerns about the cost of doing business (e.g. for a 2-day meeting). She noted there would not be a PAC field trip next year. Gibbins felt strongly, stating the lack of investment in the PAC was offensive and that more face-to-face interaction and meetings with the Trustee Council and field trips were needed to achieve useful PAC input. Studebaker echoed John's and Jennifer's thoughts on the need for PAC involvement and questioned the high costs of agency participation—it looks like feathering agency nests. Baker echoed Stacy's comment on the high cost of agency participation, but did not want to disparage the quality of anyone's work.

Brune said the political reality is that the Trustee Council is made up of agencies, and these decisions affected their budgets. Studebaker said that project management fees should be downsized. Bill Rosetti said that if project management fees were based on hours worked, it was not a great concern, and that sometimes when a program is winding down, more work is created. He also stated that he felt rushed in making PAC recommendations on the Work Plan. Amanda Bauer agreed that she, too, felt rushed.

Mutter explained that spill settlement funds, paid by the polluter, were used for restoration work rather than tax dollars, which are for other legislated programs and projects. That is why agencies receive settlement funds for their work.

Hsieh asked if the PAC wished to meet in January at the Alaska Marine Science Symposium, or if a different venue was desired. She suggested perhaps with the Trustee Council at the Alaska SeaLife Center in Seward. Baker likes going to the Symposium, but would like different timing for the PAC meeting. Brune would like to look at holding meetings in other, spill-affected communities. Hsieh would like to have a joint Trustee Council/PAC meeting at some time. PAC members supported this idea. Brune suggested avoiding meeting while the State legislature was in session. Hsieh also suggested possibly meeting telephonically to discuss the 2011 Invitation, and then having two face-to-face meetings during the next year. The PAC members supported this idea.

Brune was pleased that funds were included for professional development of EVOS staff, as that returns benefits and keeps staff on board. Studebaker said she was glad to see the outreach function provided by Rebecca Talbott expanded.

The public comment period was opened, however, there was no public comment offered.

Boerner gave an update on modifications to the draft FY 2010 Work Plan. An additional project on harlequin duck restoration was included. It is a multi-year project that was inadvertently left out of the previous version of the Work Plan. The added cost is $218,300. A modification to the Seeb herring restoration project is included. The original project has been scaled back to a 4-month pilot, proof-of-concept project and costs reduced from $380,000 to $71,300.

Mutter briefed the group on the PAC Charter renewal process and general schedule for the 2010-2012 term of the PAC. The renewal process will begin in early summer of 2010 in order to be completed by October 1. In keeping with EVOS cost-cutting efforts, the PAC membership is proposed to be reduced from 15 members to 10. The member interests would be: public-at-large, sport hunting/fishing, commercial tourism, commercial fishing, recreation users, aquaculture/mariculture, subsistence, Native landowners, conservation/environmental, and regional monitoring. The 5 eliminated seats are proposed to be:

- 1 of the 2 public-at-large [do not need 2 positions]
- local government and tribal government [not really public, Trustee Council can do government-to-government]
- science/technical [duplicates the Science Panel]
- regional transportation [not really representative of an injured resource/service]

Studebaker asked for final comments from PAC members. Baker said there were good questions asked today. Brune said he would like to see $100,000 moved from habitat protection to herring restoration. Fandrei supports this idea and also would like to see the results of past performance when examining budget documents. Gibbins reiterated her belief that the Trustee Council should invest more in the PAC and that more time is required for the PAC to adequately discuss and analyze the annual Work Plan. Studebaker thanked Cherri Womac for her support of the PAC.

The meeting was adjourned at 11:27 p.m.

H. FOLLOW-UP:

1. The Trustee Council will be reviewing nominations for filling vacant PAC seats

I. NEXT MEETINGS:

--Trustee Council Meeting August 31
--PAC to be determined (possibly in January 2010)

J. ATTACHMENTS (handed out at the meeting):

1. FY 2010 Budget (version K)
2. FY 2010 Draft Work Plan (July 21, 2009 version)

K. CERTIFICATION:

____ _______________

PAC Chairperson Date

FAC 2010-2012 Charter

EXXON VALDEZ OIL SPILL PUBLIC ADVISORY COMMITTEE CHARTER

1. OFFICIAL DESIGNATION: *Exxon Valdez* Oil Spill Public Advisory Committee (hereinafter referred to as the Committee).

2. AUTHORITY: The Committee is established as mandated by Paragraph V.A.4 of the Memorandum of Agreement and Consent Decree entered into by the United States of America, through the Department of Justice, and the State of Alaska, through the Attorney General, on August 27, 1991 and approved by the United States District Court for the District of Alaska in settlement of United States of America v. State of Alaska, Civil Action No. A91-081 CV (hereinafter referred to as the MOA) and shall be located in Alaska. Additional authority for its creation is found in the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended, 42 U.S.C. subsection 9601 et seq. This Committee is established in accordance with the provisions of the Federal Advisory Committee Act (FACA), as amended, 5 U.S.C., App.

3. SCOPE AND OBJECTIVES: By order of the District Court for the District of Alaska, the Committee is to advise the Trustees (State of Alaska Department of Law, State of Alaska Department of Fish and Game, State of Alaska Department of Environmental Conservation, U.S. Department of Agriculture, the National Oceanic and Atmospheric Administration of the U.S. Department of Commerce, and the U.S. Department of the Interior) appointed to administer the fund established in settlement of United States v. Exxon Corporation, Civil Action No. A91-082, and State of Alaska v. Exxon Corporation, Civil Action No. A91-083, both in the United States District Court for the District of Alaska, in all matters described in Paragraph V.A.1 of the MOA referenced above.

4. DESCRIPTION OF DUTIES: The Committee functions are advisory only, and its officers shall have no administrative authority by virtue of their membership. The Committee shall advise the Trustees through the Trustee Council with respect to the following matters:

   All decisions relating to injury assessment, restoration activities, or other use of natural resource damage recoveries obtained by the Governments, including all decisions regarding:

   a. Planning, evaluation, and allocation of available funds;
   b. Planning, evaluation, and conduct of injury assessments and restoration activities;
   c. Planning, evaluation, and conduct of long-term; monitoring and research activities;
   d. Coordination of a, b, and c.

5. AGENCY OR OFFICIAL TO WHOM THE COMMITTEE REPORTS: The Committee shall report to the *Exxon Valdez* Settlement Trustee Council through the Federal members of the Trustee Council.

6. BUREAU RESPONSIBLE FOR PROVIDING NECESSARY SUPPORT: Support for the Committee shall be provided by the Trustee Council's Executive Director, who shall

procure all needed space, supplies, equipment, and support for the Committee. The Executive Director shall prepare an annual budget for the Committee. The budget shall provide for the Committee such funds as the Trustee Council deems appropriate for administrative support for the Committee, from the *Exxon Valdez* Oil Spill Investment Fund established as a result of the settlement of United States v. Exxon Corporation and State of Alaska v. Exxon Corporation.

7. ESTIMATED ANNUAL OPERATING COSTS: The estimated annual operating cost for the Committee is $35,000, including all direct and indirect expenses. It is estimated that .4 staff years will be required to support the Committee. Members of the Committee serve without compensation. However, while away from their homes or regular places of business, members engaged in Committee business approved by the Trustee Council Executive Director or the Designated Federal Officer will be allowed travel expenses, including per diem in lieu of subsistence, in the same manner as persons employed intermittently in Government service.

8. DESIGNATED FEDERAL OFFICER: The Designated Federal Officer is the U.S. Department of the Interior, Alaska Office of Environmental Policy and Compliance's Regional Environmental Assistant, or his/her designee.

9. ESTIMATED NUMBER AND FREQUENCY OF MEETINGS: The Committee is expected to meet approximately, and no less than, two times per year.

10. DURATION: The requirement for the Committee will continue throughout the life of the settlement agreement referenced in item 2, above.

11. TERMINATION DATE: The Committee is subject to the provisions of FACA and is subject to biennial review and will terminate two years from the date the charter is filed, unless, prior to that time, the charter is renewed in accordance with section 14 of FACA.

12. MEMBERSHIP AND DESIGNATION: The Committee shall consist of 8 representative members, including a Chair and Vice-Chair elected by the Committee members. Each member will serve a two-year term and members are eligible for re-nomination and reappointment. No member shall participate in any matter specifically concerning a lease, license, permit, contract, claim, agreement, or related litigation in which the member has a direct financial interest. One member will be appointed representing each of the interests identified below.

    a. aquaculturist/mariculturist (e.g., fish hatcheries and oyster/shellfish farming)
    b. commercial fisher (e.g., commercial fishing for salmon, halibut, herring, shellfish and bottom fish; including boat captains and crews, cannery owners/operators, and fish buyers)
    c. commercial tourism business person (e.g., promoting or providing commercial travel or recreational opportunities, including charter boating, guiding services, visitor associations, boat/kayak rental)
    d. recreation user (e.g., recreation activities that occur within the area, including kayaking, power boating, sailing, sightseeing)
    e. conservationist/environmentalist (e.g., organizations interested in the wise use and protection of natural resources)

f. Native landowner (e.g., regional or village corporations in the affected area established by the Alaska Native Claims Settlement Act)

g. sport hunter/fisher (e.g., hunting and/or fishing for pleasure)

h. subsistence user (e.g., customary and traditional use of wild renewable resources for direct personal or family consumption as food, shelter, fuel, clothing, tools or transportation; for the making and selling of handicraft articles; and for customary trade)

13. SUBCOMMITTEES: The Committee may, upon approval of the Trustee Council, establish such workgroups or subcommittees as it deems necessary for the purpose of compiling information or conducting research. However, such work groups or subcommittees may not conduct business and must report to the full Committee.

14. RECORDKEEPING: Records of the Committee, and any workgroups or subcommittees established, will be handled as part of the Trustee Council's Official Record, available at their office. A public copy of those records is available at the Alaska Resources Library and Information Services. These records shall be available for public inspection and copying, subject to the Freedom of Information Act, 5 U.S.C. 552.

15. FILING DATE:

________________________________ ________________

Secretary of the Interior Date

____

Date Filed

DRAFT

9 PAC Seats to Retain – These positions are supposed to represent people, services and/or entities directly affected/impacted by the EVOS

1. Aquaculturist/mariculturist (e.g., fish hatcheries and oyster/shellfish farming)

2. Commercial fisher (e.g., commercial fishermen for salmon, herring, halibut, shellfish and bottom fish; including boat captains and crews, cannery owners/operators, and fish buyers)

3. Commercial tourism business person (e.g., promoting or providing commercial travel or recreational opportunities, including charter boating, guiding services, visitor associations, boat/kayak rental)

4. Recreation user (e.g., recreation activities that occur within the area, including kayaking, birding, wildlife photography, power boating, sailing, sightseeing)

5. Conservationist/environmentalist (e.g., non-government organizations interested in the wise use and protection of natural resources)

6. Native landowner (e.g., regional and village corporations in the affected area established by the Alaska Native Claims Settlement Act)

7. Regional monitoring program operator (e.g., monitoring and reporting on environmental conditions in the affected area, including monitoring for pollution and the status of biological resources)

8. Sport hunter/fisher (e.g., hunting and/or fishing for pleasure)

9. Subsistence user (e.g., federally recognized tribes in the affected area) (e.g., traditional user of wild renewable resources for direct personal or family consumption as food, shelter, fuel, clothing, tools or transportation for the making and selling of handicrafts articles; and for customary trade)

No less than 2 face-to-face PAC meetings per year plus teleconference meetings when necessary.

One field trip every other year.

PAC Chair attends all PAC and Trustee Council meetings in person, and sits at the table with the TC.

Budget: $~~50~~,000.
30,000.

PAC 2002-2010
Attendance Record

Exxon Valdez Oil Spill Public Advisory Committee
Attendance: October 2002-August 2004

Member/ Interest Represented	PAC Meetings/Briefings/Field Trips (excludes participation in subgroups, work sessions, public meetings, or other Trustee Council activities)									
	12-3-02	1-14-03	2-6-03	6-7-03	7-23-03	8-14-03	1-15-04	2-25-04	5-19-04*	7-21-04
Torie Baker Commercial Fishing		X		X		X				X
John Devens Regional Monitoring	X	X				X	X			
Gary Fandrei Aquaculture/Mariculture	X	X		X		X	X	X	X	X
John Gerster Public-at-Large	X	X				X		X	X	X
Bret Huber (Chair) Sport Hunting & Fishing	X	X		X		X				
Charles Hughey Subsistence	X	X						X		X
R J Kopchak Public-at-Large	X	X				X	X	X		X
Pat Lavin Conservation/Environmental	X	X		X		X	X	X	X	X
Charles Meacham (Vice-Chair) Science/Academic	X	X		X		X	X	X	X	X
Brenda Norcross Science/Technical and STAC	X	X		X		X	X		X	X
Pat Norman Native Landowner								X		X
Ed Page Marine Transportation	X			X		X	X		X	X
Martin Robards Conservation/Environmental	X	X		X		X	X	X		X
Stan Senner Conservation/Environmental	X	X				X	X			
Gerald Sanger Commercial Tourism	X									

Member/ Interest Represented	PAC Meetings/Briefings/Field Trips (excludes participation in subgroups, work sessions, public meetings, or other Trustee Council activities)									
	12-3-02	1-14-03	2-6-03	6-7-03	7-23-03	8-14-03	1-15-04	2-25-04	5-19-04*	7-21-04
Scott Smiley Public-at-Large	X	X						X		
Stacy Studebaker Recreation Users	X			X		X			X	X
Michael Vigil Tribal Government	X	X								X
Kate Williams Conservation/Environmental	X	X		X		X				
Ed Zeine Local Government				X		X	X	X	X	X

Exxon Valdez Oil Spill Public Advisory Committee
Attendance: October 2004-August 2006

Member and Interest Represented	PAC Meetings/Briefings/Field Trips (excludes participation in subgroups, work sessions, public meetings, or other Trustee Council activities)									
	1-27-05	3-18-05	4-28-05	6-11-05	7-19-05	1-26-06	3-06-06	7-14-06	8-24-06	
Torie Baker Commercial Fishing	X			X		X	X		X	
Jason Brune Public-at-Large	X	X	X	X		X	X	X		
Kurt Eilo Sport Hunting and Fishing						X				
Larry Evanoff Native Landowners	X					X		X		
Gary Fandrei Aquaculture/Mariculture		X	X	X		X	X		X	
John Gerster (Chair) Science/Technical	X	X		X	X	X				
Randy Hagenstein Recreation Users	X			X		X	X			
Lisa Ka'aihue Regional Monitoring	X	X	X	X	X		X	X	X	
R J Kopchak Commercial Fishing	X	X		X		X			X	
Pat Lavin Conservation/Environmental				X		X	X			
Vern McCorkle Public-at-Large						X	X	X	X	
Brenda Norcross Science/Technical and STAC	X	X	X	X			X	X	X	
Pat Norman Native Landowner	X	X	X	X						
Ed Page Marine Transportation										
Ron Peck Commercial Tourism	X		X	X	X	X				

Member and Interest Represented	PAC Meetings/Briefings/Field Trips (excludes participation in subgroups, work sessions, public meetings, or other Trustee Council activities)									
	1-27-05	3-18-05	4-28-05	6-11-05	7-19-05	1-26-06	3-06-06	7-14-06	8-24-06	
Martin Robards Conservation/Environmental	X		X	X		X	X		X	
Stacy Studebaker (Vice-chair) Recreation Users	X	X	X	X		X	X	X		
Mead Treadwell Science/Technical			X	X	X		X	X		
Andrew Teuber Subsistence	X	X	X				X			
Ed Zeine Local Government			X	X	X	X	X	X	X	

X = attended

Exxon Valdez Oil Spill Public Advisory Committee
Attendance: October 2006-September 2008

Member and Interest Represented	PAC Meetings/Briefings/Field Trips (excludes participation in subgroups, work sessions, public meetings, or other Trustee Council activities)										
	11-2-06	1-25-07	2-1-07	3-2-07	7-24-07	8-30-07	12-6-07	1-24-08	3-5-08	9-3-08	9-17-08
Torie Baker Marine Transportation	X		X	X	X	X	X	X	X		X
Jason Brune Public-at-Large	X	X	X	X	X	X	X	X	X		X
Kurt Eilo Sport Hunting and Fishing	X		X	X	X	X	X		X	X	X
Larry Evanoff Native Landowners	X					X	X				X
Gary Fandrei Aquaculture/Mariculture	X	X	X	X	X	X	X	X	X	X	X
Mark King Tribal Government	X										
R J Kopchak Commercial Fishing	X	X	X	X	X	X	X		X		X
Pat Lavin Conservation/Environmental	X	X			X	X	X			X	
Steve Lewis Regional Monitoring	X		X	X		X	X			X	
Vern McCorkle Public-at-Large	X	X		X	X	X					
Ron Peck Commercial Tourism				X	X	X	X				
Martin Robards Science/Technical	X	X	X	X	X				X		
Stacy Studebaker Recreation Users	X	X	X	X	X	X	X	X			X
Martha Vlasoff Subsistence	X	X	X		X	X		X			
Ed Zeine Local Government	X	X	X	X	X	X	X	X	X	X	X

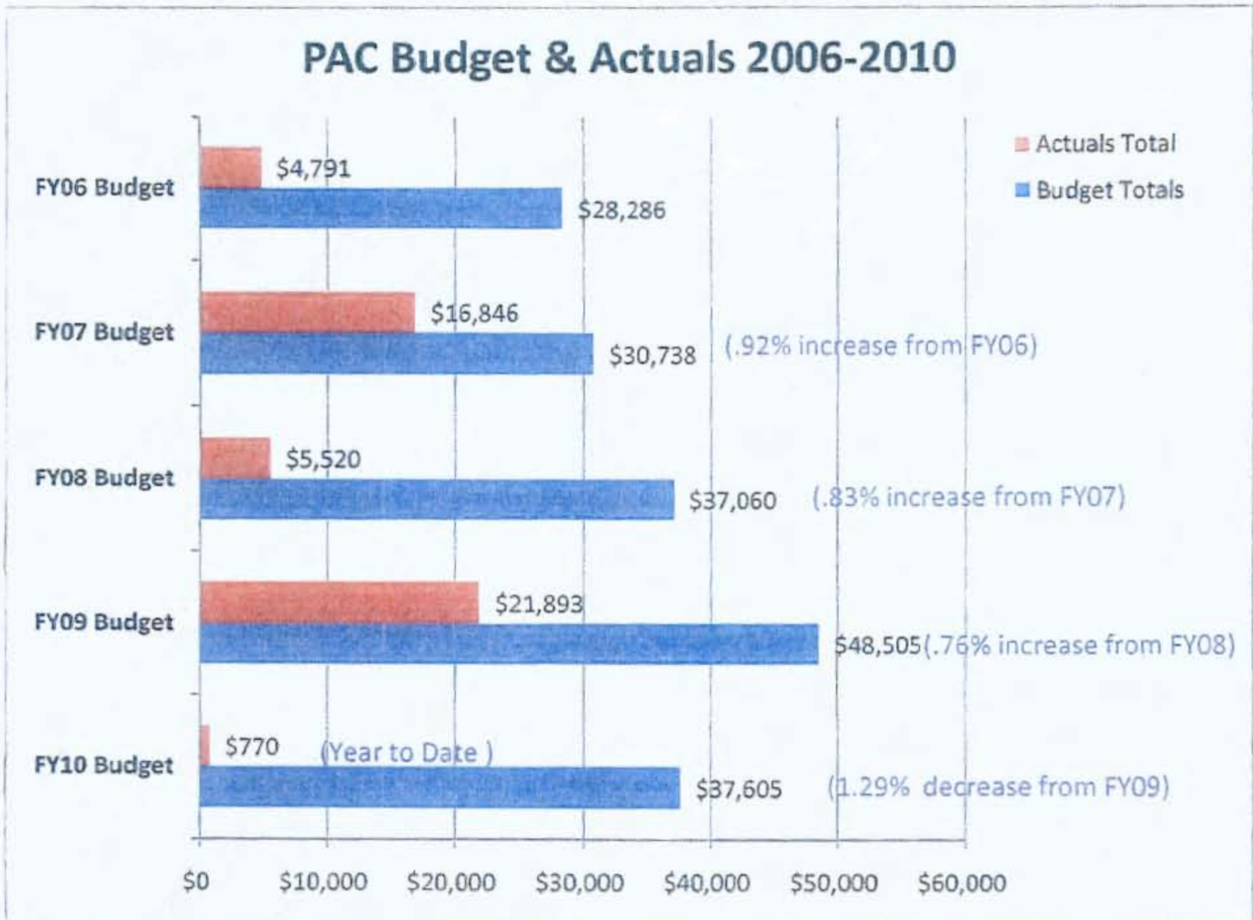
X = attended

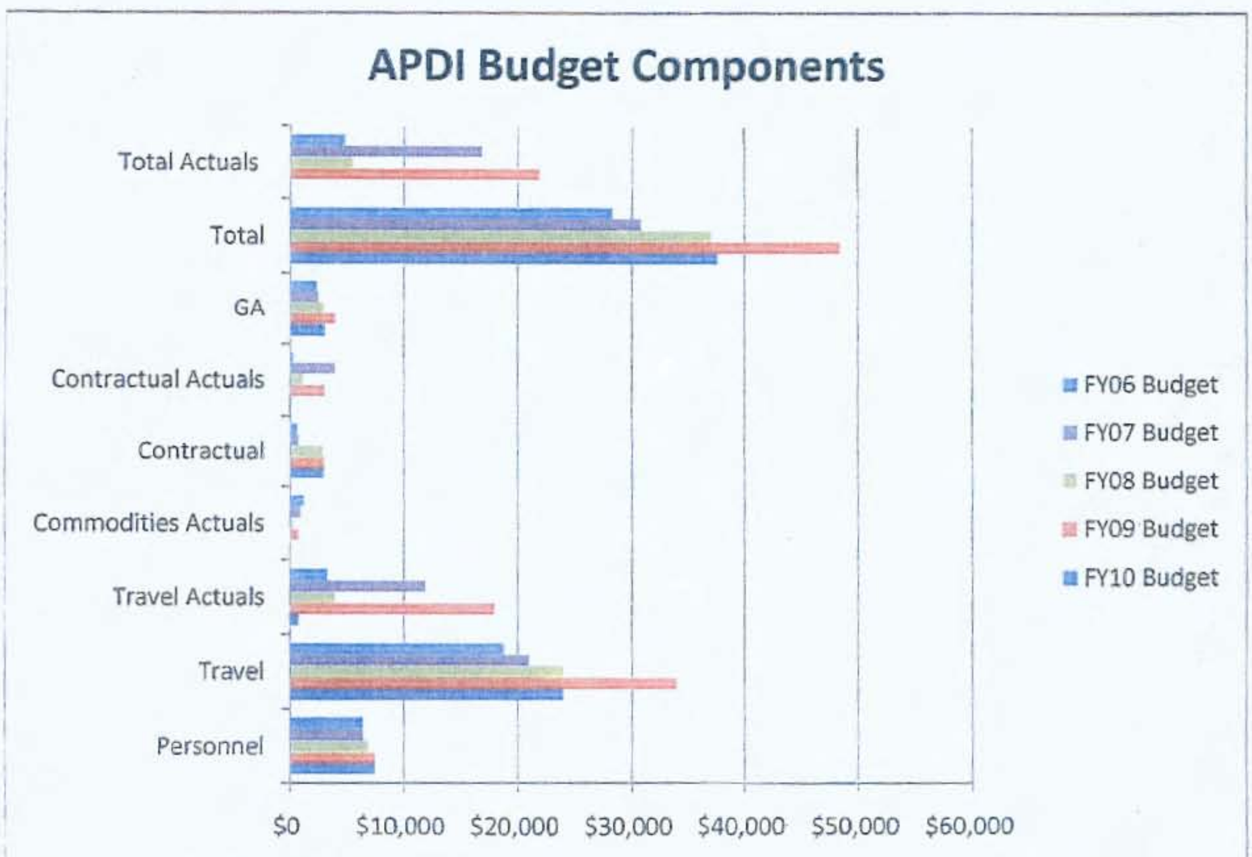
Exxon Valdez Oil Spill Public Advisory Committee
Attendance: October 2008-September 2010

