First documentation of oil fouling in subsistence-harvested ringed (*Phoca hispida*) and spotted seals (*Phoca largha*) in Bering Strait - Fall 2012

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INTRODUCTION

The Bering Strait is a narrow waterway that divides Alaska from Russia and forms the only maritime transportation corridor for shipping routes between the Pacific and Arctic oceans. Concurrently, reliance on marine resources harvested in this region remains essential to the human population. Decreasing ice conditions herald not only ecosystem changes but increased opportunities for industrialized maritime use in the Bering Strait.

During fall 2012, an oil spill of unknown origin was detected in the Bering Strait region by the subsistence harvest of three oiled female ice seals [spotted (*Phoca largha*; n=2); ringed (*Phoca hispida*; n=1)] near Shishmaref (Figure 1) and Saint Lawrence Island (Figures 2, 3). Concurrently, several oiled seabirds were located near Saint Lawrence Island.

Figure 1. A subadult spotted seal harvested for subsistence near Shishmaref, September 5, 2012 (ID N52-2012). Photo by G. Sheffield.

Figure 2. A subadult spotted seal harvested for subsistence near Gambell, October 16, 2012 (ID 2012-166). Photo by L. Tungiyan.

Figure 3. A ringed seal harvested for subsistence near Gambell, November 12, 2012 (ID N55-2012). Photo by G. Sheffield.

OBJECTIVE

Document the chemical contamination, gross necropsy, and histological findings for three seals harvested for subsistence.

	Skin	Blubber	Liver	Muscle	Lung	Stomach contents	Feces
2012: Spotted seal – Shishmaref - N52-2012	220/58/280	35/0.6/36	22/2.6/25	14/1.2/15	13/<LOQ/13	13/4.7/18	22/3.2/25
2012: Spotted seal – Gambell - 2012-166	-/-/-	48/0.4/48	6.3/5.1/11	8/0.2/8.2	7.3/<LOQ/7.3	-/-/-	-/-/-
2012: Ringed seal – Gambell - N55-2012	37/8.9/46	18/<LOQ/18	7.9/<LOQ/7.9	6.9/0.2/7.1	7.1/<LOQ/7.1	11/7.7/19	-/-/-
1989: Unoiled Harbor seal –EVOS-PWS	-/-/-	19/2/21	<LOQ/<LOQ/<LOQ	<LOQ/<LOQ/<LOQ	-/-/-	-/-/-	-/-/-
1989: Oiled Harbor seal –EVOS-PWS	-/-/-	520/4/520	1.5/LOQ/1.5	5/<LOQ/5	-/-/-	-/-/-	-/-/-

Table 1. PAH Concentrations determined from various tissues of two spotted seals and a ringed seal collected in the Bering Strait region during 2012 as well as an unoiled and oiled harbor seal collected during the 1989 Exxon Valdez Oil Spill (EVOS) in Prince William Sound, Alaska. All results expressed in ng/g, wet weight. The first result number in each three number series is the sum of low molecular weight PAHs containing 2-3 ring compounds (LMWAH) and the second is the sum of high molecular weight PAHs containing 4-5 ring compounds (HMWAH). The sum of LMWAH and HMWAH is indicated by the underlined result number. Less PAH than the lower limit of quantification is indicated by <LOQ.

Animal ID	Skin Oiling	Liver Gross	Liver Histopath	Lung Gross	Lung Histopath	Gastrointestinal Tract Gross	Gastrointestinal Tract Histopath
N52-2012 # Spotted seal B Shishmaref, AK 5-Sep-2012	• Ventrum • Fore flippers • Hind flippers	• Pale brown to ochre; diffuse • Multiple grey and yellow pinpoint size raised lesions	• Autolyzed	• Congested • Tracheal edema	• Tracheal edema • Pulmonary edema • Bronchopneumonia , chronic	• Stomach empty • Green slime with oily sheen	• N/A
2012-166 Spotted seal Gambell, AK 16-Oct-2012	• Ventrum • Fore flippers • Neck	• Pale diffuse, subacute, severe	• Vacuolar hepatopathy, multifocal, mild (lipid accumulation)	• Congested	• Interstitial pneumonia	• Stomach empty • No ulcers • Thorny threadworms	• Ulcerative gastritis
N55-2012*# Subadult, female Ringed seal Gambell, AK 12-Nov-2012	• Dorsum	• Pale diffuse, severe	• Hepatitis multifocal, random • Neutrophilic -mild to moderate	• Congested • Lung worms	• Bronchopneumonia, lymphoplasmacytic and eosinophilic	• Stomach full with mucosal erosions • Multiple eroded oval oral lesions	• Stomatitis, erosive and proliferative • Duodenitis • Enterotyphlitis