Member and Interest Represented	PAC Meetings/Briefings/Field Trips (excludes participation in subgroups, work sessions, public meetings, or other Trustee Council activities)										
	1-9-09	2-4-09	5-28-09	6-25-09	8-26-09						
Torie Baker Marine Transportation	X	X			X						
Amanda Bauer Commercial Tourism	X	X	X	X	X						
Jason Brune Public-at-Large	X	X	X	X	X						
Kurt Eilo Sport Hunting and Fishing	X		X								
Larry Evanoff Native Landowners	X	X		X	X						
Gary Fandrei Aquaculture/Mariculture	X	X		X	X						
Patience Anderson Faulkner Subsistence	X	X	X	X							
John French Regional Monitoring	X	X	X	X	X						
Jennifer Gibbons Conservation/Environmental	X	X	X	X	X						
Lori "Sue" Johnson Tribal Government	X										
Commercial Fishing											
Bill Rosetti Science/Technical	X	X		X	X						
Stacy Studebaker Recreation Users	X	X	X	X	X						
JoAnn Vlasoff Subsistence	X		X	X							
Local Government											

X = attended

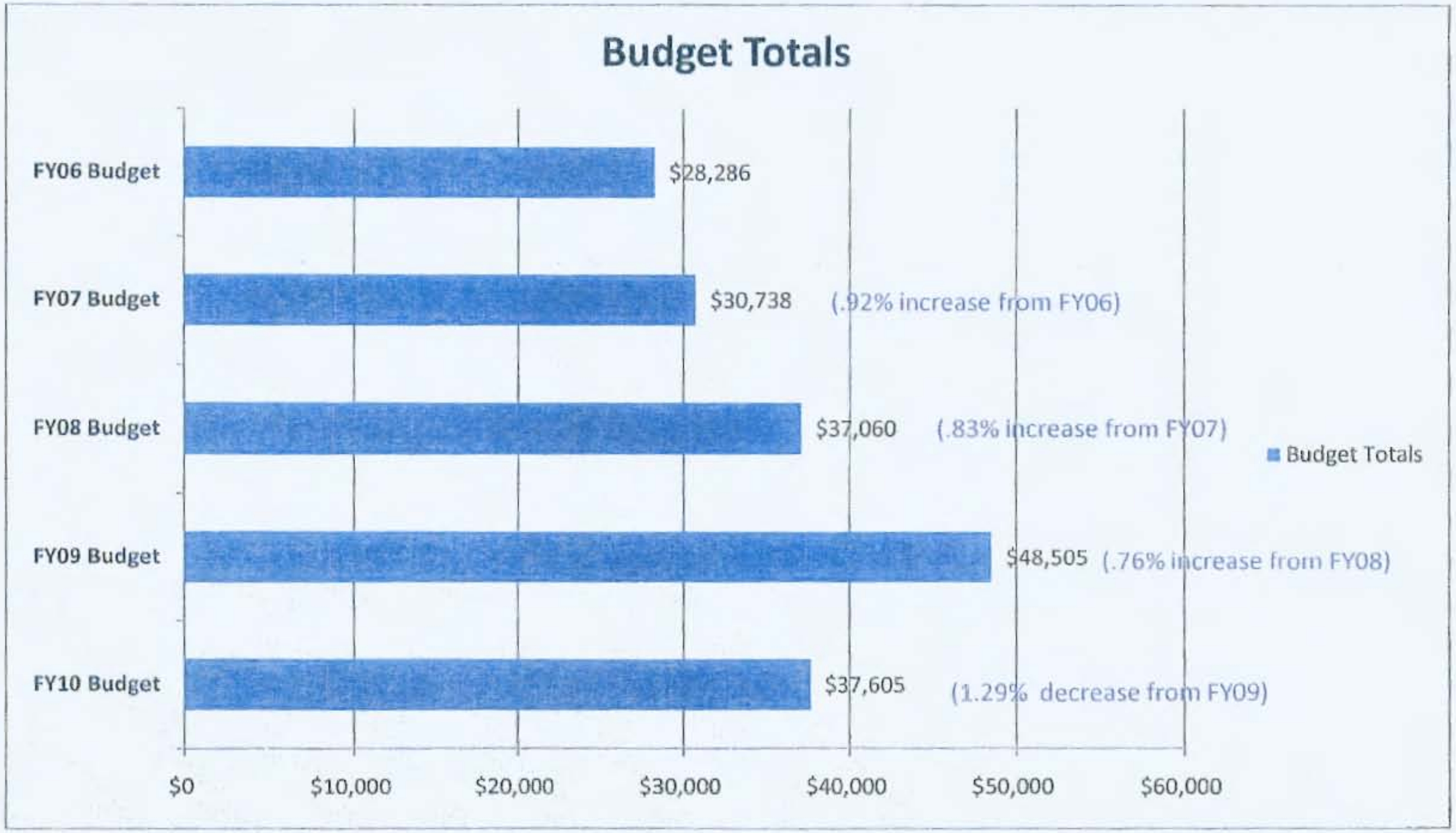
PAC Budget Comparison


PAC Budget & Actuals 2006-2010
Actuals Total
Budget Totals
FY06 Budget
$4,791
$28,286
FY07 Budget
$16,846
$30,738
(.92% increase from FY06)
FY08 Budget
$5,520
$37,060
(.83% increase from FY07)
FY09 Budget
$21,893
$48,505
(.76% increase from FY08)
FY10 Budget
$770
(Year to Date)
$37,605
(1.29% decrease from FY09)
$0
$10,000
$20,000
$30,000
$40,000
$50,000
$60,000


APDI Budget Components
Total Actuals
Total
GA
Contractual Actuals
Contractual
Commodities Actuals
Travel Actuals
Travel
Personnel
FY06 Budget
FY07 Budget
FY08 Budget
FY09 Budget
FY10 Budget
$0
$10,000
$20,000
$30,000
$40,000
$50,000
$60,000

All Components (Totals)

	Budget Totals
FY10 Budget	$37,605
FY09 Budget	$48,505
FY08 Budget	$37,060
FY07 Budget	$30,738
FY06 Budget	$28,286



Note: FY09 includes additional $10,000 for Knight Island site visit

NEPA Notice of Intent
(NOI)

Billing Code:

DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

[Docket No. ________; I.D.____________]

RIN: 0648-XT64

AGENCY: National Oceanic and Atmospheric Administration (NOAA), U.S. Department of Commerce.

COOPERATING AGENCIES: Alaska Department of Law, Alaska Department of Environmental Conservation, Alaska Department of Fish and Game, the U.S. Departments of Interior and Agriculture.

ACTION: Notice of Intent to Prepare a Supplemental Environmental impact statement; Request for Comments.

SUMMARY

NOAA, as a member of the *Exxon Valdez* Oil Spill Trustee Council (Council), announces the intent of the Council to prepare a supplement to the existing environmental impact statement (EIS) on the Council's restoration efforts, in accordance with the National Environmental Policy Act of 1969, 42 U.S.C. § 4321 *et seq.* (NEPA). This supplemental EIS (SEIS) is necessary to respond to significant new circumstances bearing on the Council's restoration efforts as assessed in the original EIS. Specifically, as the restoration funds remaining from the Exxon Valdez settlement diminish, the Council seeks a more discrete and efficient funding mechanism by which to direct the remaining funds. The SEIS would assess the environmental impacts of the Council's proposal to narrow and refine the scope of the Council's restoration efforts to five defined

restoration categories: 1) herring; 2) lingering oil; 3) long-term monitoring of marine conditions; 4) harbor protection and marine restoration; and 5) habitat acquisition and protection.

DATES: Written comments on the intent to prepare and the scope of a SEIS will be accepted on or before April 1, 2010. Preliminary public scoping meetings are scheduled as follows; updates or changes to the meeting times or dates, due to weather or other factors, can be found at http://www.evostc.state.ak.us.:

1. February 16, 2010 from 6:00 p.m. to 8:00 p.m. at the Alaska Islands and Oceans Visitor Center, 95 Sterling Highway, Homer, AK 99603___.
2. February 17, 2010 from 6:00 p.m. to 8:00 p.m. at the _____, Anchorage, AK 9___.
3. February 18, 2010 from 7:00 p.m. to 9:00 p.m. at the Cordova Public Library, 622 First Street, Cordova, AK 99574.
4. March 16, 2010 from 6:00 p.m. to 8:00 p.m. at the K.M. Rae Building, 125 Third Avenue, Seward, AK 99664.
5. March 17, 2010 from 6:00 p.m. to 8:00 p.m. at the Valdez City Council Chambers, 206 Pioneer Drive, Valdez, AK 99686.
6. March 18, 2010 from 6:00 p.m. to 8:00 p.m. at the Kodiak Refuge Visitor Center, 402 Center Street, Kodiak AK 99615.

A draft SEIS will be released for public comment by spring 2010. Specific dates and times for future events will be publicized on the EVOSTC website, http://www.evostc.state.ak.us, when scheduled.

ADDRESSES: Written comments on suggested alternatives and potential impacts should be sent to Laurel Jennings, *Exxon Valdez* Oil Spill Trustee Council, 441 West 5th

Avenue, Suite 500, Anchorage, AK 99501. Emailed comments will be received at dfg.evos.nepacomments@alaska.gov.

FOR FURTHER INFORMATION CONTACT: Laurel Jennings (907.265.9335).

SUPPLEMENTARY INFORMATION

Background

In 1992, the *Exxon Valdez* Oil Spill Trustee Council was formed by six trustees, three State of Alaska trustees and three federal trustees, to oversee restoration of the natural resources and ecosystem damaged by the 1989 oil spill. The *Exxon Valdez* Oil Spill Trustee Council was funded by settlement of civil claims brought against Exxon Companies by the State of Alaska and the United States. The Council initiated an extensive public process to begin the work of restoration using these joint trust funds and, in 1994, adopted a Restoration Plan to guide restoration through research and monitoring, habitat protection and general restoration. The Restoration Plan also established a Restoration Reserve recognizing that recovery from the spill would not occur for decades.

As part of this effort, the Council also adopted an official list of resources and services injured by the spill. When the 1994 Plan was drafted, the distinction between the effects of the spill and those of other natural or human-caused stressors on injured resources or services was not clearly understood. Through the hundreds of studies conducted over the last twenty years, the Council has come to recognize that ecosystem restoration is not easily addressed. The interactions between a changing environment and the injured resources and services are only beginning to be understood, and, as time passes, the ability to distinguish the effects of the oil from other factors affecting fish and wildlife populations becomes more difficult. These complexities and the difficulties in measuring the continuing impacts from the spill result in some inherent uncertainty in defining the status of a resource or service through a specific list.

The 1994 Plan also outlined an ecosystem approach to restoration, a more integrated view that has become increasingly recognized as essential. Even before the Plan was final, the Council began efforts to better understand the marine ecosystem. This approach has provided and continues to provide an abundance of information on fish, marine birds, and mammals.

Proposed Action

Of the approximately $780 million of joint trust funds initially funding the Council, over $180 million has been used for research, monitoring and general restoration and over $375 million has funded habitat protection. Council annual program development, implementation and administration have cost over $45 million dollars. Approximately $76 million remains available for research, monitoring and general restoration and $24 million remains available for habitat acquisition and protection. Recognizing that funding for future restoration is limited and that it is becoming increasingly difficult to distinguish between spill impacts and other effects in measuring recovery, the Council is considering an organized and strategic transition to a modest program which would focus the remaining funds on a few specific programs and habitat protection.

Long-term management of species and resources initially injured by the spill lies with the agencies and entities that have the mandate and resources to pursue these long-term goals. To support natural restoration and to enable management consistent with this long-term restoration, the Council has increasingly directed funds toward research that provides information that is critical to monitor and support the healthy functioning of the spill ecosystem.

Building on its past efforts, the Council has identified five areas of focus for its remaining work: (1) herring; (2) lingering oil; (3) long-term monitoring of marine conditions; (4) harbor protection and marine restoration; and (5) habitat acquisition and protection. The following paragraphs elaborate on the details of each of these proposed areas of focus.

1. Herring

The Council has classified the Prince William Sound (PWS) population of Pacific herring (*Clupea pallasi*) as a resource that has not recovered from the effects of the 1989 oil spill. The PWS herring population was increasing prior to 1989 with record harvests reported just before the spill. The 1989 year class was one of the smallest cohorts of spawning adults recorded and by 1993 the fishery had collapsed with only 25% of the expected adults returning to spawn. The PWS fishery was closed from 1993 to 1996, but reopened in 1997 and 1998, based on an increasing population. Numbers again declined in 1999, and the fishery remains closed today. The 1993 collapse can be explained by several competing hypothesis; however, data uncertainty makes it unlikely that the reasons will be known.

The Council recognizes the uncertainty with regard to the role of the 1989 spill and the current depressed state of the PWS herring population. However, herring are considered a keystone species in the marine ecosystem and play a vital role in the food chain of many injured species. Thus, rebuilding the herring population has the potential to support the restoration of these injured species. In addition, supporting a healthy herring population may compensate for some of the losses in fishing opportunities that resulted from the spill and its damage to salmon and species other than herring. In April 2006, prompted by public comments about the continuing impacts to communities and commercial fishermen from herring losses, the Council convened scientists and researchers, commercial and subsistence fishermen, and natural resource managers for a herring workshop. One of the most important outcomes of the workshop was the consensus that a long-term strategic herring restoration program was needed if viable herring recovery activities were to be implemented. From 2006 to 2008, Council representatives met with natural resource managers, commercial fishers, scientists, the Public Advisory Committee (PAC) and Alaska Native residents of spill-area communities to gain sufficient input to draft a cost-efficient, scientifically credible, and coordinated program. This effort produced the first draft of the Integrated Herring Restoration Program (IHRP) in December 2008.

The goal of the IHRP is to determine what, if anything, can be done to successfully restore PWS herring; to determine what steps can be taken to examine the reasons for the continued decline of herring in the Sound; to identify and evaluate potential recovery options; and to recommend a course of action for restoration. The document is currently being reviewed and updated with new information and will serve as a general road map for the Council's herring-related funding decisions. The Council has proposed to fund $20 million for research in this area over a twenty-year period.

2. Lingering Oil

One of the most surprising revelations from two decades of research and restoration efforts since the 1989 spill is the persistence of subsurface oil in a relatively un-weathered state. This oil, estimated to be around 97.2 metric tons (or 23,000 gallons), is contained in discontinuous patches across beaches that were initially impacted by the spill. The patches cannot be visually identified on the beach surface, but their presence may be a source for continued exposure to oil of sea otters and birds that seek food in sediments where the oil persists and remains a concern and a perception of contamination by subsistence users. The survey work completed to date indicates that the oil is decreasing at a rate of zero to four percent per year, with only a five percent chance that the rate is as high as four percent. As a result, it may persist for decades.

Passive and subsistence uses were significantly impacted by the spill and this has affected the overall health of the communities in Prince William Sound. The lingering oil has also impacted the public's perception of the spill area as the pristine environment that was present before the spill occurred. This perception has continued to preclude full recovery for some passive and subsistence uses. It may require additional resources to evaluate, monitor, and redress the impact of lingering oil on these uses in the spill-area. An important function of this information gathering would be to pass this information back to the communities and the general public.

In an effort to address the issue of lingering oil, the governments developed a restoration plan under the terms of the Reopener provision in the Consent Decree with Exxon (http://www.evostc.state.ak.us/facts/reopener.cfm). Efforts to date include the development of a spatial probability model to identify beach segments with a high likelihood of persistent oil, and investigations of the reasons for the persistence of oil as a means to consider options that may accelerate the oil degradation. Under the lingering oil initiative, the Council envisions completion of the studies underway to reach a decision point on further efforts for active remediation. Upon receiving additional lingering oil information from these current lingering oil studies and the resolution of the Reopener, the Council will evaluate the need for restoration of related services and thus no prospective funding amount has been proposed.

3. Long-term monitoring of marine conditions

In the twenty years since the *Exxon Valdez* oil spill, it has become apparent that the ocean ecosystem can undergo profound changes and such changes likely preclude a return to pre-spill conditions. The 1994 Restoration Plan (Plan) recognized that recovery from the spill would likely take decades. A Restoration Reserve was created from the Plan in part to provide for long-term observation of injured resources and services and provide for appropriate restoration actions into the future. To further this effort, in 1999 the Council also supported the development of a long-term research and monitoring program.

Long-term monitoring has two components: monitoring the recovery of resources from the initial injury and monitoring how factors other than oil may inhibit full recovery or adversely impact recovered resources. This second type of monitoring collects data on environmental factors that drive ecosystem-level changes. The information that is produced from such monitoring may be used to manage individual injured species and resources. However, such data is increasingly valuable in illuminating the larger ecosystem shifts that impact and influence a broad variety of species and resources injured by the spill.

By monitoring these changes, agencies and interested parties may be able to adjust their own activities and management strategies to adapt to what may lie ahead and to further support injured resources in these quickly-shifting marine ecosystems. The Council has a history of supporting oceanographic monitoring by helping to establish and fund long-term data collections. In this initiative, the Council envisions seeking partnerships with scientific entities or consortiums able to maintain those collections and that can demonstrate an ability to leverage this support and develop science-based products to inform the public of changes in the environment and the impacts of these changes on injured resources and services. The Council proposes to fund this effort with approximately $25 million, to be spent over a twenty-year period.

4. Harbor protection and marine restoration

a. Storm water, wastewater, and harbor projects

Many coastal communities in the spill area have a limited ability to collect and properly dispose of waste, such as oily bilge water, used engine oil, paints, solvents, and lead-acid batteries. Improper disposal of these wastes in landfills adversely affects the quality of nearby marine waters through runoff and leaching. In some cases, these wastes are discharged directly into marine waters. Chronic marine pollution stresses fish and wildlife resources, possibly delaying recovery of resources injured by the oil spill. For example, with regard to the worldwide mortality of seabirds, the effects of chronic marine pollution are believed to be at least as important as those of large-scale spills.

The Council has approved the funding of several projects to prepare waste management plans and has contributed to their implementation. These projects resulted in the acquisition of waste oil management equipment and the construction of environmental operating stations for the drop-off of used oil, household hazardous waste and recyclable solid waste in Cordova, Valdez, Chenega Bay, Tatitlek and Whittier, Kodiak and lower Cook Inlet. The Council seeks to further reduce pollution in the marine environment to contribute to the recovery of injured natural resources or services and is considering funding this effort with ten million dollars.

b. Marine debris removal

Marine debris is an issue in the marine and near-shore environment in Alaska, where it is likely that thousands of tons of marine debris exist within three nautical miles of the Alaska coastline. Marine fish and wildlife become entangled in and ingest debris from foreign and domestic sources that may be a day or decades old and that range from small plastic items to very large fishing nets. Approximately 175 metric tons of debris was collected from Alaska coasts by citizen cleanup projects in 2007. Marine debris removal projects can result in an immediate improvement to the coastal habitat.

Coastal communities are effective in marine debris cleanups due to their intimate knowledge of the locations of debris accumulation. In addition, when communities participate in marine debris cleanups, they often alter the common practices that led to marine debris as their awareness of the effects of the debris on their coastline and the fisheries upon which they depend increases. Marine debris removal reduces marine pollution affecting injured resources and services and thus further supports natural restoration. The Council proposes to fund marine debris removal with approximately three million dollars.

c. Response, damage assessment and restoration implications

Damage to natural resources occurs not only with an initial oil spill, but additional damage can also be caused by spill response efforts. Damage assessment from the 1989 spill has yielded information that can assist in mitigating damage from spill response activities in future spills. Skilled damage assessment also quantifies the extent of injury and allows for the accurate monitoring and measurement of restoration after a spill. Organizing, preserving, and passing on such information will help responders and those conducting future damage assessments. These efforts ensure that restoration efforts are truly effective. Outreach efforts could include a conference or series of papers sharing information to be used by future responders, including natural resource assessment, the long-term costs of high-pressure washing, use of dispersants in the near-shore, sub-arctic environment, and the effects of potential burning scenarios. The Council proposes to fund this effort with one million dollars.

5. Habitat acquisition and protection

The protection of habitat is an important component of the *Exxon Valdez* oil spill restoration program. The acquisition of private lands or partial interests in private lands promotes the natural recovery of spill-injured resources and associated services by removing the threat posed by additional development impacts. The program is implemented by state and federal resource agencies, often in partnership with non-governmental organizations. The habitat program has protected approximately 650,000 acres of valuable habitat through a variety of purchases of various property rights, ranging from fee simple acquisition to conservation and timber easements. The goals of the habitat protection program remain viable. Resource and land management agencies, such as the Alaska Department of Natural Resources, Alaska Department of Fish and

Game, U.S. Fish and Wildlife Service, National Park Service and U.S. Forest Service, continue to receive parcel nominations for Council consideration. Approximately $24 million remains within the habitat subaccount for future habitat protection efforts. The Council is considering alternatives for allocation of these funds. For example, half of the funds remaining may be allocated to the purchase of large parcels within a period of two to three years, and the remaining half to a program spanning a 12-year period focused on the protection of small parcels less than 1,000 acres or $1 million in price. The Council proposes to utilize the approximately $24 million remaining to continue the habitat program. A variety of administrative options, funding allocations, time frames, and management strategies will be considered.

Public Involvement

Scoping is an early and open process for determining the scope of issues to be addressed in a SEIS and for identifying if there are significant environmental effects or issues related to the proposed action. A principal objective of the scoping and public involvement process is to identify a range of reasonable alternatives that will delineate critical issues and provide a clear basis for distinguishing among those alternatives and selecting a preferred alternative. Through this Notice, the Council notifies the public that a NEPA analysis and decision-making process has been initiated so that interested or affected people may participate and contribute to the final decision.

Through this scoping process, the Council is seeking input and feedback on the areas, issues and projects proposed above, as well as possible alternatives to these proposals. The Council seeks public involvement in the development of the SEIS and encourages members of the public to submit comments in writing at the address shown above (see ADDRESSES). Written comments should be as specific as possible to be the most helpful. Written comments received during the scoping process, including the names and addresses of those submitting them, will be considered part of the public record on this proposal and will be available for public inspection.

The Council also invites the public to participate in the scoping meetings shown above (see DATES). When the lead federal agency considers a change to a proposed action analyzed in an environmental impact statement (EIS), or new information relevant to the action becomes available, the federal agency must determine whether a supplement to the EIS (also referred to as a "supplemental EIS") or a new EIS is appropriate. In this instance, NOAA, as the lead agency, has determined that a SEIS is appropriate and will be prepared under the authority and in accordance with the requirements of NEPA, Council on Environmental Quality Regulations (40 CFR 1500-1508), other applicable federal laws and regulations, and NOAA's established policies and procedures for compliance with those regulations. A SEIS must consider all reasonable alternatives, including the preferred action and the no action alternative. Even the most straightforward actions may have alternatives, often considered and rejected in early stages of project development that should be discussed. Opportunities for public comment are provided through public review and comment on documents contained in the Administrative Record as well as on the Public Review Document, Draft and Final Environmental Impact Statement when prepared.

In compliance with 15 CFR 990.45, the Council will prepare an Administrative Record (Record). The Record will include documents that the Council relied upon during the development of the SEIS. After preparation, the Record will be on file at the *Exxon*

Valdez Oil Spill Trustee Council office in Anchorage, AK and duplicate copies will be maintained at the following website: http://www.evostc.state.ak.us.

Ouzinkie Native Corporation, Afognak Island

Owner:	Ouzinkie Native Corporation
Physical Location:	This parcel is located on northern Afognak Island immediately south of parcels recently acquired from Shuyak and Uganik Corporations.
Acreage:	Approximately 7,200 acres
Brief Description:	Phase I: T.21 S., R. 20W. Sections 25-36, all and T. 21 S., R. 21 W., Section 36, SE ¼
Agency Sponsor:	Alaska Department of Natural Resources in cooperation with US Fish and Wildlife Service
Appraised Value:	Unknown

Parcel Description. This parcel is the most northern portion of Ouzinkie property covered by an option agreement held by Rocky Mountain Elk Foundation and American Land Conservancy. The landowner prefers to pursue phased acquisition opportunities for their lands on Afognak. The Ouzinkie parcel consists of mostly low elevation rolling terrain with approximately 10 miles of coastline in total. Phase one contains approximately one mile of shoreline on Perenosa Bay and runs east to west just south of lands previously acquired from Shuyak and Uganik Corporations. The western edge of the property rises in piedmont fashion until connecting with the mountainside boundary of the Kodiak National Wildlife Refuge Red Peak unit. Naturally occurring Sitka spruce forest, meadows, ponds, rivers and creeks, including some salmon spawning systems occur on the property. Most of the parcel has been logged, including the Phase I property currently under consideration. Some second growth has already begun on the remainder of the Ouzinkie parcel. Compliance with Forest Practices Act requirements will continue.

Linkage to Restoration:

Resources that will benefit from protection of this parcel include Pacific herring and Pigeon guillemots, which are currently listed as not recovering. Northern Afognak is exceptionally rich in wildlife including harlequin ducks and black oystercatchers. The parcel will also contribute to the recovery of associated services such as recreation, commercial fishing and passive use. A variety of recovered resources are found in this area and protection of contiguous habitat will support the continued the health of these recovered species.

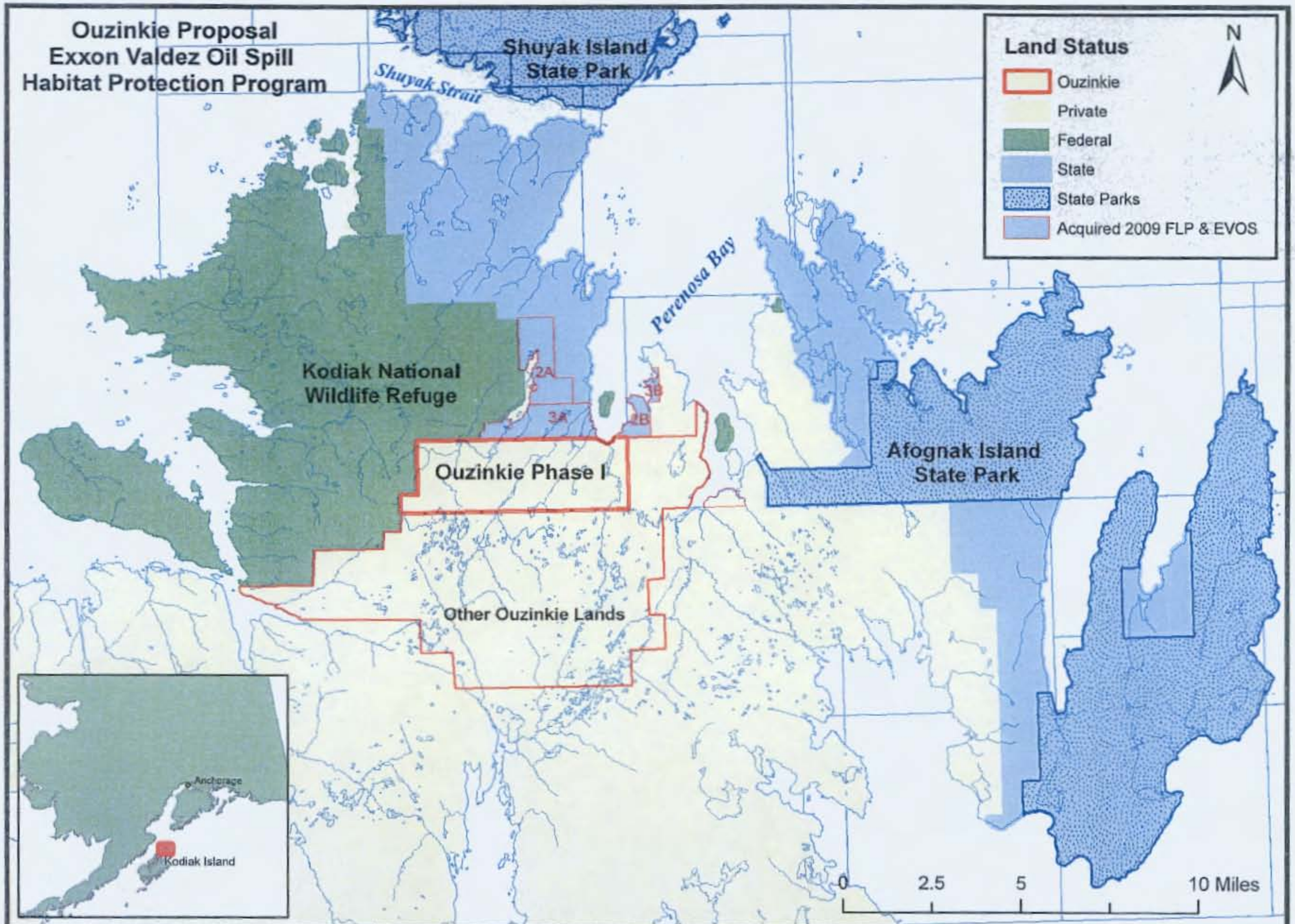
Not Recovering	Recovery Unknown	Recovering	Recovered
Pacific herring	Kittlitz's murrelet	Harlequin duck	Common Loon
Pigeon guillemot	Rockfish	Black Oystercatchers	Cormorant
	Marbled murrelets	Intertidal communities	Harbor Seal
		Barrows Goldeneye	Dolly Varden
		Sea Otters	River Otters
		Recreation	Bald Eagles
		Commercial fishing	
		Passive Uses	

Potential Threats.
Ouzinkie Native Corporation has logged this parcel and as logging operations diminish, native corporations come under pressure to find other means of providing returns to their shareholders, creating the potential for subdivision and development.

Rocky Mountain Elk Foundation and American Land Conservancy (RMEF/ALC) are nominating the Ouzinkie parcel because of the exceptional connectivity and benefits to adjacent lands and habitats already conserved on north Afognak offered by the Ouzinkie lands. RMEF and ALC support the long-standing view of conservationists and naturalists that Afognak Island's combination of terrain, climate, and marine richness based on its location in the Gulf of Alaska make it uniquely productive for fish and wildlife in the State of Alaska. RMEF/ALC's partnership on Afognak is now ten years old and the partners remain committed to the protection lands on Afognak Island where there is a willing seller and it is determined to be in the public interest to protect the conservation values of particular parcels. This commitment extends to the Ouzinkie Native Corporation property and echoes previous conservation assessments of the island dating back to the late 1800's and confirmed during the initial EVOS habitat assessment.

Proposed Management.
The Phase I parcel will be managed by the Alaska Department of Natural Resources, Division of Parks and Outdoor Recreation, for the purposes of protecting resources and services injured by the *Exxon Valdez* Oil Spill. RMEF/ALC, the State and the US Fish and Wildlife Service are discussing management options for subsequent phases of the Ouzinkie Native Corporation lands.

Request.
The State would like to move forward with preliminary due diligence efforts including an appraisal. The State will work with RMEF to utilize funds previously authorized for due diligence efforts on northern Afognak. Efforts will be coordinated with the US Fish and Wildlife Service.



AK Dept of Natural Resources, Print Date 1/6/10

Photos of Ouzinkie Lands

Ouzinkie Native Corporation Lands along the border with Kodiak National Wildlife Refuge looking NW.

Ouzinkie Native Corporation Lands looking North to Delphin Bay.

Transpac logged Ouzinkie lands.

Ouzinkie lands looking toward recently acquired Uganik parcel.

KEN 3006, Coal Creek Moorage 2

Owner:	Linda McLane
Physical Location:	This parcel is located immediately adjacent to previously acquired KEN 19 located on the confluence of Little Coal Creek and the Kasilof River.
Acreage:	6.94 acres
Brief Description:	Lot 4 and Lot 5 Coal Creek Moorage Subdivision Part One, T 3N R 12 W Sec 13 SM
Agency Sponsor:	Alaska Department of Natural Resources
Appraised Value:	Unknown, assessed value $51,700

Parcel Description. This parcel, comprised of two lots fronting on Coal Creek, is located at the confluence of Little Coal Creek and the Kasilof River and is part of the Kasilof River Flats on the east shore of the Kasilof River. The lots are approximately 2.5 miles upstream from the mouth of the Kasiloff River and the shores of Cook Inlet. The parcel is located immediately adjacent to previously acquired EVOS parcel KEN 19, which was purchased from Mr. and Mrs. McLane in 1997. Both lots contain important tidally influenced wetlands. Uplands on the parcels are densely wooded with mixed spruce and birch.

The original Coal Creek parcel was considered unique because of the highly productive tidal marshes on and adjacent to this property, due to their limited distribution. The Kenai Peninsula Borough wetlands delineation illustrates the continuation of the marshes on the parcels currently under consideration.

Linkage to Restoration:

Restoration Benefits.
Injured species that will benefit from this parcel include intertidal resources, pink and sockeye salmon, Dolly Varden, and bald eagles; the parcel also supports species such as chinook and coho salmon; steelhead and rainbow trout; Canada, Tule and lesser snow geese; Sandhill cranes; and numerous other waterfowl and shorebirds. Coal Creek is an important wildlife movement corridor for black bear and moose that travel between the adjacent uplands and the Kasilof River Flats. The Cook Inlet Aquaculture Association has used Coal Creek as a release site for sockeye salmon smolts, which contribute to the overall Cook Inlet commercial fishery. The area supports recreational use by fishermen, birdwatchers and hikers.

The parcel also has significant cultural values. It includes remnant structures from an early 20th century fox farm, but more importantly it includes house depressions and other features from a prehistoric or early historic Denai'na village site. There is also evidence of early Russian structures with features indicating this may be the site of the first Russian settlement in southcentral Alaska. The site is in relatively pristine condition, with integrity of locations and setting.

The original Coal Creek proposal was strongly supported by the Kenai Peninsula Borough and Kenai Peninsula legislators. In 1997, these parcels were appraised in an effort to include them in the previous transaction. Unfortunately court proceedings prevented further action on the part of the Council. In 2004, Ms. McLane was able to purchase these parcels back from the Court in hopes of eventually placing them in public ownership.

Potential Threats.
The owner is very interested in selling this parcel. Adjacent neighbors have expressed interest in the parcel however, it is the owner's preference that this parcel be acquired by the State and managed consistent with the Coal Creek parcel previously purchased by the Trustee Council. Conversion of this property to home sites has the potential to diminish public access to the upper reaches of Coal Creek, negatively impact valuable cultural resources, and negatively impact estuarine and intertidal areas. Potential user conflicts could also occur over time.

Proposed Management.
This parcel has been identified as a priority for the Division of Parks and Outdoor Recreation. The State Historic Preservation Officer considers protection of this parcel critical.

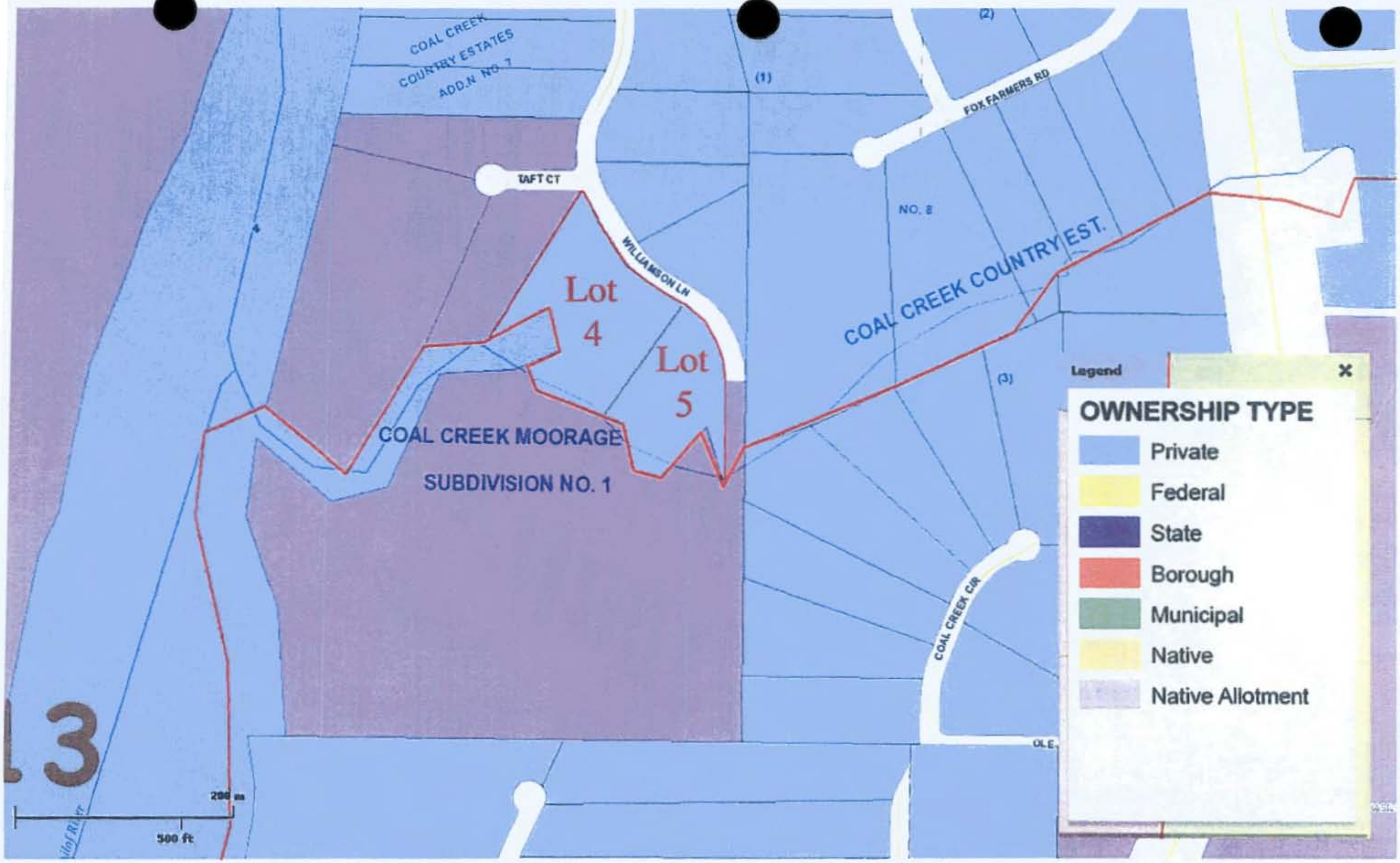
This parcel will be managed by the Alaska Department of Natural Resources, Division of Parks and Outdoor Recreation, Kenai Area Office in consultation with the State Historic Preservation Officer, consistent with the management of KEN 19, Coal Creek Moorage, for the purposes of protecting resources and services injured by the *Exxon Valdez* Oil Spill.

Request.
The State would like to move forward with preliminary due diligence efforts including an appraisal. We will utilize existing funds to do so and are not requesting any additional funding at this time.

Coal Creek Moorage 2, Imagery

Wed Dec 30 2009 12:59:06 PM

KPB Parcel Viewer



Coal Creek Moorage 2, Land Ownership

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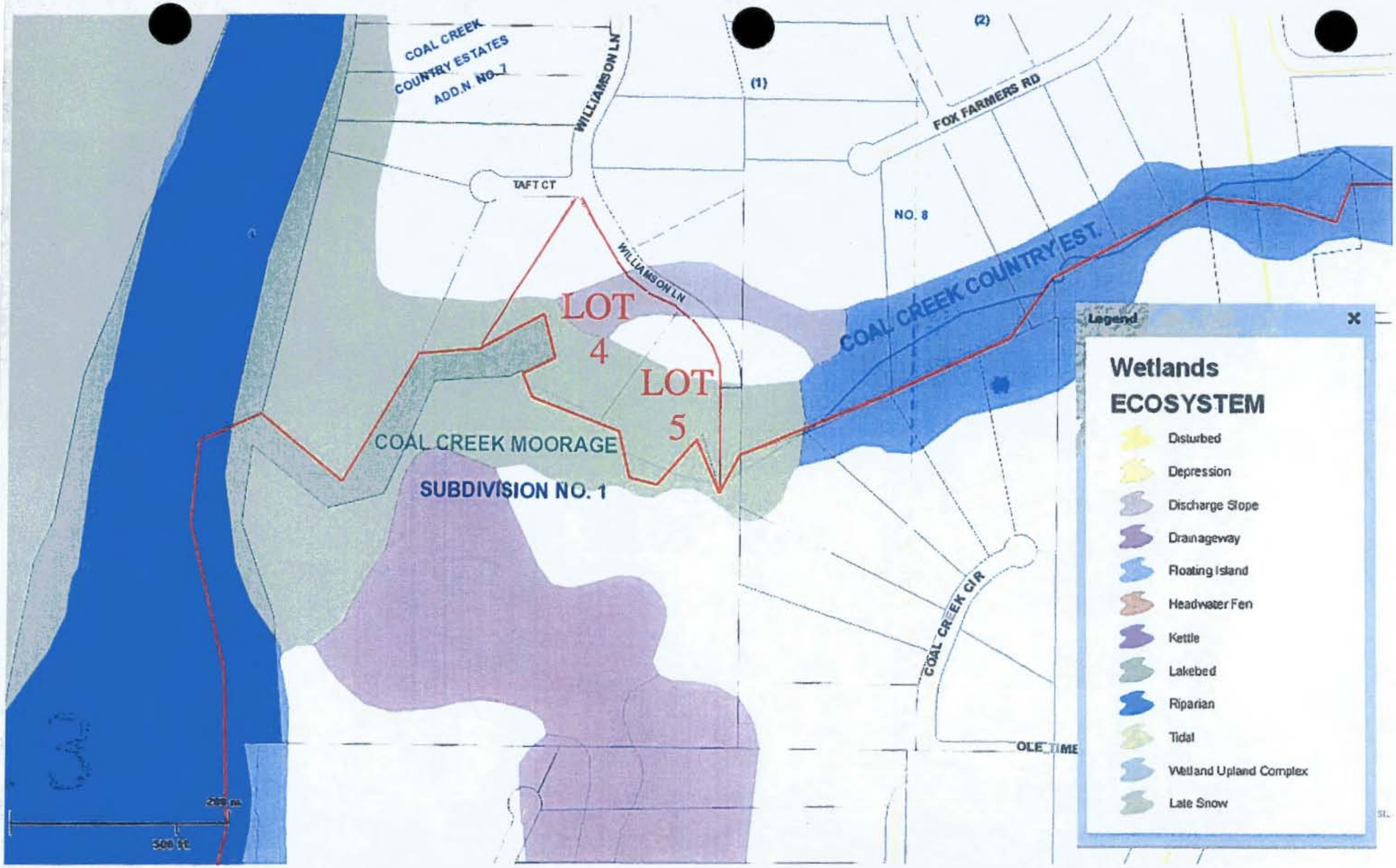
KPB Parcel Viewer

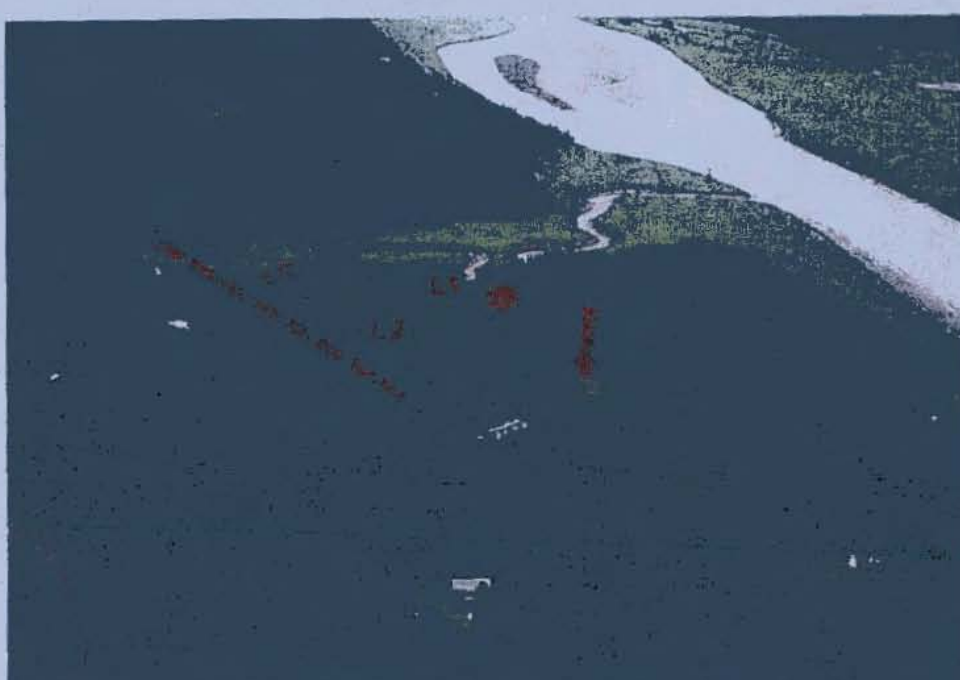


Coal Creek Moorage 2, Wetlands Delineation

Wed Dec 30 2009 12:32:03 PM

KPB Parcel Viewer

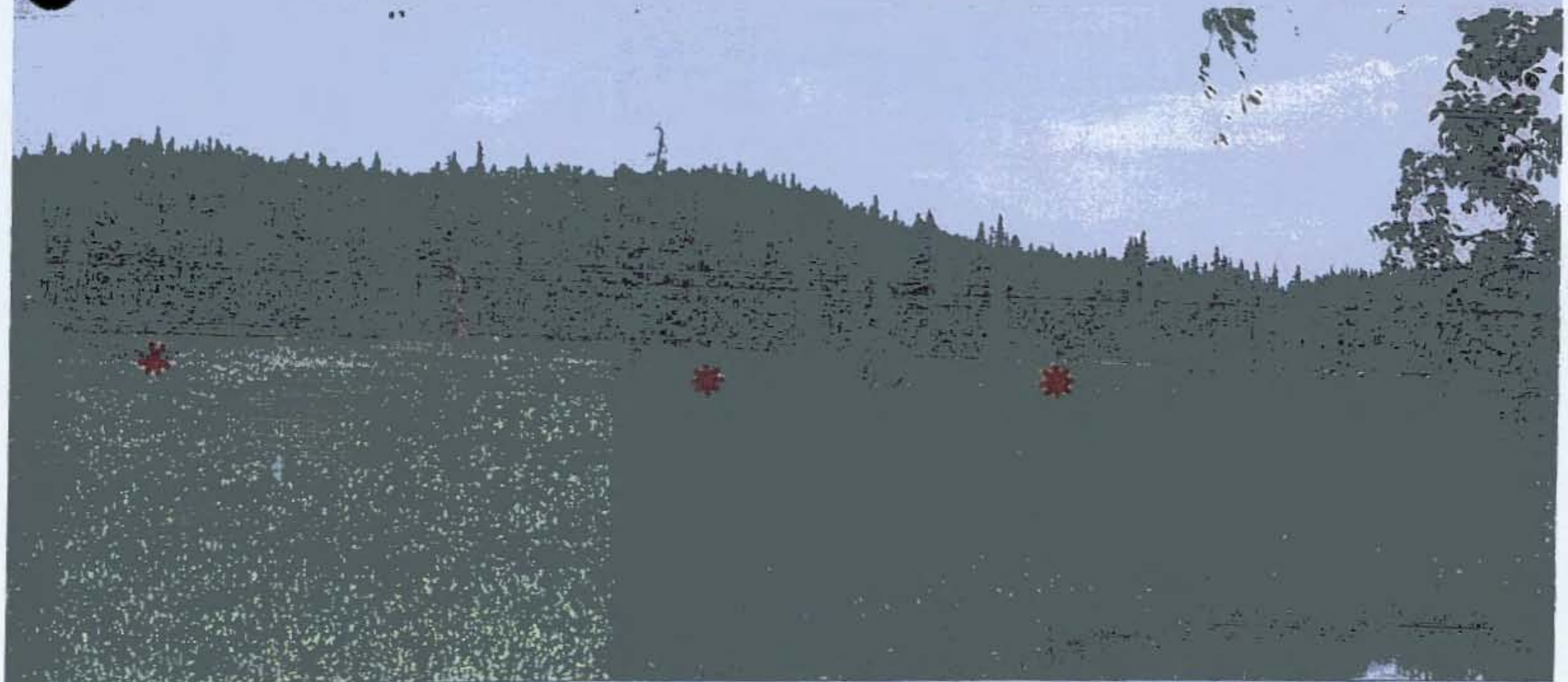
Aerial view taken 8/2/95; east over the Kasilof River(*) toward Coal Creek(-) and the subject subdivision. SE corner of Lot 5, Block 1 is located at the creek in vicinity of arrow. The extent of Lot 4's creek frontage is shown with dots. Note dense tree cover on upper portion of both lots.