Table 3: Summary of key gross and histopathological findings (HP) in oil fouled seals. Seals were in good body condition and thymus glands were present. N55-2012* was also classified on the basis of observed skin lesions as an Alaskan Northern Pinniped UME (Type II) seal. Myocarditis present in seal is indicated by #. Tissue PAH patterns confirming exposure to mixed PAH sources - petrogenic (i.e different oil sources) and pyrogenic (emissions from burning etc) are indicated by the yellow colored rows. PAH patterns confirming single source petroleum exposure are indicated by the light blue colored row.

	Protein mg/ml	NPH equivalents[1]	PHN equivalents[2]	BaP equivalents[3]	PHN / NPH
Spotted seal – Shishmaref - N52-2012	98.7	620,000	150,000	1,000	0.24
Ringed seal – Gambell - N55-2012	48.2	66,000	21,000	1,200	0.32

Table 2. Levels of PAH metabolites and protein determined in bile of one ringed seal and one spotted seal collected in the Bering Strait region during 2012. All equivalents of fluorescent aromatic compounds results expressed in ng/g bile, wet weight.

[1]Concentrations in parts per billion (ng/g) based on total area compared to the fluorescence of naphthalene standard at 292/335 nm
[2]Concentrations in parts per billion (ng/g) based on total area compared to the fluorescence of phenanthrene standard at 260/380 nm
[3]Concentrations in parts per billion (ng/g) based on total area compared to the fluorescence of benzo[a]pyrene standard at 380/430 nm

Key findings

- Overall PAH levels were relatively low (sum PAH < 50 ng/g, wet wt.), except skin from the spotted seal from Shishmaref (N52-2012; sum PAHs=280 ng/g, wet wt.), with higher blubber PAH concentrations measured in both spotted seals vs. ringed seal (Table 1)
- Blubber PAH concentrations were lower than those measured in post EVOS oiled seals.
- High bile protein values indicated non-feeding status of the oiled seals and the bile PAH metabolite values in the oiled ice seals are most likely confounded by feeding status since they concentrate in the bile of non-feeding animals (Table 2).
- PAH equivalents measured in seal bile confirmed exposure to PAHs and were similar to, or higher, than those reported in oiled harbor seals collected in Prince William Sound, Alaska after the *Exxon Valdez* oil spill (EVOS).
- Fluorescence chromatogram and PHN/NPH ratio data were inconclusive in determining petroleum exposure.
- Tissue PAH patterns (% of summed PAHs) of the spotted seal from Shishmaref (N52-2012) showed petroleum exposure whereas tissue PAH patterns of the ringed (N55-2012) and spotted (2012-66) seals harvested near Gambell showed exposure to mixed PAH sources (Table 3).
- Histopathological lesions were observed in the digestive, respiratory, and integumentary system; their relationship to oiling was inconclusive (Table 3).

Food For Thought

- This is the first documentation of oil fouling in Alaskan ringed and spotted seals.
- Spill detection is most likely in coastal communities with active subsistence utilization of marine resources.
- Prevention, assessment, and clean-up of hazardous material spills - as it relates to Bering Strait marine wildlife cannot be viewed solely as a wildlife conservation concern . Investigations of contaminated marine wildlife must consider analytical methodology, research strategies, and management issues – in terms of regional public health/safety and food security concerns.
- Oiled ice seals present a serious food security and potential food safety risk for Alaskan coastal communities in the Bering Strait region that rely on marine mammal resources for cultural, nutritional, and economic needs.

ACKNOWLEDGEMENTS

- We thank Shishmaref and Saint Lawrence Island community members for acting on their public safety and health concerns. Without sharing their discovery and their efforts of sending their harvests for examination, none of this information would be available.
- We thank the US Coast Guard and the Unified Command of the Saint Lawrence Island Oiled Wildlife Event for responding to the public safety and food security concerns of coastal communities in the Bering Strait region.
- Work was conducted under NMFS Permit 17350-00 issued to the NSB Dept. of Wildlife Management.