Looking SW over the subdivision. The cul-de-sac on Williamson Lane is noted at arrow. The road continues to Lot 4, Block 1 along break in tree line(*). The general location of the subject lots is shown. East boundary of subdivision is approximated at dashed lines.

DERRY & ASSOCIATES

View north on Lot 4 showing slope up from grassy wetlands to upper treed portion of the lot. Ox bow(*) is at far left.



Summertime view looking NE from the south side of Coal Creek(*) at Lots 4 (left photo) and 5 (through center). Photo taken June 28, 1995. Stairway at far left is at the head of the ox bow on Lot 4.

Lingering Oil Report

Report on Recent Lingering Oil Studies

I. Introduction

In the 20 years since the *Exxon Valdez* Oil Spill, the Trustee Council has commissioned numerous scientific studies to evaluate effects of the spill on the environment. At the time of the spill, most scientists believed that, within a few years, the process of weathering would either break down and decompose the oil, or would cause it to turn into a form of asphalt that would have little potential to release toxic components into the environment. Contrary to these expectations, oil persists at some sites in Prince William Sound and the Gulf of Alaska in a relatively unweathered and potentially toxic condition. Therefore, the Trustee Council has undertaken several studies to determine the impact that this lingering oil may have on the environment and the feasibility of measures to address any potential adverse effects.

This report contains summaries of recent studies to address lingering oil. These studies can be divided into three categories: (1) development of a model to identify the geological and hydrological features that are most likely to result in the persistence of unweathered oil; (2) field and laboratory studies of the species most likely to show the effects of exposure to lingering oil; and (3) field and laboratory studies to evaluate the feasibility of treating lingering oil to reduce its potential impact.

II. Extent of Lingering Oil

In 2007 the Trustee Council funded a project to develop a model for predicting the likelihood that lingering subsurface *Exxon Valdez* oil would be found within individual shoreline segments of Prince William Sound and the Gulf of Alaska. The model that was generated used oiling data from 264 shoreline segments randomly sampled in 2001, 2003, and 2007 by NOAA's Auke Bay Laboratory and Research Planning, Inc. and from six oiled sites in the Gulf of Alaska found by representatives of the United States Geological Survey conducting studies there in 1999 and 2006. The model also incorporated various geomorphological characteristics of the nearly 2,000 kilometers of shoreline in Prince William Sound and the Gulf of Alaska that were oiled, including shoreline type, topographic and bathymetric complexity, exposure to wave action, beach slope, grain size of beach materials, and subsurface hydrology. Just as a coastal geomorphologist would integrate all of the factors when evaluating a shoreline segment for the likelihood of having subsurface oil, the model simultaneously evaluates all of the variables to make a similar assessment in a rigorous, unbiased manner. The model was validated with additional field surveys in 2008.

The final model indicates that there are a significant number of unsurveyed locations in Prince William Sound and the Gulf of Alaska that likely contain lingering *Exxon Valdez* oil below the surface. The number of such sites that the model generates differs depending on the confidence threshold and the level-of-oiling criteria. For example, using a 90% positive predictive value cutoff, the model predicts that there are 167 sites with any subsurface oil; however, there are 64 sites with moderately or heavily oiled residues, totaling 3.57 kilometers of shoreline. Using inputs of moderately or heavily oiled residues at greater than 15% frequency of oiled pits, at the 90% positive predictive value threshold, there are 52 sites totaling 2.62 kilometers of shoreline. This information can be used to prioritize beach segments in Prince William Sound and, to a lesser extent, the Gulf of Alaska, for remediation.

III. Environmental Effects

To evaluate potential effects of lingering oil on the environment, field and laboratory studies have focused on vertebrates most likely to be exposed to lingering oil in the intertidal environment, including several species of birds, sea otters, and fish.

A. Birds

Bird studies have focused primarily on harlequin ducks, although other species that feed in intertidal areas (Barrow's goldeneyes, black oystercatchers, and pigeon guillemots) have been examined. Studies have addressed both exposure to oil and its potential effects.

To consider exposure, cytochrome P4501A was measured in all four bird species. P4501A is part of vertebrates' systems for breaking down certain compounds, including those found in oil. For years after the spill, birds were exposed to oil, as shown by higher levels of P4501A in oiled areas compared to unoiled areas in all species measured. The most recent data, however, suggest declines in exposure. In the case of Barrow's goldeneye, 2009 data show little difference in average P4501A values between oiled and unoiled areas. Similarly, 2008 data from pigeon guillemots showed no difference between oiled and unoiled areas. However, black oystercatchers had slightly higher P4501A on oiled areas during 2008, and harlequin ducks in 2009 had considerably elevated P4501A on oiled areas, indicating that at least some bird species continued to be exposed to oil.

A study has been conducted recently that shows that other potential causes of P4501A expression, specifically polychlorinated biphenyls (PCBs), were not higher on oiled areas in harlequin ducks or sea otters. This finding indicates that P4501A results can be confidently interpreted as measures of exposure to lingering oil.

Potential effects of oil exposure in harlequin ducks were addressed by comparing survival of female ducks over the winter in oiled versus unoiled areas. Survival of females is an important factor determining duck population trends. During the mid-1990's, survival rates were significantly reduced in areas affected by the spill. A population model showed that this difference would lead to lack of population recovery in oiled areas. A study conducted during

2000-03, however, indicated that female winter survival rates in oiled areas had returned to normal and the population model indicated that duck populations should be on a trajectory to recover, with full recovery about 24 years after the spill. This appears to be corroborated by the latest surveys of wintering harlequin ducks, which show slight numerical increases in oiled areas. Further data will be needed to determine whether this trend will continue.

Additional studies are being conducted to determine whether there are adverse effects from oil exposure on harlequin ducks at the cellular level. These studies are still in progress.

B. Sea Otters

Sea otters often dig pits underwater in soft sediments to find prey. Digging pits in intertidal areas places them at risk of exposure to lingering oil. Recent otter studies are intended to evaluate whether otters are being exposed and adversely affected by lingering oil.

Exposure studies are designed to determine whether otters from areas affected by the spill continue to show exposure to oil. Recent studies have relied on measures of the induction of P4501A, as well as the expression of other genes that can be caused by oil exposure. These studies are currently underway.

Another exposure study was designed to determine the degree of sea otter use of intertidal zones, through use of time and depth recorders attached to otters. This study confirmed that foraging otters use intertidal habitat for at least some of their foraging, which means that they disturb sediments at tidal heights in which lingering oil remains. Moreover, pits dug by otters during feeding were found on beaches known to contain lingering oil.

Other studies are addressing the potential for adverse physiological effects of oil exposure on otters, through examination of gene expression related to immune response, tumor suppression, cellular stress-response and reproduction. This work is still in progress.

Population models have been used to estimate effects of oil on otter population dynamics. These models used demographic data, such as the age composition of otter carcasses, to conclude that otter populations remained depressed in heavily oiled areas up to at least 2005. The most recent data, collected in 2006-09, have not been incorporated into these models, however.

Recent surveys of otter populations show increasing numbers in the most heavily oiled areas of western Prince William Sound since 2003, in contrast to stable numbers prior to that period. Although current numbers are still below the estimated pre-spill population, this is some evidence of progress towards recovery.

C. Fish

Recent field studies also have examined two species of fish that use intertidal areas: masked greenlings and crescent gunnels, which had both shown evidence of exposure to oil in previous studies. In 2008, gunnels taken from areas that were heavily oiled during the spill continued to show elevated P4501A compared to those from unoiled areas. However, greenling did not show significant differences between oiled and unoiled areas during 2008. This difference between species is probably due to gunnels' greater use of intertidal sediments. As with the birds, reductions in levels of P4501A to background levels in some species suggest that conditions have improved.

IV. Restoration

A. Can the Lingering Oil Be Further Bio-degraded?

A microcosm study was designed to address the extent to which the lingering oil in Prince William Sound (PWS) is biodegradable given varying degrees of weathering. At the 2007AMOP conference, Exxon-Mobil consultants developed and presented an oil bioremediation index (BI) based on the degree of weathering of the oil contamination. They argued that, if the degree of weathering of oil is 70% or more, then further attempts to bioremediate it would be futile and not justified. To test this conclusion, the microcosm study collected samples of beach substrate from representative sites in PWS contaminated with oil residues with BI weathering index values of 76%, 60%, and 30%.

The results of the study demonstrated that the lingering oil is still very much biodegradable, regardless of the degree of weathering. Nutrient addition significantly stimulated biodegradation compared to natural attenuation. However, substantial biodegradation occurred in the natural attenuation microcosms, even without the addition of nutrients. This is likely due to relatively high levels of natural biogenic nitrogen that was found in the sediments.

The primary conclusion was that the reason for most of the observed biodegradation was the presence of excess dissolved oxygen, which was not present in the field. Nitrogen was a limiting factor, but oxygen was the primary one. This strongly indicates two points relating to remediation of lingering oil: first, that bioremediation appears to be a promising technology able to remove the persistent oil present in some locations in PWS, and second, any effective *in-situ* bioremediation treatment needs to introduce oxygen and nutrients in a manner that will increase their contact with the oil.

B. What Factors Are Limiting Further Bio-degradation of the Lingering Oil?

Before remediation methods can be developed to treat the lingering oil, the factors that are limiting the natural degradation of the oil must be understood. Therefore, a "limiting factors study" was designed to identify and compare the hydrogeological processes on gravel beaches with and without the presence of lingering subsurface oil. The field work for the initial study was conducted in 2007 and 2008, with supplemental field work in 2009.

One of the key findings of the 2007 and 2008 studies was that the beaches consisted of two layers: an upper layer with a very high permeability and a lower layer with a very low permeability. The contrast in permeability between the layers was found to be around three orders of magnitude. The dissolved nutrient concentration in the beaches was much smaller than that needed for maximal growth of microorganisms and the subsequent consumption of oil. Modeling suggested that the concentration of dissolved oxygen in the lower layer was most likely too low to sustain aerobic biodegradation.

The 2009 field program gathered important data about groundwater flow in the lower layer of the beaches. In designing effective *in-situ* remedial techniques, it is critical to know the flow rates in the lower layer, the "area of influence" of an injection well under different injection pressures, and the maximum injection pressure that can be reliably applied while maintaining well integrity. The 2009 study determined an allowable pressure range for injection into the lower layer, and showed that the area of influence after one day of pressure injection extended to a radius of 6-feet from the injection well. On Smith Island, introduction of tracer chemicals in the lower beach layer at ambient pressures determined the extent of influence to be 6 feet seaward and 1 foot landward in one day.

The results of the 2009 field work can be used to design pilot studies of the best approaches for *in-situ* remediation. The data on flow rates and area of influence in the lower layer can be used to design injection trenches or injection wells as a means of introducing oxygen and nutrients in the beaches. The data is used to design the distance between injection trenches or wells, the injection pressure for wells, and the amounts of oxygen and nutrients to be injected, whether by well or trench injection. It can also be used to design the distance between wells or injection trenches and monitoring locations.

V. Conclusions and Recommendations

The most significant remaining oil residues constitute approximately 50 beach segments that represent a total shoreline length of about 2.5 kilometers, although not all of the subsurface sediment within these segments would contain lingering oil. We can identify these 50 sites with a high degree of confidence.

The studies of the species most likely to have been affected by lingering oil present a generally consistent picture. Organisms that use the intertidal were severely affected by the spill and continued to show adverse effects from exposure to oil for many years after the spill. These effects manifested themselves in reduced survival rates and diminished populations. In recent years, however, there is evidence of improvement. The extent of oil exposure appears to be diminishing in most species, and there is evidence that the populations of some species are beginning to increase. Further monitoring will be needed to determine whether the environment is truly on a trend to complete recovery. Therefore, existing studies should be completed to verify these conclusions and there should be continued monitoring of sea duck and otter populations to determine whether current population trends continue.

The remaining lingering oil can significantly further bio-degrade under the right conditions, no matter how weathered the oil is. The key factor is to expose the lingering oil to oxygen; lack of exposure to oxygen is the primary reason that lingering oil remains. Techniques for exposing lingering oil to oxygen *in situ* have limitations, but studies to date have shown that these techniques have promise on beaches with certain physical characteristics. Pilot studies to test *in situ* remediation techniques could determine how effective these techniques would be, and whether wider employment of these techniques on beaches with lingering oil is warranted.

Finally, to focus remediation efforts, it would be useful to identify, at a minimum, those beaches that are both highly likely to contain lingering oil and are used by the species exposed to lingering oil. To that end, additional work is recommended to determine the spatial correlations between known and modeled distribution of lingering subsurface oil and data the Trustee Council has gathered on duck and otter populations (abundance, trends, intertidal habitat use and bioindicators of health).

Appendix

Summary of Lingering Oil Studies Funded by the *Exxon Valdez* Oil Spill Trustee Council

Prepared by
Jacqueline Michel[1] and Dan Esler[2]

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INTRODUCTION

Since 2001, the *Exxon Valdez* Oil Spill Trustee Council (EVOSTC) has funded a number of studies to assess the amount and location of lingering subsurface oil, factors that might be causing its persistence, effects it may be having on natural resources, and feasible methods for remediation.

An early "lingering oil" project was a study conducted in 2001 by Jeff Short of the Auke Bay Laboratory, National Oceanic and Atmospheric Administration (NOAA). The study was conducted because, as of 2001, it was known that relatively unweathered oil remained at some locations that were heavily oiled initially and protected from dispersion by storm-generated waves. The extent of the remaining oil was unknown, and this uncertainty raised concerns about the effects that lingering oil may have had on humans and on fauna that may become exposed to the oil. The project sought to address these concerns by providing a quantitative estimate of the amount of shoreline (length, area, sediment and volume) that remained contaminated. Using a stratified random sampling design, Short et al. (2004) estimated that there were 7.8 hectares (range of 4.06-12.7) of remaining subsurface lingering oil in Prince William Sound (PWS). The mass of remaining subsurface oil was estimated at 55,600 kilograms (kg) (range of 26.1-94.4 kg).

Short et al. (2007) also estimated that the areal extent of oiled beaches in PWS had not changed significantly between 2001 and 2005, indicating that the rate of decline had slowed. No studies had been conducted to estimate the geographic extent of lingering subsurface oil in the Gulf of Alaska, although Irvine et al. (2006) documented the persistence of subsurface oil at specific sites along the Alaska Peninsula.

Following the work describing occurrence and extent of lingering oil, the EVOSTC funded the following studies to better understand the persistence and potential effects of the lingering oil:

- Modeling the distribution of lingering subsurface oil
- Indices of oil exposure in nearshore vertebrates:
    - Sea ducks

    - Other birds (black oystercatchers and pigeon guillemots)
    - Intertidal fish
    - Sea otters
- Consideration of alternative CYP1A inducers
- Sea otter spatial relations with lingering oil
- Potential effects of exposure to lingering oil – demographic:
    - Harlequin duck survival
    - Harlequin duck population model
    - Sea duck population trends
    - Sea otter survival
    - Sea otter population model
    - Sea otter population trends
- Potential effects of exposure to lingering oil – suborganismal effects:
    - Sea otters
    - Harlequin ducks
- Factors responsible for limiting the oil degradation rate on Prince William Sound beaches
- Biodegradability of lingering oil 19 years after the *Exxon Valdez* Oil Spill

This Appendix summarizes the key results of these studies. The objective is to provide a clear, concise explanation of the results of each study, in order to facilitate an understanding of the likely correlations between lingering oil and injuries.

MODELING THE DISTRIBUTION OF LINGERING SUBSURFACE OIL

Basis for the Study

The *Exxon Valdez* spill oiled approximately 2,000 kilometers (km) of shoreline. Short et al. (2004) estimated that about 0.2% of the spill volume remained stranded on the shoreline, primarily in the subsurface. But, they did not map out specifically the subsurface oil locations. It is not feasible to investigate every potential location for subsurface oil. Therefore, a study was conducted to determine whether a model could be constructed that relates shoreline characteristics that are known everywhere, to the presence of subsurface oil and shoreline characteristics known at a relatively few sampled locations. If so, it was hoped, the model then could be translated into a map predicting where subsurface oil may occur, with different degrees of accuracy. With such a map, it was thought, it would be possible to assess the feasibility of different cleanup methods, better determine potential effects, and inform the public on where it might encounter lingering oil. The draft final report is currently under review.

Study Approach and Methods

The study approach consisted of the following steps:

1. Build a preliminary model based on data from Short et al. (2004). They sampled 124 locations in PWS randomly selected from segments that were described during Shoreline

Cleanup Assessment Team (SCAT) surveys as heavily or moderately oiled at any time during the period from 1990 to 1993 and beaches described as heavily oiled during 1989 but that had only light to no oil impact during subsequent years. It is important to note that ***all*** of these segments would have a high probability of having lingering oil because of their initial degree of oiling. The data for these segments with subsurface oil were related to available geomorphic variables to generate a map predicting the presence of subsurface oil.

2. Use the preliminary map results to randomly select sites for field investigation in 2007 that:
    a. Were located in both PWS and the GOA, to expand the geographic scope
    b. Included all segments that were documented as being oiled so the model could be "trained" to know where the lingering oil did not occur and be able to predict oil locations throughout the oil-impacted areas
3. Conduct field sampling at 108 sites in PWS and 32 segments in the GOA using the same methods as Short et al. (2004).
4. Test the model performance with the new field data.
5. Review field data from all 264 sites that were sampled to identify the geomorphic and hydrologic factors that appear to be controlling the presence and absence of subsurface oil. Use these data to develop new predictor variables.
6. Refine the model using the new predictor variables, better model methodology, and at a higher spatial resolution.
7. Validate the refined model through additional field sampling in 2008, focusing on sites predicted to have the most oiling.
8. Use the refined model to generate maps and statistics for different degrees of oiling at different levels of accuracy.

Results

Geomorphic and Hydrologic Controls

A systematic review of all collected field data was conducted to summarize geomorphic controls on the persistence of subsurface oil. A number of factors were identified as being associated with ***increased*** likelihood of retaining lingering subsurface oiling, including:

- Low topographic slope
- Low exposure to wave action
- Armoring of gravel beaches
- Tombolos/natural breakwaters
- Rubble accumulations
- Subsurface hydrology
- Edge effects (transitions between permeable and impermeable shoreline types)

Similarly, a number of factors and morphologies were identified as being associated with ***reduced*** likelihood of retaining lingering subsurface oiling, including:

- Impermeable bedrock
- Platforms with thin sediment veneer
- Wide fine-grained gravel beaches
- Extensively treated bayhead beaches
- Steep exposed gravel beaches
- Low-permeability raised bay-bottom beaches
- Strong shallow groundwater flow
- Sandy tidal flats
- Proximity to a stream outlet

The report includes detailed discussion of these factors, which would be of particular value when identifying areas within priority segments to search for subsurface oil prior to implementation of treatment methods. It would guide field teams on sites to focus on within segments with a high probability for containing subsurface oil, as well as guide them on sites to avoid.

Subsurface Oil Thickness and Location in the Intertidal Zone

Figure 1 shows the average thickness and depth of burial for the different degrees of oiled sediments, for the 509 oiled pits (out of 12,357 pits dug) from all PWS surveys in 2001, 2003, and 2007. The heavier oiled sediments (HOR and MOR; see definitions in Figure 1) were thicker and nearer to the surface than the lightly oiled sediments (LOR, OF, and SH). Half of the oiled pits contained MOR. Figure 2 shows the number of pits (and by oiling degree) by tidal elevation; 25% of the pits with subsurface oil were in the upper intertidal zone, 70% were in the middle intertidal zone, and 5% were in the lower intertidal zone (zones = tidal range of 4.8 m/3).

Refined Model Results

The refined model included the following data-processing steps and variables:

1. A finer-scale topographic/bathymetry digital elevation model was generated and used to calculate intertidal slope and an index of local topographic complexity, as a measure of the influence of slope and natural breakwaters.
2. The shoreline type (based on the Environmental Sensitivity Index [ESI] data) was used to calculate an index of geomorphic complexity based on distance to an interface between a permeable and impermeable shoreline type (e.g., transition from a gravel beach to a rocky shore), as a measure of the edge effect and local sheltering.

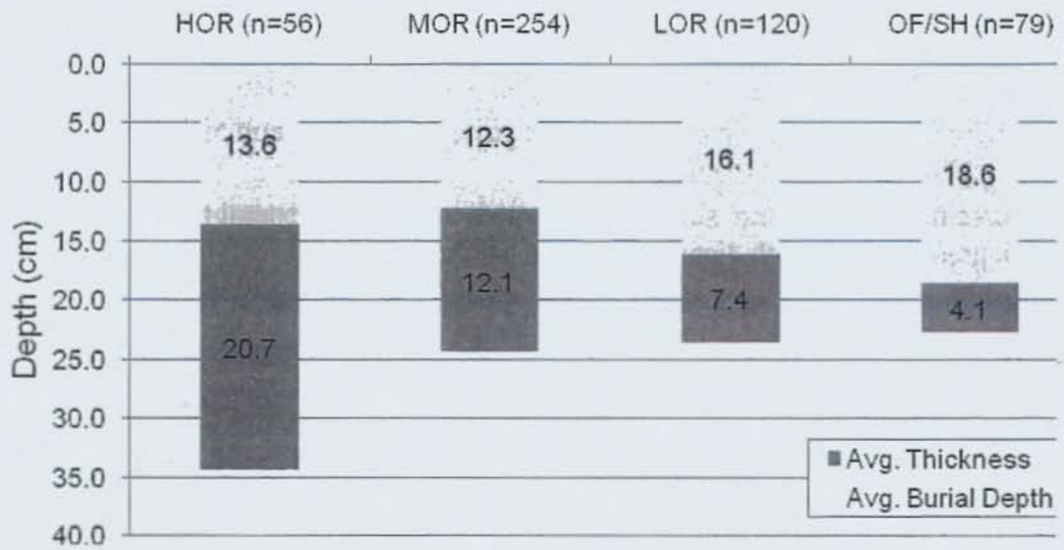

Figure 1. Average thickness of subsurface oiled layers and burial depth in cm below the surface by oiling descriptor based on data from pits in PWS surveyed in 2001, 2003, and 2007 (n=509). SO = surface oiling, SSO = subsurface oiling, OF = oil film, SH = sheen, LOR = lightly oiled residue, MOR = moderately oiled residue, and HOR = heavily oiled residue.

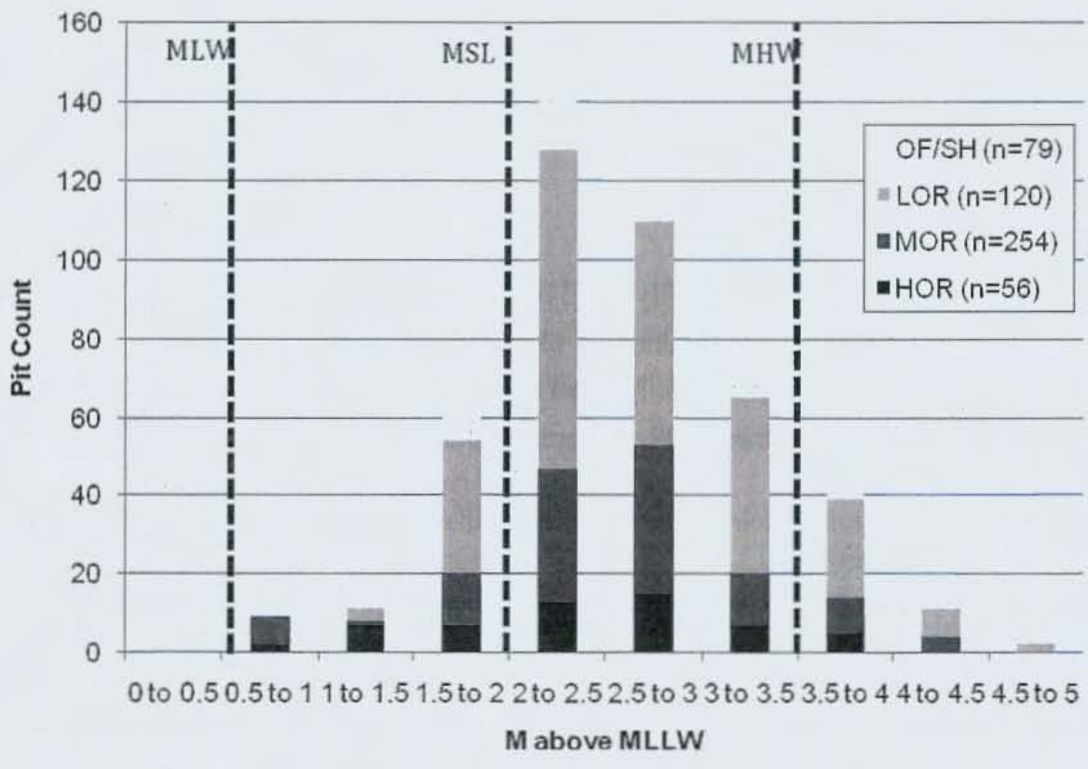

Figure 2. Counts of oiled pits by oiling descriptor by tidal elevation in meters above MLLW based on data from oiled pits in PWS surveyed in 2001, 2003, and 2007 (n=509). The elevations of MHW, MSL, and MLW are indicated on the chart.

3. An index of substrate permeability was developed based on the ESI shoreline types.
4. Distance to stream mouths was calculated, to reflect surface and ground water flow and the tendency for finer-grained sediments and higher sediment reworking.
5. Indices of shoreline convexity were calculated at scales of 50, 100, and 500 m, to reflect small-scale sheltering from wave energy.
6. Overwater distance to the release site was calculated, to reflect a general trend in decreased degree of oiling with distance from the source.
7. An oil-approach angle index was calculated, to reflect the orientation of the shoreline relative to the angle of the approach of floating oil slicks.
8. A quantitative index of oiling history based on SCAT oiling categories (No Oil, Very Light, Light, Moderate, and Heavy) for 1989, 1990, and 1991 was calculated.
9. Exposure to wave action was represented by fetch and an exposure index.
10. Inclusion of all the field data from 2001, 2003, and 2007, and six oiled sites in the GOA from Irvine et al. (1999, 2006).
11. A reduction in the spatial scale for all the variables in the model (from segments that were ~10-100 m in length to cells that were ~10 m in length).

The refined model was constructed using an ensemble of tree-based classifiers via Generalized Boosted Modeling (GBM) that can inherently handle non-linearities and interactions among multiple predictor variables. Model performance statistics showed excellent overall model performance. The oiling histories (e.g., SCAT oiling descriptors) were the most significant drivers, though all of the predictor variables played some role.

Different models were run for the following:

- Any subsurface oil
- Any oil equal to or greater than lightly oiled residues (LOR)
- Any oil equal to or greater than moderately oiled residues (MOR)
- Any oil equal to or greater than heavily oiled residues (HOR)
- Any oil equal to or greater than MOR and greater than 15% cover (representing oil in 1 of 6 pits in the column)
- Any oil equal to or greater than MOR and greater than 30% cover (representing oil in 2 of 6 pits in the column)
- Any oil equal to or greater than MOR and greater than 50% cover (representing oil in 3 of 6 pits in the column)

The results are shown in Tables 1-3 for different degrees of accuracy. The tables show number of cells (about 10 m in shoreline length), the total length in kilometers, and the number of "sites" defined as a group of cells within 100 m of each other. Looking at Table 1, under the "known" category, there are 393 cells, 2.85 km, and 67 sites with any kind of subsurface oil. These statistics were derived from only the actual field-based sampling. Based on the model predictions for the entire oil-impacted area (PWS and GOA), using the 90% positive predictive value threshold, there are 2,668 cells, 19.36 km, and 167 sites with any subsurface oil. Similar statistics are provided in Table 3 for the three different geographic regions: PWS, the Kenai Peninsula (KEN), and Shelikof Strait (SHL). Using a treatment threshold of any oil equal to or greater than MOR and the 90% positive predictive value threshold, there are 492 cells, 3.57 km, and 64 sites. Looking at Table 2, using treatment thresholds of any oil equal to or greater than MOR and greater than 15% frequency of oiled pits, at the 90% positive predictive value threshold, there are 361 cells, 2.62 km, and 52 sites. Using treatment thresholds of any oil equal to or greater than MOR and greater than 50% frequency of oiled pits, at the 90% positive predictive value threshold, there are 114 cells, 0.83 km, and 31 sites. The model could be used to predict the number of cells, kilometers of shoreline, and number of sites for different screening criteria and accuracy thresholds.

Table 4 shows the model-based estimates of area and mass from this study (10.51 ha of oiled area and 82.6 tons). These values are slightly higher but well within the 95% confidence intervals (CI) of the design-based estimates from the stratified-random sampling of Short et al. (2004) who estimated 7.80 hectares (ha) (95% CI: 4.06–12.7) and 55.6 tons (95% CI: 26.1–94.4). These calculations, like those of Short et al., include areas with subsurface oiling descriptors of oil film (OF) in the estimates of area, but not of mass (because oil film does not have significant amounts of measurable oil). The similarity of these two estimates is encouraging when evaluating overall model validity.

Figures 3 and 4 show histograms of the cumulative length of oiled shoreline per discrete contiguous site. These plots provide a descriptive summary of the estimated along-shore length of the subsurface oil patches meeting the type and relative amount criteria within these discrete sites. As can be seen in Figure 3, about 80% of all the sites with any subsurface oil are 10 m or greater in length. For sites with MOR or greater and 15% coverage, 32 of the 52 sites (62%) are 10 m or greater. The relatively small sizes of the heavier lingering oil sites is not of particular concern in terms of treatability given the results of the Boufadel et al. studies (discussed below), which indicate there likely are effective treatment methods for remediating small patches of subsurface oil.

Summary

This work sought to develop a suite of geospatial models to: (1) identify potential areas where subsurface oil is still present on the shorelines of PWS and GOA affected by the *Exxon Valdez* oil spill; and (2) differentiate between relative amounts of subsurface oil so that the models could be used as screening tools to prioritize shorelines for different remediation methods. The models were based on data collected at 314 shoreline segments that were surveyed between 2001 and 2008. These data allowed identification of a number of geomorphologic and hydrologic factors that have contributed to the persistence of subsurface oil within PWS and GOA two decades after the spill.

Because detailed data layers for each of these factors were not available, the model used existing data sets as surrogates to represent these factors, such as distance to a stream mouth or shoreline convexity. While the linkages between the data used and the physical phenomena that drive persistence are not clearly understood in all cases, the performance of these models was remarkably good. Just as a coastal geomorphologist would integrate all of the factors when evaluating a shoreline segment for the likelihood of having subsurface oil, the model

Table 1. Known and model-estimated shoreline raster cell counts, lengths, and discrete site counts by model version and model score cutoff for all subsurface oil (SSO), and the three oiling descriptors LOR, MOR, and HOR; discrete site defined as cluster(s) of shoreline locations with a given cutoff for a given model version and contiguous by less than 100 m.

Cutoff	All SSO			LOR or >			MOR or >			HOR or >		
	Cells	Length (km)	# Sites	Cells	Length (km)	# Sites	Cells	Length (km)	# Sites	Cells	Length (km)	# Sites
Known	393	2.85	67	353	2.56	57	200	1.45	37	66	0.48	17
90% PPV	2668	19.36	167	1598	11.59	113	492	3.57	64	304	2.21	47
80% PPV	4829	35.04	276	3176	23.04	194	885	6.42	105	405	2.94	49
70% PPV	6832	49.57	321	4439	32.21	235	1560	11.32	147	807	5.86	88

Table 2. Known and model-estimated shoreline raster cell counts, lengths, and discrete site counts by model version and model score cutoff for all MOR, and three different frequencies of MOR occurrence; discrete site defined as cluster(s) of shoreline locations with a given cutoff for a given model version and contiguous by less than 100 m.

Cutoff	MOR or >			MOR or > and > 15% Cover			MOR or > and > 30% Cover			MOR or > and > 50% Cover		
	Cells	Length (km)	# Sites	Cells	Length (km)	# Sites	Cells	Length (km)	# Sites	Cells	Length (km)	# Sites
Known	200	1.45	37	160	1.16	32	97	0.71	19	35	0.25	6
90% PPV	492	3.57	64	361	2.62	52	122	0.89	22	114	0.83	31
80% PPV	885	6.42	105	702	5.09	75	493	3.58	55	198	1.44	42
70% PPV	1560	11.32	147	1024	7.43	98	1205	8.74	126	221	1.60	53

Table 3. Known and model-estimated shoreline raster cell counts, lengths (km), and discrete site counts by region and model score cutoff for the binary all surface oil model for the entire study area, PWS, Outer Kenai Peninsula (KEN), and Shelikof Strait (SHL); discrete site defined as cluster(s) of shoreline locations with a given cutoff for a given model version and contiguous by less than 100 m.

Cutoff	All SSO - Total			All SSO - PWS			All SSO - KEN			ALL SSO - SHL		
	Cells	Length (km)	# Sites	Cells	Length (km)	# Sites	Cells	Length (km)	# Sites	Cells	Length (km)	# Sites
Known	393	2.85	67	349	2.53	60	3	0.02	2	41	0.30	5
90% PPV	2668	19.36	167	2223	16.13	138	196	1.42	14	249	1.81	15
80% PPV	4829	35.04	276	4040	29.31	227	350	2.54	24	439	3.19	25
70% PPV	6832	49.57	321	5660	41.07	261	497	3.61	30	675	4.90	30

Table 4. Model-estimated intertidal area (ha) and oil mass (metric tons [t]) for PWS. Results also presented for the study area of Short et al. (2004) for comparison. Results are not presented for the GOA regions due to lack of reliable descriptor-specific model version output outside of PWS.

Region	All SSO		LOR or >		MOR or >		HOR or >	
	Area (ha)	Mass (t)	Area (ha)	Mass (t)	Area (ha)	Mass (t)	Area (ha)	Mass (t)
PWS – Heaviest Initial Oiling per Short et al. (2004)	10.51	82.6	5.19	27.00.2 2	4.48 24	27.0	1.2	24.5
PWS Entire Oil-Impacted Shoreline (Michel et al. 2009)	12.4	97.2	6.1	36.6	2.9	31.7	2.9	28.8

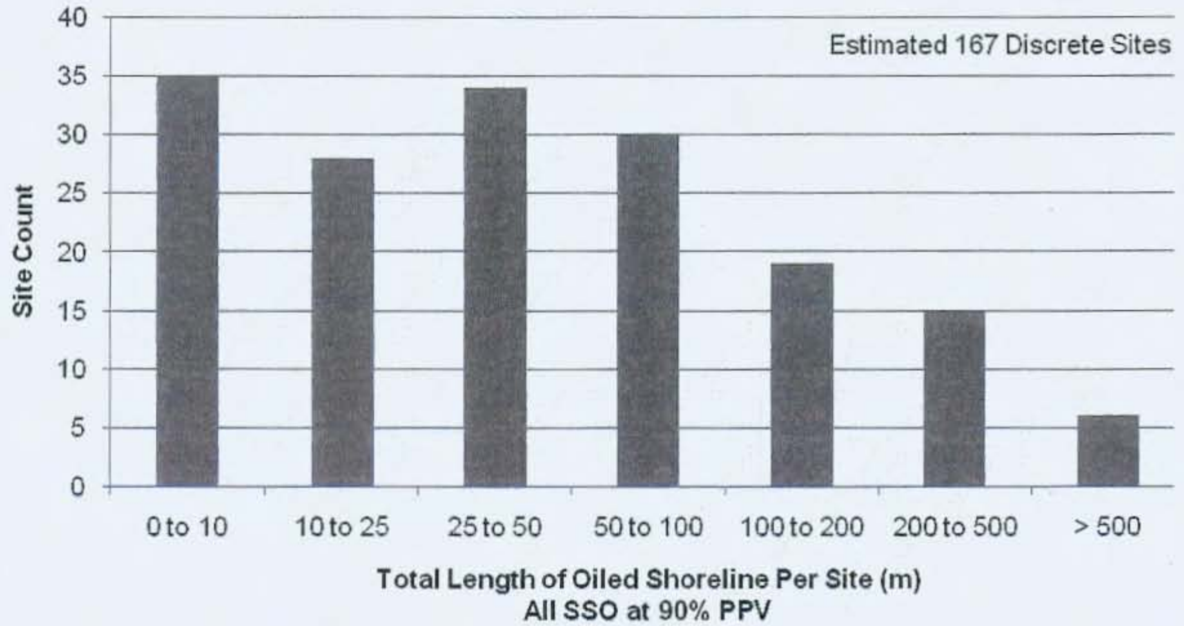

Figure 3. Histogram of total cumulative length of oiled shoreline length per discrete contiguous site for all regions; discrete site defined as cluster(s) of shoreline locations with a cutoff value above the 90% PPV for the binary oiled vs. unoiled model version and contiguous by less than 100 m.

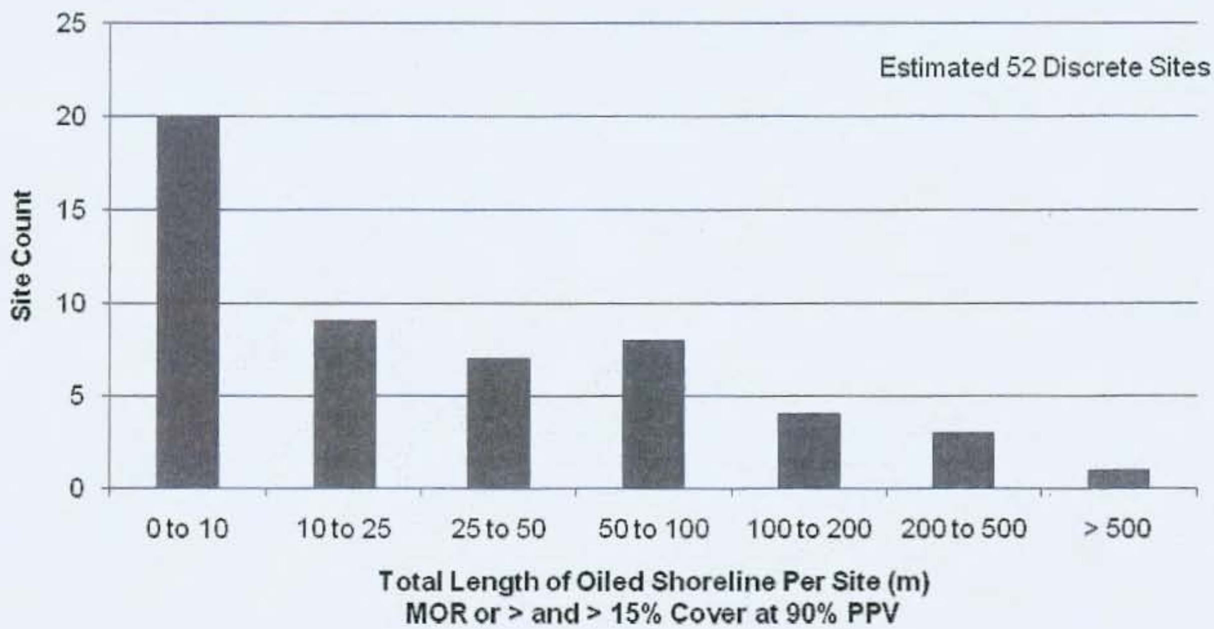

Figure 4. Histogram of total cumulative length of oiled shoreline length per discrete contiguous site for all regions; discrete site defined as cluster(s) of shoreline locations with a cutoff value above the 90% PPV for the MOR or > and > 15% cover and contiguous by less than 100 m.

simultaneously evaluates all identified variables to make a similar assessment in a rigorous, unbiased manner. The model results suggest there are a limited but significant number of as-yet unsurveyed locations in PWS and GOA that are likely to contain lingering subsurface oil. Furthermore, the model results may be used to quantitatively prioritize shoreline locations for investigation with known uncertainty.

It should be noted that regional differences in physical environment and oiling history, and sparser recent data, mean that extra caution should be used in interpreting model results in the GOA region. With understanding of these limitations, these model results can be used by educated field practitioners in concert with the factors that increase or decrease the likelihood of subsurface oil within a given shoreline segment. Used as such, the models presented here are capable of predicting the distribution of the lingering oil across the entire spill area with sufficient accuracy and resolution to perform as useful tools for evaluating potential ongoing impacts to users of these shorelines and prioritizing shoreline locations for potential remediation based on various screening criteria.

GENERAL INTRODUCTION ON BIOLOGICAL EFFECTS OF LINGERING OIL

The studies described in this section were funded to consider the issues of (1) exposure of vertebrates to the lingering oil, and (2) consequences of any exposure, as well as how both of these have changed over time. These studies have focused largely on two species, sea otters and harlequin ducks, which had been shown to have reduced abundance, density, and/or survival in oiled areas during the mid to late 1990s, coincident with evidence of exposure of some vertebrates to oil (Bodkin et al. 2002, Esler et al. 2002). More recently Barrow's goldeneyes, black oystercatchers, pigeon guillemots, crescent gunnels, and masked greenlings have been studied, because they also are vertebrates that inhabit intertidal areas and, thus, might be at risk of exposure to residual oil.

EXPOSURE OF VERTEBRATES TO LINGERING OIL

A number of studies have indicated exposure to, or uptake of, hydrocarbons by animals in areas of PWS oiled by the 1989 *Exxon Valdez* oil spill (Jewett et al. 2002 and citations therein). Some of these indicators declined relatively quickly post-spill, but others persisted for a least a decade (Trust et al. 2000, Jewett et al. 2002). In this section, measures of exposure in several vertebrates are summarized for the second decade post-spill.

One of the most useful tools for evaluating exposure to lingering oil has been the use of bioindicators of induction of cytochrome P4501A (CYP1A). CYP1A is a member of the cytochrome P450 family of genes, which are induced by exposure to certain compounds and play an important role in oxidation of those compounds. In the case of CYP1A, induction results from exposure to specific PAHs, including those found in crude oil, and halogenated aromatic hydrocarbons, including polychlorinated biphenyls (PCB) and dioxins. Because the latter compounds do not occur in high concentrations in PWS and there are no other broad-scale sources of bioavailable PAH contamination (see below), CYP1A has been interpreted as an indicator of spatial and temporal variation of exposure of vertebrates to residual *Exxon Valdez* oil. CYP1A induction may or may not indicate deleterious effects on individuals or populations (see below), but it does serve as a reliable measure of exposure to inducing compounds.

Sea Ducks

Basis for the Studies

Two species of sea ducks, harlequin ducks and Barrow's goldeneyes, have been examined for indicators of elevated induction of CYP1A on oiled areas relative to unoiled areas. Both of these species forage on benthic invertebrates in intertidal and shallow subtidal zones, placing them at risk of exposure to lingering *Exxon Valdez* oil. A study of sea duck CYP1A induction during 1996 to 1998 (Trust et al. 2000) found significantly elevated indicators of CYP1A induction in oiled areas in both species. More recent work has examined CYP1A induction in both species up to 2009, to track the timeline of exposure to lingering oil.

Study Approaches and Methods

For sea ducks, induction of CYP1A was estimated by measurement of hepatic 7-ethoxyresorufin-O-deethylase (EROD) activity, a method that has been widely used in many taxa, including birds. This method required small liver samples, which were surgically removed from anesthetized birds captured in oiled and unoiled areas of PWS. Sea ducks were captured in floating mist nets in a number of areas oiled during the *Exxon Valdez* spill, including Bay of Isles, Herring Bay, Crafton Island, Falls Bay, Green Island, and Foul Pass. Also, birds were captured on nearby northwestern Montague Island and Culross Passage, which were not oiled and thus were considered reference sites.

Since the results reported by Trust et al. (2000), harlequin ducks have been captured in November 2000, November 2001, November 2002, March 2005, November 2006, March 2007, and March 2009. Sample sizes and other details for 2000 through 2002 samples are found in Esler and Iverson (2010); for 2005 through 2009, details are in Esler et al. (in press). For Barrow's goldeneyes, captures following up on the work of Trust et al. (2000) occurred during March 2005 and March 2009.

Measures of EROD activity were conducted at two labs: Woods Hole Oceanographic Institution (WHOI; 1998-2005) and the University of California Davis (UCD; 2005-2009). During one sampling period (March 2005), a comparison of results between labs using paired samples from the same individual harlequin ducks confirmed that the labs were producing similar results. EROD activity is expressed in picomoles per minute per milligram of protein, i.e., pmol/min/mg protein. To contrast or combine EROD activity data across years, a standardizing index of CYP1A values was created, in which average EROD activity in unoiled areas for a given year and species was set to 1, and all values were adjusted accordingly within the same sample year (Esler and Iverson 2010).

Results

Harlequin Ducks

Harlequin ducks consistently had elevated CYP1A induction (indicated by EROD activity) in oiled areas relative to unoiled areas from 2000 through 2009 (Figure 10), similar to the findings of Trust et al. (2000) for samples from 1998. For the years 2000, 2001, and 2002 combined, the index to CYP1A induction averaged significantly higher in oiled areas than in unoiled areas (Esler and Iverson 2010). Similarly, findings from 2005 through 2009 (Esler et al. in press) indicated higher EROD activity on oiled areas than unoiled, with no effects of age, sex, body mass, or season. Figure 10 shows the average EROD activity index across study years on oiled areas, which are all well above the average on unoiled areas by factors between 2 and 5.

As another metric of changes in exposure to oil over the years, proportions of captured individuals with elevated EROD activity were calculated. Elevated EROD activity was defined as any individual with ≥ 2 times the average EROD activity on unoiled areas within that year (or group of years in the case of 2000-02). The proportions of harlequin ducks from oiled areas with

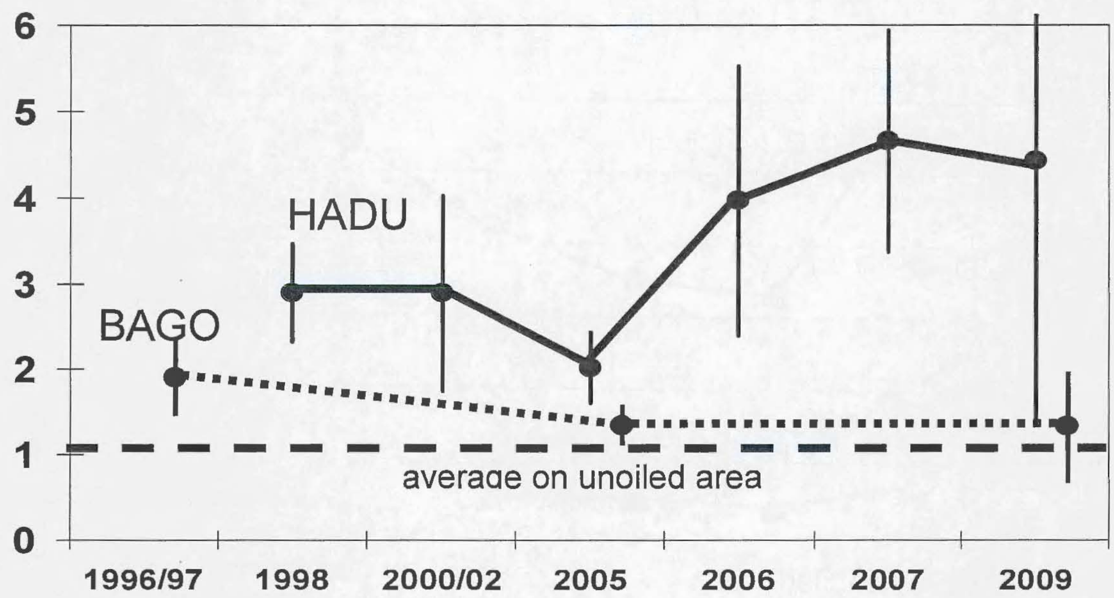

Figure 10. Average (± 95% C.L.) index of CYP1A induction (measured as EROD activity) of harlequin ducks (HADU) and Barrow's Goldeneyes (BAGO) captured on areas oiled during the *Exxon Valdez* spill, relative to unoiled areas, where the average is standardized to 1.0.

elevated EROD activity (Figure 11) were consistently above 0.20, and above 0.40 in every year except 2009, whereas the proportions from unoiled areas were always below 0.20. The drop in the proportion of harlequin ducks with elevated EROD activity in 2009 is an encouraging sign of potential progress towards recovery. Recent lab studies (see below) indicate that harlequin ducks have particularly sensitive CYP1A responses. This may result in higher and more variable levels of endogenous expression (i.e., in unoiled areas) and stronger responses when exposed to an inducing compound.

Barrow's Goldeneyes

Patterns of indicators of CYP1A in Barrow's goldeneyes differed from those of harlequin ducks. Average hepatic EROD activity of Barrow's goldeneyes differed between oiled and unoiled areas during 2005, after accounting for effects of sex, age, and body mass, although the magnitude of the difference between areas was reduced relative to the Trust et al. (2000) findings from winter 1996-97. By 2009, average EROD activity was similar between oiled and unoiled areas, with subtle relationships between EROD and sex and mass. The patterns are illustrated in Figure 10, which shows the decline in the average CYP1A index on oiled areas from 1996-97 through 2009, and the point estimate in 2009 with confidence intervals that overlap the average from the unoiled area.

Consistent with comparisons of averages, the proportion of Barrow's goldeneye individuals captured on oiled areas with elevated EROD activity declined from 41% in winter 1996/97 to 10% and 15% in 2005 and 2009, respectively (Figure 11). No individuals captured in unoiled areas showed elevated EROD in any year.

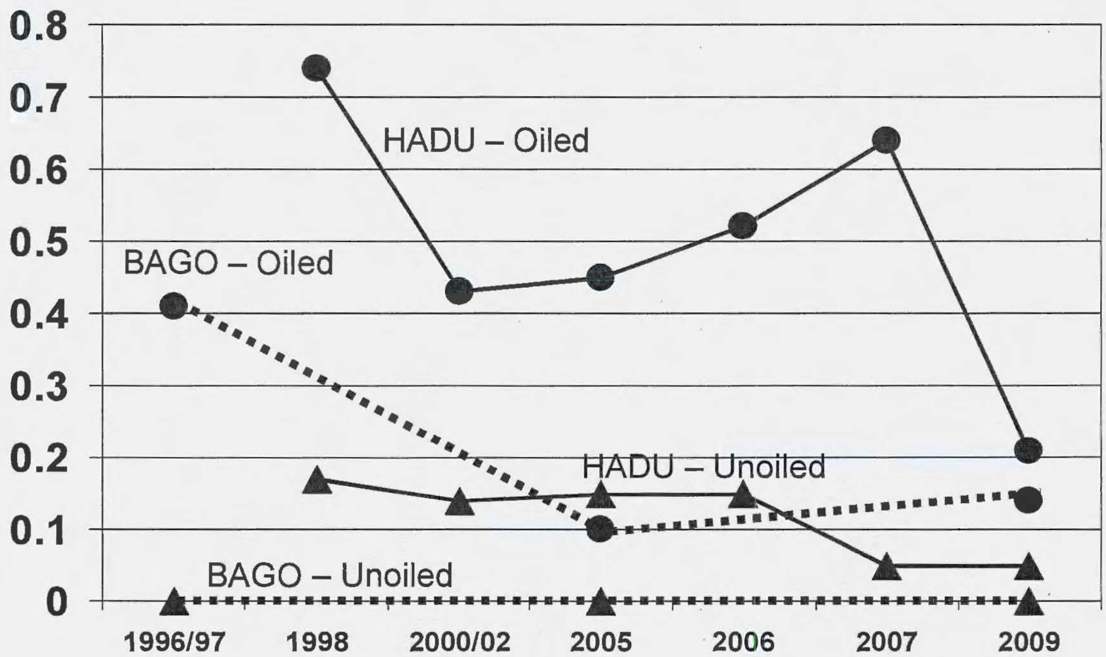

Figure 11. Proportion (y-axis) of individuals with elevated EROD activity, defined as ≥ 2 times the average on unoiled areas for that species and time period. HADU = harlequin duck and BAGO = Barrow's goldeneye.

Summary of the Sea Ducks Exposure Studies

Indicators of CYP1A induction (EROD activity) showed that harlequin ducks from areas of PWS oiled by the *Exxon Valdez* spill were exposed to inducing compounds through 2009. Given the low likelihood of other potential inducers (see below), this is interpreted as evidence of continued exposure to lingering oil. Barrow's goldeneyes also had higher EROD activity in oiled areas during 2005, but not 2009. These patterns are corroborated by examination of the proportion of individuals with elevated EROD activity. The reduction in EROD responses to near reference levels in Barrow's goldeneyes by 2009, as well as the decline in the proportion of harlequin ducks with elevated EROD, suggest that exposure to lingering oil is declining over time in these sea duck species that are highly susceptible to exposure. The timeframe over which exposure occurred (e.g., at least 2 decades in harlequin ducks) was unanticipated at the time of the spill, but the evidence of progress towards cessation of exposure is encouraging.

Exposure Studies of Other Birds

Basis for the Study

Two other bird species, black oystercatchers and pigeon guillemots, were examined for EROD activity indication of elevated CYP1A induction in oiled areas of PWS relative to unoiled areas during 2004. Both of these species feed in intertidal zones where lingering oil occurs, although oystercatchers feed largely on benthic invertebrates, whereas guillemots feed on both fish and invertebrates. Oystercatcher CYP1A induction had not been examined previously, but they were thought to be at risk of exposure due to their habitat and prey preferences. Guillemot adults, but not pre-fledging chicks, showed elevated EROD activity on oiled areas in 1998/99. Guillemot adults may have been exposed to oil during foraging activities in intertidal zones or through consumption of invertebrates, which (unlike fish, see below) tend to accumulate rather than metabolize hydrocarbons.

Study Approach and Methods

Liver biopsies were surgically collected from adult pigeon guillemots captured on nests in the Naked Island group (oiled; n = 25) and Jackpot and Icy Bays (unoiled; n = 19) during June 2004. Samples were immediately frozen in liquid nitrogen and shipped to Woods Hole Oceanographic Institution for analysis of EROD activity.

Similarly, adult black oystercatchers were captured on nests on Knight and Green Islands (oiled; n= 24) and Montague Island (unoiled; n = 20). Surgeries, sample collection, and lab analysis followed those of sea ducks and guillemots.

Results and Summary of Exposure Studies of Other Birds

Adult pigeon guillemot EROD activity did not differ between oiled and unoiled areas of PWS. In contrast, average EROD activity of adult black oystercatchers was slightly (but statistically significantly) higher on oiled areas than unoiled, by a factor of 1.5 (Golet et al. 2002).

By 2004, pigeon guillemots did not show evidence of exposure to lingering Exxon Valdez oil, suggesting that conditions had improved since the previous measure in 1999. However, black oystercatchers had higher EROD activity in oiled areas of PWS, suggestive of exposure to lingering oil. This is consistent with findings from several other species that occur in intertidal zones and consume benthic invertebrates (see above and below).

Exposure Study of Intertidal Fish

Basis for the Study

Jewett et al. (2002) examined several indicators of hydrocarbon exposure in two species of intertidal fish during 1998 and 1999. All of their measures, including hepatic EROD activity as an indicator of CYP1A induction, were elevated in either masked greenlings or crescent gunnels collected from oiled areas, relative to those collected in unoiled areas. These results were interpreted to indicate exposure of these benthic-feeding, intertidal fish to lingering *Exxon Valdez* oil for at least a decade following the spill. Recent studies funded by the Trustee Council were designed to replicate this work and evaluate exposure of benthic fish to lingering oil during summer 2008, nearly two decades after the spill.

Study Approach and Methods

Both species of intertidal fish were collected in areas considered previously to be heavily oiled, moderately oiled, and unoiled; these were northern Knight Island, Prince of Wales Passage and, for gunnels, northwestern Montague Island, whereas for greenlings, the unoiled area was Parry Island. Greenlings were caught by hook and line, and gunnels were collected from the intertidal during minus tides. Fish were anesthetized, and livers removed and frozen immediately in liquid nitrogen. Lab analysis of hepatic EROD activity was conducted at the University of California Davis following standard procedures.

Results and Summary of the Exposure Study of Intertidal Fish

A one-way analysis of variance for gunnels ($n = 43$) indicated that fish from heavily oiled areas had significantly higher hepatic EROD activity than those from unoiled areas in 2008. Average EROD activity from heavily oiled sites was 2.8 times that on the unoiled site. Gunnels from the moderately oiled area did not differ from those from unoiled sites.

In contrast, results for greenling ($n = 42$) indicated that average EROD activities of individuals from both heavily and moderately oiled areas did not differ from the average from unoiled areas.

Similar to results described for sea ducks, above, EROD activity indicated significant exposure to CYP1A inducing compounds on oiled areas for one intertidal fish (gunnels) but not another (greenling). EROD is a sensitive and specific measure of exposure, and significantly higher activity in gunnels from oiled areas is interpreted as evidence of continued exposure to lingering *Exxon Valdez* oil nearly two decades after the spill. Lack of elevated EROD in greenlings suggests that exposure to oil in that species has diminished to reference levels. Gunnels are more closely associated with intertidal sediments than greenling, which may explain observed interspecific differences.

Sea Otters Exposure Study

Basis for the Study

As benthic foragers that excavate large numbers of pits in soft sediments, including in intertidal zones where lingering oil occurs (see below), sea otters are at risk of exposure to residual *Exxon Valdez* oil. Sea otters have been sampled since the mid-1990's for biomarker studies; however, the approach used to measure CYP1A in otters has proven to be methodologically challenging and, unfortunately, data that were generated are not considered to be reliable. However, efforts funded by the Trustee Council are underway to test alternative, newer methods for reliably measuring biomarkers of oil exposure that can be applied to recent and archived samples.

Study Approach and Methods

A method for measuring differential gene expression of sea otters in response to hydrocarbon exposure has been developed; this approach is based on research that was conducted with captive mink dosed with hydrocarbons (Bowen et al. 2007). The array of genes that is evaluated includes CYP1A1 and aryl hydrocarbon receptor (AhR), which are both measures of hydrocarbon exposure, as well as other genes that may vary in expression following hydrocarbon exposure, and which may play roles in various aspects of physiological responses and consequences of that exposure (see below).

Results and Summary of the Sea Otter Exposure Study

This work is in progress, and results of comparisons of gene expression, including those that would indicate oil exposure, are not yet available to report. However, to date, methods have been successful and are being applied to recently collected samples. These same approaches will be tested for samples that have been archived from as far back as the mid-1990s, with the intent of providing a longer timeline of variation in exposure to oil.

POTENTIAL CONFOUNDING CYP1A INDUCERS

Basis for the Study

Several studies have contrasted CYP1A induction in vertebrates between areas oiled by the *Exxon Valdez* spill and unoiled areas. In many of these studies, indicators of CYP1A induction have been elevated in animals from oiled areas; this pattern has been interpreted as evidence of continued exposure to lingering oil (e.g., Trust et al. 2000, Jewett et al. 2002, Esler et al. 2010). Although CYP1A is induced by a limited number of compounds, there is the potential that vertebrates are being exposed to inducing chemicals other than *Exxon Valdez* oil.

Hydrocarbons from sources other than the *Exxon Valdez* oil spill occur in PWS. These include local-scale contamination associated with boat harbors, residual oil in the form of tar balls remaining from releases caused by the 1964 earthquake, and natural hydrocarbons. However, Short et al. (2004) estimated that the vast majority of hydrocarbons on beaches in oiled areas originated from the *Exxon Valdez* spill. Therefore, observed patterns in temporal and spatial distribution of CYP1A induction are not reasonably explained by other hydrocarbon sources.

Another family of compounds known to induce CYP1A is polychlorinated biphenyls (PCB). A recent Trustee Council-funded study analyzed data on PCB concentrations in blood plasma of sea otters and harlequin ducks to determine whether the distribution and concentrations of PCB were a plausible explanation for observed induction of CYP1A in vertebrates from areas of PWS that were oiled during the *Exxon Valdez* spill. Objectives were to determine: 1) concentrations and composition of PCBs in blood plasma of sea otters and harlequin ducks inhabiting oiled and unoiled areas in PWS; 2) PCB composition relative to recent or point source exposure; and 3) PCB concentration relative to reproductive status and age in sea otters.

Study Approach and Methods

Blood plasma was collected from sea otters and harlequin ducks that were captured during 1998; samples included 18 otters and 10 harlequin ducks from oiled areas and 10 of each species from unoiled areas. Plasma samples were analyzed for total PCBs, as well as concentrations of more than 90 specific congeners. Data were analyzed to evaluate differences between areas for four groupings of congeners: 1) Total PCBs comprised all congeners analyzed; 2) the sum of several congeners known to strongly induce CYP1A; 3) a panel of congeners recommended for monitoring in marine environments as indicators of bioaccumulative PCB pollution by the International Council for the Exploration of the Sea (ICES); and 4) congener 138 because of its recalcitrant nature and because it was the only congener detected in all samples.

Results

PCB concentrations in harlequin duck blood plasma were similar between oiled and unoiled areas for all groupings of congeners (Figure 12). For sea otters, concentrations of total PCB and CYP1A-inducing PCB differed between areas, although not in a direction that would explain elevated CYP1A induction observed in many vertebrates in oiled areas of PWS. In this case, PCB concentrations were higher for sea otters from unoiled areas (Figure 12).

Most measures of PCB concentrations did not differ by sea otter age or pup dependency status. However, concentrations of ICES congeners were significantly lower in females with dependent pups than those without pups. Also, PCB concentrations were not correlated with any plasma chemistry factors.

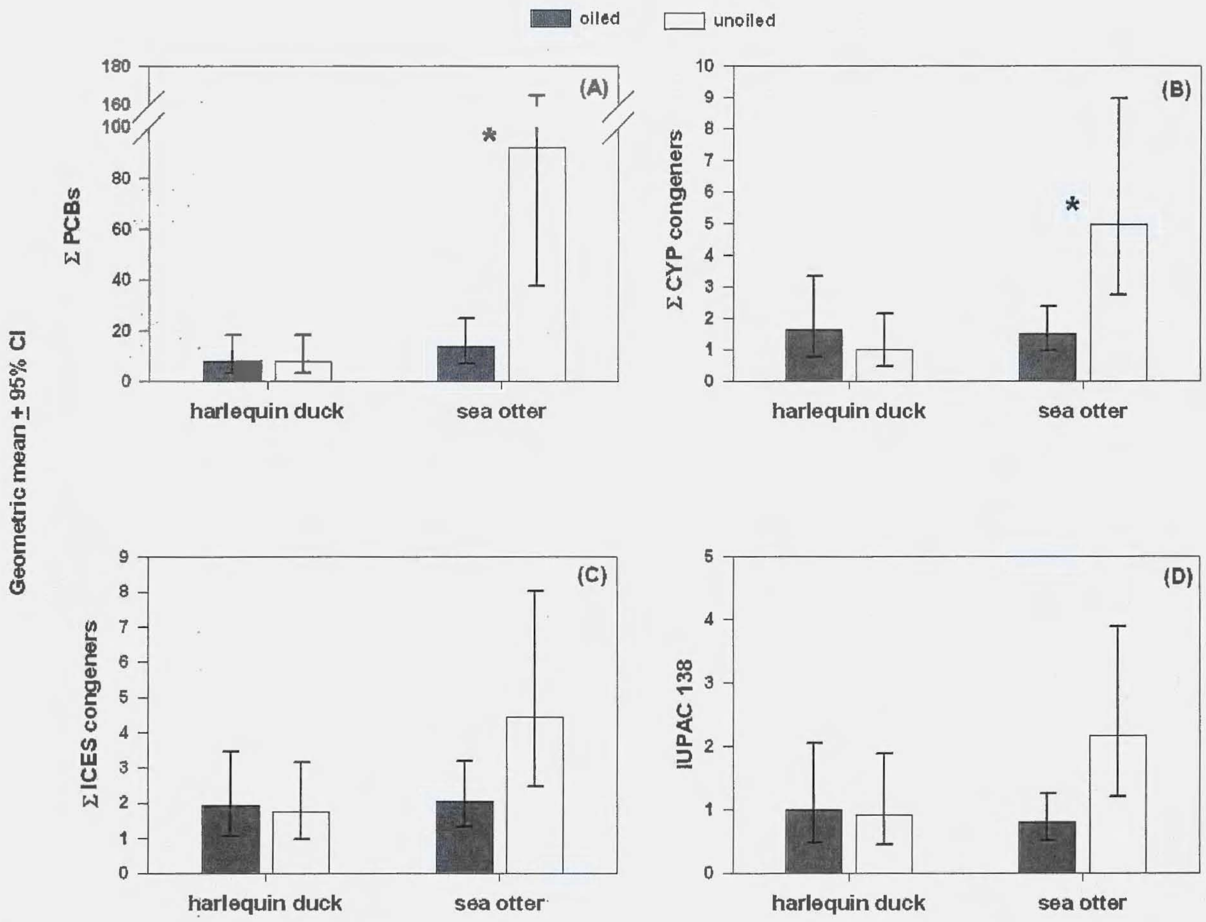

Figure 12. Back-transformed geometric mean concentrations (ng/g, wet weight) and 95% confidence intervals for PCBs in blood plasma samples from harlequin ducks and sea otters inhabiting oiled and unoiled areas of PWS, 1998. PCBs are grouped according to the sum of (A) 93 congeners, (B) non-, mono, and di-*ortho* congeners capable of inducing the cytochrome p450 (CYP) mixed function oxygenase system, (C) IUPACs 28, 52, 101, 118, 138, 153, 180 recommended for monitoring in marine environments by the International Council for the Exploration of the Sea, and (D) IUPAC 138. Asterisks above groups denote significant ($P < 0.05$) differences determined by ANOVA. Note variable y-axis scales.

Summary

Overall, concentrations of PCBs were low in harlequin ducks and sea otters from PWS. It is unlikely that PCBs exerted immunotoxic or physiological effects on the species in the study. Further, the patterns of PCB composition in sea otters and harlequin ducks did not suggest recent exposure to persistent PCBs but rather exposure to distantly derived, weathered PCBs.

Because PCB concentrations were similar between oiled and unoiled areas of PWS or higher in unoiled areas for some groupings of PCBs in sea otters, PCBs do not explain observed patterns of CYP1A induction described above for some species, namely higher induction in areas oiled during the *Exxon Valdez* spill. Combined with considerations of sources of hydrocarbons on beaches (Short et al. 2004), it is unlikely that there are any compounds confounding interpretation of CYP1A induction as an indicator of exposure to lingering *Exxon Valdez* oil.

SEA OTTER SPATIAL RELATIONS WITH LINGERING OIL

Basis for the Study

Much of the lingering oil from the *Exxon Valdez* spill is found in sediments in the middle and lower intertidal zones (see above). The degree of risk of exposure to that oil incurred by sea otters depends on their degree of use of the intertidal zone for foraging. This issue was addressed by measuring dive depth distributions and foraging effort using time-depth recorders, surveying beaches for evidence of sea otter foraging (pits), and an experiment to evaluate how long pits persist on beaches to help interpret findings from the pit survey.

Study Approach and Methods

In 2003 and 2004, sea otters at northern Knight Island were captured and instrumented with archival time-depth recorders (TDRs), which were programmed to record depth at 2-second intervals. In 2004 and 2005, instrumented otters were targeted for recapture to retrieve the devices and access archived information of numbers and depths of dives. Of the 28 devices deployed, 16 were recovered from 12 adult females and 4 adult males. Numbers of dives, depth of dives, and the proportions of dives that occurred in the intertidal zone were calculated from the TDR data.

Surveys for sea otter foraging pits were conducted during negative tides in summer 2008 at soft sediment beaches of the northern Knight Island archipelago. At each beach segment, the entire area of exposed intertidal soft sediments was searched for evidence of sea otter foraging; areas with foraging pits were mapped using GPS and the density of pits and tidal elevation were recorded.

Experimental pits were dug to simulate those created by foraging sea otters, to evaluate their persistence over time. Pits were dug in soft sediment beaches within the northern Knight Island archipelago during April – June 2008, using an experimental design that allowed consideration of different exposures and intertidal elevations. Sites were revisited regularly during negative tide cycles and the status of each pit was documented.

Results

Based on the TDR data, individual sea otters averaged 197 foraging dives per day, of which an average of 13% were in the intertidal zone; taken together, roughly 25 foraging dives are estimated to occur in the intertidal zone per sea otter per day, on average. Females tended to dive more often and in shallower water, including intertidal zones, than males. Season also had an effect, with both sexes foraging in intertidal areas most frequently during spring.

Natural sea otter pits were detected in the intertidal areas of most of the soft sediment beaches (71%) surveyed in the northern Knight Island archipelago, including some that were known to have lingering *Exxon Valdez* oil. Further, the proportion of the entire length of soft sediment beaches that had evidence of sea otter pits was 54%. Most of these were in the lower intertidal (-0.5 to 0.5 m), although some pits were found at all tidal elevations.

Pit persistence was related to intertidal elevation; by September (3 to 5 months after pits were excavated), 56%, 42%, and 20% of pits were detectable at 0 m, 1 m, and 2 m, respectively. By March 2009, almost all (97%) of the pits at all tidal elevations were gone, supporting a conclusion that natural pits observed on beaches are indicative of sea otter foraging activity that has occurred recently, on a scale of months.

Summary

Results of these studies demonstrate that sea otters definitely forage in intertidal zones, including the tidal elevations and specific beaches that harbor lingering *Exxon Valdez* oil. Given the average number of daily intertidal dives estimated for foraging sea otters, observations of extensive foraging in soft sediment beaches of northern Knight Island, and the apparent lack of avoidance of beaches known to contain lingering oil, exposure of some individuals to residual *Exxon Valdez* oil is likely, corroborating estimates by Short et al. (2006). As a related note, the large amount of sediment turnover caused by sea otter foraging likely serves as a form of bioremediation, exposing residual oil to weathering and dispersal.

CONSEQUENCES OF EXPOSURE OF VERTEBRATES TO LINGERING OIL

As described above, a number of vertebrates have been shown to have been exposed to lingering oil during the second decade post-spill, with some species continuing to show evidence of exposure through 2009. In this section, studies funded by the Trustee Council that consider potential effects of exposure to lingering oil are summarized. These include studies of population-level demography (e.g., survival rates and population trends), as well as studies examining potential deleterious effects at the individual or sub-organismal levels.

DEMOGRAPHIC RELATIONSHIPS WITH LINGERING OIL

HARLEQUIN DUCKS: SURVIVAL

Basis for the Study

In the mid- to late-1990s, nearly a decade after the 1989 *Exxon Valdez* oil spill, winter survival of female harlequin ducks was lower in oiled areas of PWS relative to unoiled areas (Esler et al. 2000). This observation was coincident with evidence of exposure to lingering oil, and the survival differential was determined to be sufficient to cause different population trajectories and lack of recovery in oiled areas. A more recent study evaluated female survival during winters 2000-01 to 2002-03 to determine whether differential survival persisted and to evaluate whether individual-level indices of oil exposure were related to survival (Esler and Iverson 2010).

Study Approach and Methods

Female harlequin duck winter survival was measured using radio telemetry. In the most recent studies, females were captured on oiled and unoiled areas during Novembers of 2000, 2001, and 2002 and equipped with implanted VHF radio transmitters. While under anesthesia, a liver biopsy was removed from each individual to be used to evaluate CYP1A induction (see above). Radioed individuals were tracked by airplane through March. Variation in survival was analyzed in relation to area (oiled versus unoiled), age class (hatch-year versus after-hatch-year), season (mid-winter [December and January] versus late-winter [February and March]), and a measure of CYP1A induction.

Results

In contrast to earlier studies (Esler et al. 2000), survival during winters 2000/01 through 2002/03 did not differ by area. Also, individual measures of oil exposure (CYP1A) were not related to survival probability. These results were interpreted to indicate that exposure to lingering oil was no longer affecting gross demographic attributes of the harlequin duck population in oiled areas of PWS. Effects of age and season were evident (Figure 13) and consistent with previous studies, with younger females having poorer survival and mid-winter survival lower than late-winter.

Summary

Despite evidence of continued exposure to lingering *Exxon Valdez* oil in harlequin ducks (see above), winter survival rates were similar between oiled and unoiled areas within PWS during winters 2000//01 – 2002/03. These findings indicate that direct, gross demographic consequences of chronic oil exposure had abated by the early 2000s. Potential subtle and suborganismal effects of continued exposure are discussed below.

HARLEQUIN DUCKS: POPULATION MODEL

Basis for the Study

Harlequin ducks have been well-studied in PWS following the *Exxon Valdez* oil spill and this body of work has generated a considerable amount of population demographic data, including results on female winter survival (Esler et al. 2000, Esler and Iverson 2010), dispersal (Iverson and Esler 2006), and population abundance and age structure (McKnight et al. 2006, Rosenberg et al. 2005). These data were assembled in a population model to (1) compare the relative magnitudes of acute and chronic oil spill mortality, (2) assess the current recovery status of harlequin ducks in PWS, and (3) project a timeline to recovery.

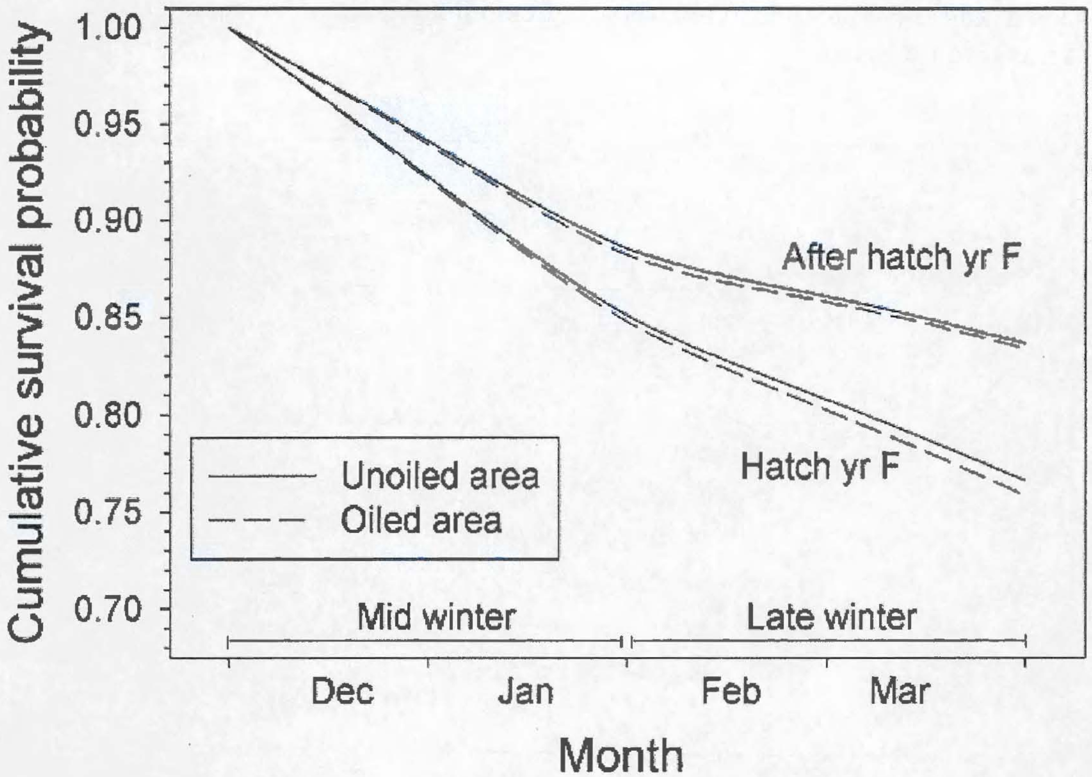

Figure 13. Cumulative winter survival probabilities of radio-marked female harlequin ducks (n = 138) from PWS during winters 2000-01 through 2002-03. Lines represent model-averaged estimates across models allowing variation in relation to season, age class, and area.

Study Approach and Methods

A deterministic, age-structured matrix model was constructed for female harlequin ducks, with measured estimates of winter survival, population abundance, and dispersal, and estimates of fecundity from the literature, as model inputs. A number of scenarios and permutations were run to accommodate variability and uncertainty in model inputs and formulations. Results are presented as the findings from the most likely scenario, bounded by the best-case and worst-case scenarios.

Results

As expected based on the life history of harlequin ducks, variation in survival rates had the strongest effect on population dynamics. Estimated acute mortality of female harlequin ducks during the weeks and months after the spill was approximately 400; this was exceeded by model-generated estimates of females dying during the chronic phase of the spill (772), based on survival rates that were depressed on oiled areas for at least 9 years after the spill.

The most likely model scenario generated estimates of a declining population trend that was predicted to persist for at least 6 years after the spill across PWS, with a mean population growth rate of $\lambda = 0.976$ during this period of decline. At their lowest point, female numbers were predicted to be reduced 14.7% below pre-spill abundance overall and by 55.3% in oiled areas. After the declining trend was reversed, models projected a mean annual population growth rate at

1.008 for PWS as a whole and a timeline to recovery to pre-spill numbers of 24 [range: 16-32] years across all areas (Figure 14).

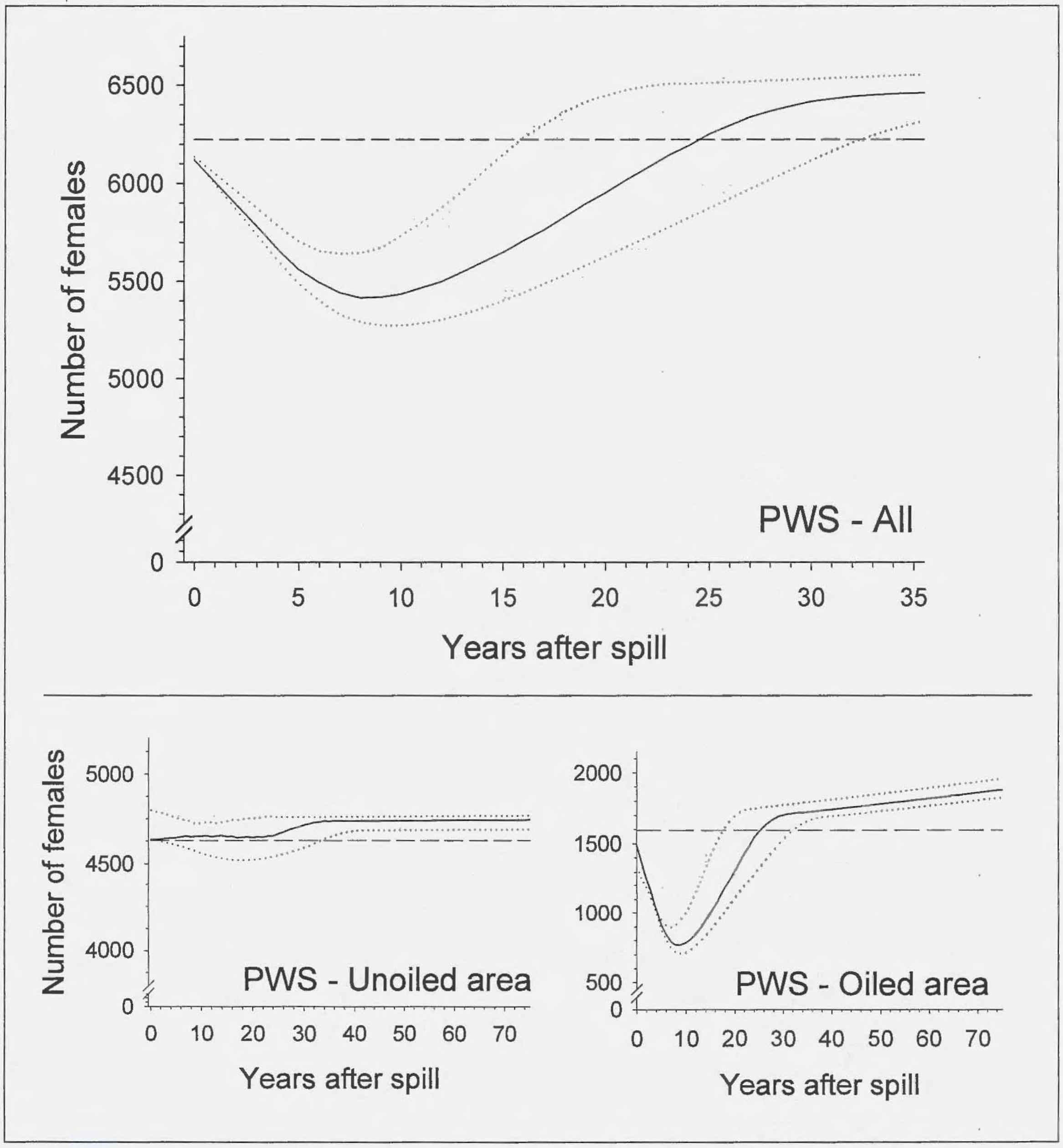

Figure 14. Model projected population recovery for harlequin ducks in relation to variation in oiling history, productivity, and dispersal among oiled and unoiled areas of PWS derived using the most likely combination of model inputs (solid line), with confidence intervals derived using worst- and best-case scenario models (dotted lines).

Summary

The population model confirmed that chronic mortality associated with lingering oil was a major driver of population dynamics and lack of recovery for the first decade following the *Exxon Valdez* oil spill. Estimated mortality during the chronic phase was roughly double that estimated during the acute phase. Equilibration of survival rates between oiled and unoiled areas after the first decade following the spill allowed the population in the oiled area, and throughout PWS, to begin to recover, with the most likely estimate of full recovery requiring two and a half decades.

SEA DUCKS – POPULATION TRENDS

Basis for the Study

Two sea ducks, harlequin ducks and Barrow's goldeneyes, have close associations with intertidal habitats and are fairly common and widespread through PWS during winter. In addition, these species have been shown to have elevated indicators of oil exposure through 2005, in the case of Barrow's goldeneyes, and 2009 for harlequin ducks (see above). Also, for harlequin ducks, demographic injury (reduced survival) was detected up to a decade post-spill, and population recovery was projected to take more than two decades (see above). Surveys of abundance are useful for gauging recovery status of these species.

Study Approach and Methods

Population trends in harlequin ducks and Barrow's goldeneyes were evaluated based on two series of boat surveys. First, the U.S. Fish and Wildlife Service (USFWS) boat surveys are designed to provide PWS-wide population estimates and trends of all marine birds (and some marine mammals), as well as estimates and trends at the scale of oiled and unoiled portions of PWS. These surveys have been conducted during March in 1990, 1991, 1993, 1994, 1996, 1998, 2000, 2004, 2005, and 2007.

Second, the Alaska Department of Fish and Game (ADFG) has conducted boat surveys specifically designed to monitor harlequin ducks. These have been conducted in March, nearly annually from 1997 to 2009. In addition to quantifying numbers, age and sex information is recorded for all harlequin duck observations. In addition to their regular surveys, ADFG conducted a series of surveys in 2007 and 2008 that replicated work conducted during pre-spill years of 1972 to 1973.

Results

USFWS surveys describe stable winter densities of both Barrow's goldeneyes and harlequin ducks since the oil spill through 2007, in both oiled and unoiled parts of PWS (McKnight et al. 2007). The authors interpret this as evidence of lack of recovery, under the expectation that recovery would require significantly increasing abundance of injured species on oiled areas.

ADFG surveys of harlequin ducks describe fairly stable numbers, densities, and distributions during the period 1997 through 2009. Slight positive increases were detected on oiled areas, particularly for females, which is consistent with a recovering population.

As expected for harlequin ducks, like many waterfowl, sex ratios were male-biased. Sex ratios did not vary over years, although there was a slight but significant difference between oiled and unoiled areas. Over all years, 40.7 (95% CI: 40.2 – 41.2) females per 100 birds were observed in oiled areas, compared to 41.9 (95% CI: 41.3 – 42.5) females per 100 birds in unoiled areas. Over the study period, recruitment has increased slightly, based on an increasing proportion of juveniles observed in both oiled and unoiled areas.

ADFG comparisons of 2007 and 2008 data with surveys conducted during March of 1972 and 1973 revealed no overall difference in densities between time periods, suggesting that current harlequin abundance is similar to pre-spill abundance.

Summary

Based on both USFWS and ADFG surveys, winter abundances of Barrow's goldeneyes and harlequin ducks have been generally stable since the *Exxon Valdez* spill. Although lack of recovery was inferred for both species due to lack of evidence of increasing trends in oiled areas during USFWS surveys, indication of increasing trends in harlequin ducks on oiled areas based on ADFG surveys is an encouraging sign. The specialized ADFG surveys have greater power to detect subtle trends. Also, ADFG work indicated that contemporary densities of harlequin ducks are similar to pre-spill densities, also suggestive of recovery and consistent with expectations of the population model (above). ADFG collected data on Barrow's goldeneyes during their harlequin duck surveys, but summaries of these data through 2009 have not yet been prepared.

SEA OTTERS – SURVIVAL

Basis for the Study

Based on data from age-at-death information from carcasses collected systematically in western PWS, Monson et al. (2000) determined that survival of sea otters was depressed in the oiled region during the *Exxon Valdez* spill through at least 1998. This was interpreted as a demographic consequence of injuries suffered during both acute and chronic phases of the spill. More recent work has updated the survival consideration through 2005.

Study Approach and Methods

Sea otter carcasses have been collected from 1976 through 2005 from shorelines of western PWS during beach surveys conducted in April or May, after snow melt but prior to the growth of beach grasses that can conceal carcass remains. From each carcass, a tooth was recovered for age estimation, providing data on ages at death of sea otters over approximately a 30-year period. Survival analyses were conducted both as simple demographic models, such as those used in previous studies (Monson et al. 2000), and as part of more complex and presumably more realistic source-sink population models (see below).

Results

In the most recent modeling effort, the simplest analyses were consistent with the previous findings of Monson et al. (2000); namely, that survival continued to be depressed in oiled areas relative to baseline conditions up to 16 years after the *Exxon Valdez* spill. In the more complex (and better supported) source-sink models, survival of juveniles was most strongly reduced during the immediate post-spill years, whereas survival of older age classes was more strongly depressed starting 4-5 years after the spill. However, survival of all age classes was estimated to be lower than baseline levels through 2005.

Summary

The findings using data collected through 2005 suggest continued depression of survival rates for all age classes of sea otters in oiled areas of PWS. Note that these analyses were not conducted using the most recent data (2006-2009) when sea otter abundance has increased at northern Knight Island (see below, Population Trends). Possibly, incorporating the more recent data will reveal different patterns of survival.

It is also worth noting that alternate estimates of sea otter survival rates, obtained from radiotelemetry studies of sea otters in western PWS from 2002-2005, are consistent with rates estimated from the modeling work and suggestive of adverse effects on the growth rate of the western PWS otter population.

SEA OTTERS – POPULATION MODEL

Basis for the Study

Population models were constructed to evaluate underlying explanations for observed sea otter population trends and age structure (both living otters and carcasses) in western PWS.

Study Approach and Methods

Various sets of model inputs representing different hypotheses about factors affecting population dynamics of sea otters in western PWS were contrasted, using data on population abundance, age composition of dead otters recovered during beach surveys (see above), and age composition of live otters captured in the field. The model structures allowed consideration of source-sink dynamics, wherein a portion of the western PWS population is constrained to have a stable or declining population trajectory (the "sink" population, which is that portion of the population with deleterious oil spill effects and declining numbers), and the remaining western PWS population is considered to be the "source."

Results

Models incorporating source-sink dynamics were most strongly supported by the available data. The best supported of these models indicated reduced survival in all age classes in the sink population, with different temporal patterns of mortality for young otters and older animals (see above). Also, the best-supported model indicated stable numbers in the sink portion of the population. This model generated an estimate of mortalities exceeding baseline conditions of approximately 540 individuals from 1990 through 2005.

A second model received modest support. In this case, the size of the sink population was allowed to change over time. Under this scenario, the proportion of the population suffering oil spill effects declined over time, i.e., effects were constrained to progressively fewer otters (<10 by 2005), and total chronic mortality above baseline was estimated to be 245 animals.

Summary

Based on these models, sea otter population dynamics in western PWS are best explained in the context of differential processes occurring in source and sink subpopulations and survival patterns that varied through time according to age class. However, these models were built using data collected through 2005, prior to the observed increase in numbers at northern Knight Island in 2007-2009 (see below). Revisiting this exercise including data during this apparent recovery period might elucidate the factors driving more recent population dynamics and recovery.

SEA OTTERS – POPULATION TRENDS

Basis for the Study

Sea otter abundance has been monitored nearly annually since 1993, to gauge the status and progress of population recovery. Surveys have focused on western PWS, where oil spilled during the *Exxon Valdez* accident accumulated, resulting in high acute mortality of sea otters, and where lingering oil persists, leading to concerns about chronic effects. Additional emphasis was placed on the northern Knight Island archipelago, which was particularly hard hit during the spill and had not appeared to recover through the early 2000s.

Study Approach and Methods

The survey methodology and experimental design are described in detail by Bodkin and Udevitz (1999). In brief, aerial surveys are conducted as strip transects, stratified into high- and low-density transects, with more effort allocated to high-density strata. Detection probabilities are calculated and applied to each survey to estimate abundance of sea otters in western PWS. Additionally, up to five replicate surveys are conducted annually for the northern Knight Island archipelago, an area where sea otters have been intensively studied.

Results

At the scale of western PWS, the sea otter population in 2009 was estimated (± SE) to be 3,958 (± 653). This represents an increase of nearly 2,000 individuals since surveys were initiated in 1993. Numbers have increased by approximately 2.6% annually over this period (Figure 15).

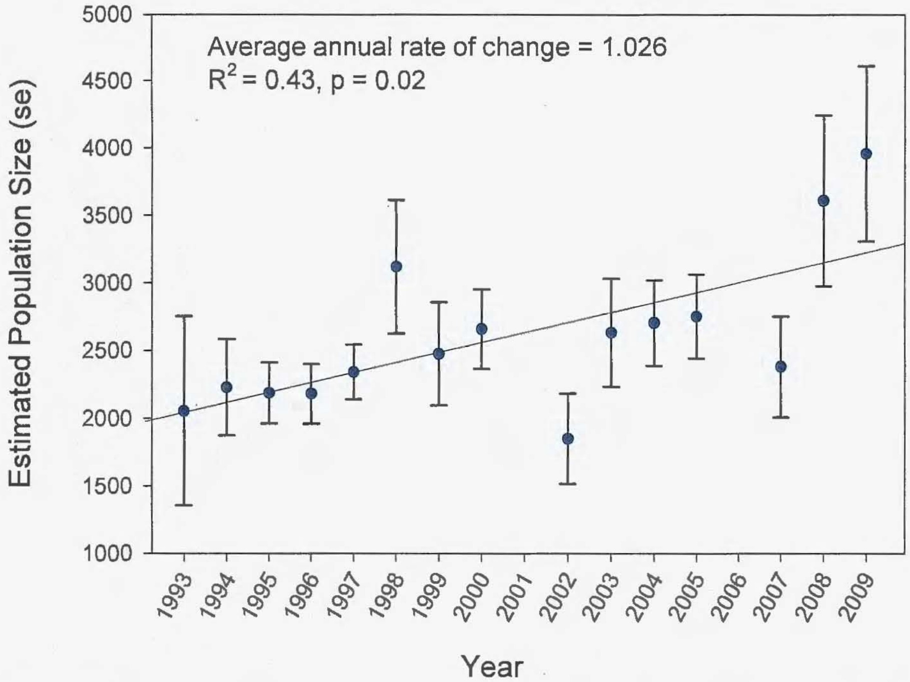

Figure 15. Sea otter population trend in western Prince William Sound, 1993-2009. Line is linear regression fitted to all points, bars indicate ±1 SE.

At northern Knight Island, numbers of sea otters were fairly constant between 1993 and 2001, averaging 78 individuals, which was well below the number estimated to occur in that area before the Exxon Valdez spill (Figure 16). However, from 2003 through 2009, numbers increased markedly, with an average annual increase of about 25%. Although numbers in 2009 were still 30% below the pre-spill estimate, the increasing trend is encouraging.

Summary

The overall increasing trend in number of sea otters in western PWS, and more specifically the recent increasing trend in numbers at northern Knight Island, indicate progress toward recovery. The northern Knight Island area suffered severe oiling and sea otter mortality approached 0.90 in some subareas (Bodkin and Udevitz 1994). Although the 2009 estimate of abundance at Knight Island remains below the best estimate of pre-spill abundance, if similar rates of increase continue, northern Knight Island may achieve pre-spill otter abundance within the next 2-3 years.

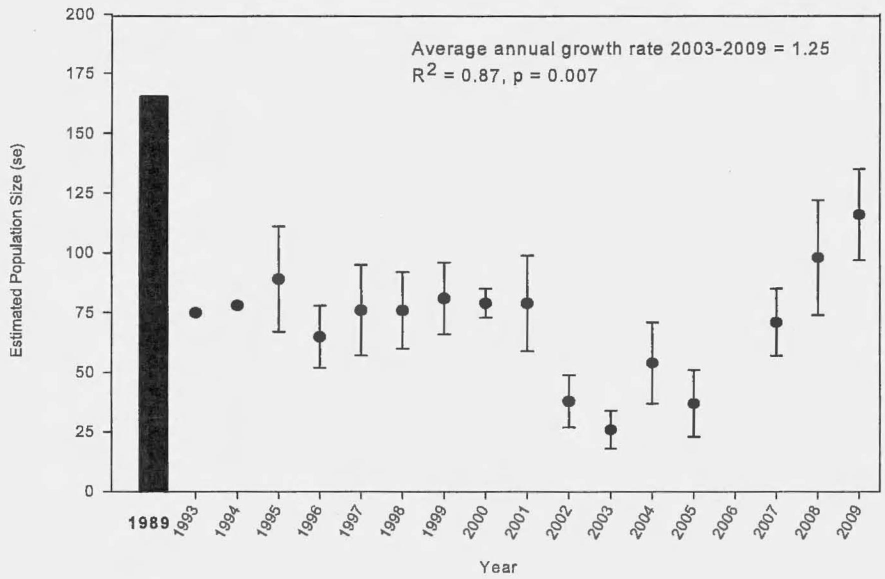

Figure 16. Sea otter population trends at the northern Knight Island study area, 1993-2009. The 1989 estimate (165) is the number of sea otters that were captured live (and taken to rescue centers) or recovered as carcasses during March and April of 1989 from the northern Knight Island area where aerial surveys were conducted from 1993-2009. This number does not include animals that survived or those that died but were not recovered in this area. It may include animals that died elsewhere but were recovered here. The only comparable pre-spill sea otter survey counted about 250 sea otters in this area in 1973.

INDIVIDUAL OR SUB-ORGANISMAL CONSEQUENCES OF EXPOSURE

HARLEQUIN DUCKS

Basis for the Study

Harlequin ducks in PWS continue to be exposed to residual *Exxon Valdez* oil through 2009 (see above). Demographic consequences of exposure were evident as differences in female winter survival between oiled and unoiled areas through 1998, but survival rates were similar between areas in the early 2000s (see above). Despite cessation of gross, population-level effects, subtle and potentially sublethal injury may still occur as a result of exposure to lingering oil. To evaluate this issue, laboratory studies are underway, in which species-specific cell lines are developed, exposed to hydrocarbons, and analyzed with a battery of bioassays to evaluate injury at the cellular level.

Study Approach and Methods

Cell lines were developed for harlequin ducks (and mallards, as a potential surrogate) from embryonic fibroblasts and livers. Cell cultures will be confronted with varying doses of several different hydrocarbon compounds (including hydrocarbons from the field where lingering oil is known to occur). Assays to evaluate cellular injury include several measures of cytotoxicity, CYP1A induction, and measures of chromosome damage and genotoxicity.

Results and Summary

This work is in progress, so definitive results about occurrence and degree of cellular injury are not yet available. However, cell lines of harlequin ducks and mallards have been successfully developed, and a standard, commercially-available rainbow trout cell line has been acquired to assist with bioassay development and interpretation. These cell lines will be exposed to site-specific complex mixtures of bioavailable hydrophobic compounds. This will be accomplished using extracts from semi-permeable membrane devices (SPMD) that were deployed at PWS sites where harlequin ducks continue to be exposed to lingering oil (see above). The battery of bioassays is in development. For greater relevance of dosing with SPMD extracts during bioassay development, reference material has been prepared from SPMDs constructed with Alaska North Slope crude (ANS) and synthetically-weathered ANS crude. During this effort, harlequin duck CYP1A response was demonstrated to be much higher than that of mallards or rainbow trout to a similar dose of chrysene, a reference material used in assay development and validation. Mallard duck response has been shown to be highly responsive to SPMD-ANS extract in spite of its lower sensitivity to CYP1A agonists. Assay validation continues and application of all assays and reporting of results will occur over the next 1.5 years.

SEA OTTERS

Basis for the Study

Sea otters, due to their high foraging rates, occurrence of intertidal foraging, and use of known oiled beaches for foraging (see above) are susceptible to oil exposure and any corresponding injury. To evaluate subtle and perhaps sublethal injury, a gene panel has been developed to evaluate expression of a number of genes that may indicate physiological stress or injury. This panel is based on work with oil-dosed, captive mink (Bowen et al. 2007).

Study Approach and Methods

Bowen et al. (2007) identified a number of genes that showed differential expression between mink that were dosed with oil relative to those that were not dosed. Genes showing differential expression in the mink study and whose functions are understood are being used to evaluate whether sea otters are showing higher expression of genes in oiled areas that may indicate injury. The array includes genes that play roles in immuno-modulation, inflammation, cyto-protection, tumor suppression, reproduction, cellular stress-response, metal metabolism, xenobiotic metabolizing enzymes, antioxidant enzymes, and cell-cell adhesion.

These methods will first be applied to Peripheral Blood Mononuclear Cells (PBMC) and liver samples collected from individual sea otters in 2003-2008. If these PBMC samples produce meaningful analytic results, gene expression will be analyzed in archived PBMC samples from 1996 through 2002.

Results and Summary

Thirteen genes have been successfully sequenced in sea otters that were the same as those expressed in mink experimentally exposed to oil (Bowen et al. 2007), as well as two additional genes that aid in interpretation of stress levels in animals exposed to xenobiotics that include aromatic hydrocarbons found in crude oil. The lab work for the initial analyses of PBMC and liver from 2003-2006 is underway, but results are not available to report at this time. However, this method holds promise, including as an opportunity to evaluate archived samples to see if expression of genes indicating injury has declined over time, as would be expected in a scenario of declining amounts and frequency of oil exposure.

FACTORS RESPONSIBLE FOR LIMITING THE DEGRADATION RATE OF *EXXON VALDEZ* OIL IN PRINCE WILLIAM SOUND BEACHES

Before remediation methods can be developed to treat the lingering oil, the factors that are limiting the natural degradation of the oil must be understood. Therefore, this study, informally called the "limiting factors study," was designed to identify and compare the hydrogeological processes on gravel beaches with and without the presence of lingering subsurface oil.

Study Approach and Methods

Studies were conducted at six gravel beaches in PWS: EL056C and EL058B (Eleanor Island) in 2007; and KN109 and KN114A (Knight Island) and SM006B and SM006C (Smith Island) in 2008. These sites were selected based on two main criteria: sediments thick enough to allow installation of injection and monitoring wells; and presence of patches of lingering subsurface oil adjacent to areas that were free of subsurface oil, allowing comparison of the hydrogeological properties of each area.

The 2007 and 2008 field study methods consisted of the installation of wells with sampling ports at multiple depths in both oiled and unoiled transects on each beach. A tracer was injected into the beach and the rate of change in the tracer concentrations monitored over time and space. Salinity, temperature, dissolved oxygen, nutrients, and pressure were also measured. Sediment samples were collected for grain size analysis, hydrocarbon analysis, TKN, and chemical oxygen demand. The field data were used to develop models of groundwater flow patterns in the beach sediments.

Key findings from the studies in 2007 and 2008 were:

1. The beaches can be viewed as consisting of two layers, an upper layer with a very high permeability and a lower layer with a very low permeability. Surprisingly, the contrast in permeability between the layers was found to be around three orders of magnitude.
2. The dissolved nutrient concentration in the beaches was much smaller than that needed for maximal growth of microorganisms and the subsequent consumption of oil.
3. The oil persisted at locations where the freshwater groundwater flow (moving seaward) was small.
4. Temperature of pore water within the beaches was higher than 12°C in the summer months, suggesting that biodegradation likely is unhindered by temperature.

5. Modeling studies using the software SUTRA (USGS) and MARUN (Boufadel et al. 1999) confirmed the two layers' configuration and suggested that the concentration of dissolved oxygen in the lower layer was most likely too low to sustain aerobic biodegradation.

Many of these findings, along with the results from the microcosm study (discussed above), motivated additional field work that was conducted in 2009.

The 2009 field program gathered important data, previously lacking, about groundwater flow in the lower layer of the beaches. In designing effective *in-situ* remedial techniques, it is critical to know the flow rates in the lower layer, the "area of influence" of an injection well under different injection pressures, and the maximum injection pressure that can be reliably applied while maintaining well integrity. Similarly, where slow-release application at beaches with a shallow oil layer may be proposed, information on the rate of flow within the oil layer and the area of influence from the point of application of slow release material was critical. It was also important to measure oxygen and nutrient levels in the lower layer.

Therefore in 2009, studies were conducted on two beaches, EL056C and SM006C, during two periods. From June 18-25, various sensors were placed into the beach along with systems for high-pressure injection (to determine the pressure at which the injection system "blows out" the well even with a bentonite layer immediately around the well) and systems for low-pressure tracer injection into the lower, less permeable layer (to determine the area of influence of the slow-release injection of bioremediation amendments into the oiled layer). All measurements were conducted during 19-27 August, to allow for the beach sediments to recover from the disturbances during well installation.

Results

The preliminary findings from the 2009 field studies are:

1. It takes approximately one month for the two-layer configuration to be reinstated after excavation and filling of pits.
2. The concentration of dissolved oxygen in the lower layer was less than 1.0 mg/L at oiled locations (Figure 8 for the beach on Eleanor Island and Figure 9 for the beach on Smith Island). It was in general higher than 3.0 mg/L in the clean transects.
3. The blowout of the high-pressure injection well on Eleanor Island (EL056C) occurred at a flow rate of 1.3 gallons per minute.
4. The low-pressure injection studies indicated that a design injection flow could be around 0.3 to 0.4 gallons per minute.
5. On the Smith Island study site (SM006C) where the tracer was released under low pressure, two horizontal manifolds, each around 3 feet long were placed approximately 3 feet deep. The tracer migrated approximately 6 feet seaward and 1.0 foot landward in a 24-hour period.

Summary

Based on both the field studies and the microcosm work described above, Boufadel et al. have concluded that lack of oxygen availability to the oil in the lower layer is the key factor limiting decomposition of the lingering oil, with nutrient availability in the lower layer as a lesser but measurable factor. The key issue is to increase the amount of oxygen and nutrients in the low permeability layer that contains the oil. The results of the 2009 field work can be used to design pilot studies of the best approaches for *in-situ* remediation. The data on flow rates and area of influence in the lower layer can be used to make design the distance between surface injection points or wells, the injection pressure for wells, and the amounts of oxygen and nutrients to be injected, whether by well or surface injection. It can also be used to design the distance between wells or injection points and monitoring locations.

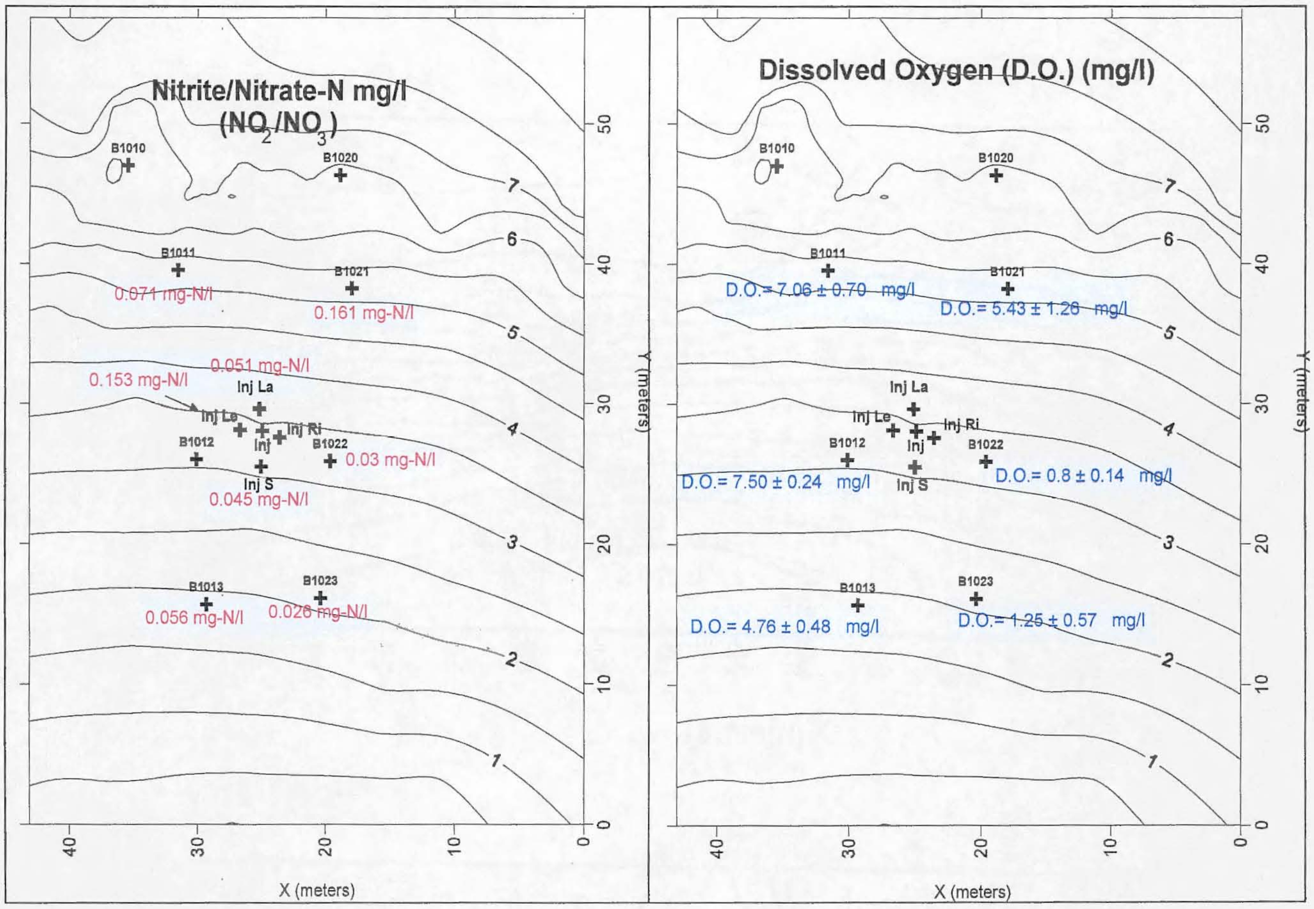

Figure 8. Plan view of beach EL056C, Northwest Bay, Eleanor Island. The landward direction is upward. The wells labeled B1010-1013 (Left) are in the unoiled transect; wells labeled B1020-1023 (Right) are in the oiled transect. Heavily oiled residue (HOR) was present at B1022 and B1023. The contours represent the topography in meters. The cluster in between the transects represents the injection well (in the middle) and the monitoring wells around it.

(Left) Average pore-water nitrate concentration, as N, measured deep into the sediments. The values are low, at least 10-fold smaller than required for optimal biodegradation of oil, which is 2 to 10 mg/L of nitrate-N.

(Right) Average pore-water dissolved oxygen concentration. The depth of the sensors was the same for corresponding Right and Left wells. However, the upper layer of the left transect was deeper, which explains the high dissolved oxygen values at B1012 and B1013 in comparison with B10122 and B1023, respectively.

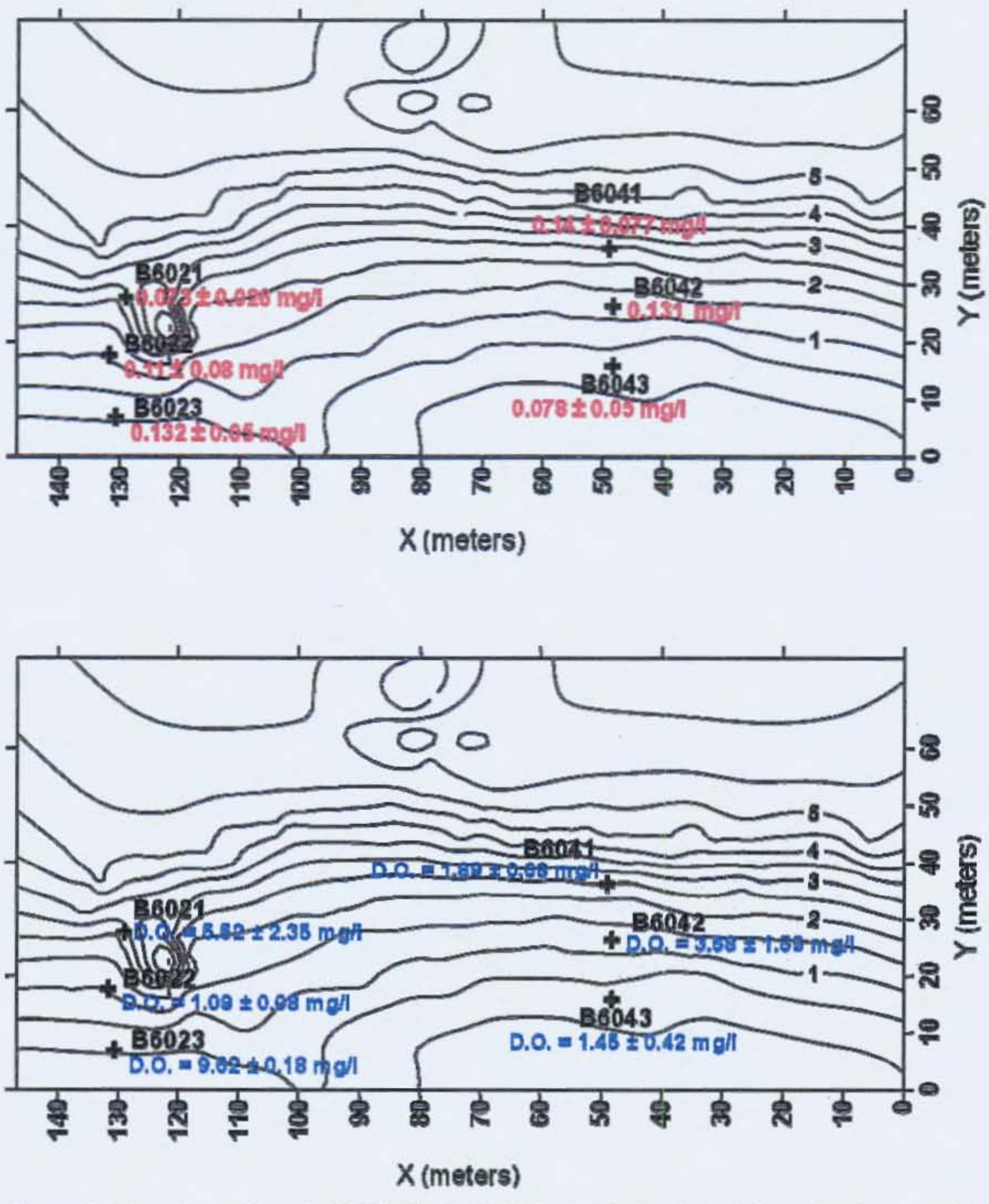

Figure 9. Plan view of beach SM006C, Smith Island. The landward direction is upward. Oil was present at well 6022. (Top) Average nitrate concentration (mg/L of N). Note that the optimal nitrate-N concentration for biodegradation of oil is 2 to 10 mg/L. (Bottom) Dissolved oxygen concentration at an average depth of 2.5 feet.

BIODEGRADABILITY OF LINGERING OIL 19 YEARS AFTER THE *EXXON VALDEZ* OIL SPILL

Basis for the Study

At the 2007Arctic and Marine Oilspill Program (AMOP) conference, Atlas and Bragg (2007) reported a new index that they called the Bioremediation Index suggesting that if the PAH fraction were > 70% weathered, further attempts at bioremediation would be futile. However, Short et al. (2004) used a different index that showed that the Bioremediation Index did not seem to fully account for the PAH content of the lingering oil. Therefore, a lab microcosm study was designed to address the extent to which the lingering oil is biodegradable given varying degrees of weathering. The objective was to measure the biodegradability of the 19-year lingering oil under conditions of excess nutrients and oxygen.

Study Approach and Methods

Samples of beach substrate were collected in the summer of 2008 from representative sites in PWS contaminated with oil residues of varying weathering states according to the Atlas-Bragg model. The three sites were KN114A at the entrance to Herring Bay (BI of 74% - highly weathered), SM006B on the north shore of Smith Island (BI of 58% - moderately weathered), and PWS3A4 on the eastern, outer shore of Eleanor Island (BI of 47% - slightly weathered). The sediments were collected and sieved in the field to meet the requirements for a grain size of less than 2-4 centimeters. Seawater from each site was also collected. Triplicate sacrificial microcosms were set up for each treatment from each site for each sampling event, as follows:

- Six sampling events (Day 0, 14, 28, 56, 112, and 168).
- Two treatments per site:
  - Natural attenuation controls consisting of sediments from each site containing seawater but no further amendments
  - Nutrient treatments where excess nitrogen and phosphorus were added for biostimulation.

The feed reservoir, microcosm, and piping were made of stainless steel. Peristaltic pumps were used to provide a low recirculating fixed flow rate from the reservoir. This recirculation mechanism was intended to simulate intermittent submergence in the intertidal zone and to provide sufficient reoxygenation to prevent anoxic conditions.

Every three days, nitrogen was measured in 2 randomly selected microcosms in each treatment. If the concentration declined to < 5 mg-N per liter (L), potassium nitrate was added to bring the water concentration back up to 10 mg/L. This concentration was increased to 50 mg/L after it was discovered that the nitrogen demand was extremely high. On a designated sampling day, specified microcosms were "sacrificed" by extracting the oil from the sediments, seawater, and all tubing and pipes. The extracts were processed and analyzed for polycyclic aromatic hydrocarbons (PAHs) including 2-4 ring PAHs and alkylated homologs (no alkanes were detected in any of the samples).

Results

KN114A was the most weathered, with loss of most of the naphthalenes, about half of the phrenanthrenes, and the parent and C_1-alkylated fluorenes and dibenziothiophenes. There were little changes in the napthbenzothiophenes and chrysenes. SM006B was moderately weathered, whereas PWS3A4 was the least weathered. The biodegradation curves for the PAHs from the three sites showed typical first-order rate behavior, with the nutrient treatments always giving about 2 to 2.5-fold higher rate coefficients than the corresponding natural attenuation treatments. Thus, the lingering oil as of 2008 was easily biodegradable regardless of the extent of weathering. After 168 days, the % degradation of PAHs was > 80% at all three sites.

Although the nutrient treatments degraded faster, it was unexpected that the natural attenuation microcosms degraded as much as they did. Total Kjehldahl nitrogen (TKN) was found to be between 450-540 mg/kg in the sediments from the three sites, which was interpreted as representing a large amount of biogenic nitrogen from decaying plant material that occurred naturally in the sediments. The significant biodegradation that occurred in the natural attenuation microcosms suggests that, although nitrogen was a contributing limiting factor, the major limiting factor in the field has been lack of oxygen. The major preliminary conclusions were:

- Excavation and removal of sediment perturbed the integrity of the low permeability zone where the oil accumulated over the years.
    - This caused exposure of new surfaces that were not previously exposed to dissolved oxygen *in situ*.
- When the sediments were then exposed to oxygen in the lab microcosms, biodegradation ensued unimpeded.
- The excess nitrogen and phosphorus caused enhanced biodegradation, but the majority of the biodegradation was due to the presence of oxygen.

Bioremediation appears to be a promising technology able to remove the persistent oil present in some locations in Prince William Sound. However, to be successful, *in-situ* treatment needs to introduce oxygen and nutrients in a manner that will increase the contact with these amendments with the oil.

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From: Onken, Melissa A. [mailto:monken@OMM.com]
Sent: Wed 1/6/2010 3:33 PM
To: Schorr, Jennifer L (LAW)
Subject: Public Records Act Request of July 21, 2009

Ms. Schorr:

We are unable to open the files on the CD enclosed in your Sept. 18, 2009 production in response to our Public Records Act Request of July 21, 2009 for AMSS and AFE presentations. I'd appreciate it if you could provide another copy.

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PAC Agenda

DRAFT 1/6/10

Exxon Valdez Oil Spill Trustee Council

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AGENDA

Exxon Valdez Oil Spill Trustee Council
Public Advisory Committee
Wednesday, January 13, 2010
9:30 a.m. – 11:30 a.m.
"Meet Me" teleconference no. 800.315.6338 (7224#)

PURPOSE: **1.** PAC Charter 2010-2012 Term
2. NEPA Notice of Intent

9:30 a.m.	Welcome	Stacy Studebaker, PAC Chairperson
	Trustee Council introductions	
	Roll call	Doug Mutter, Designated Federal Officer
	Approval of the August 26, 2009 meeting summary	
9:40	Executive Director's report	Elise Hsieh, Executive Director
9:45	Public Comment	
10:00	PAC Charter	Doug Mutter, US DOI
10:30	NOAA Lingering Oil Report	Craig O'Connor, NOAA Trustee
10:45	NEPA Notice of Intent	Laurel Jennings, NOAA
11:15	Habitat - Ouzinkie Nomination - Small Parcel Nominations	Carol Fries, ADNR
11:30	Adjourn	