## Appendix 1.

Agencies, organizations, and people who were consulted about the environmental effects of the Shell EP.

#### MMS DISTRIBUTION LIST FOR SHELL'S EXPLORATION PLAN

Governor Sarah Palin P.O. Box 110001 Juneau, Alaska 99811-0001

Don Perrin State of Alaska Department of Natural Resources Office Project Management Permitting 550 W. 7th Ave, Suite 705 Anchorage, Alaska 99501-3559

Ben A. Greene State of Alaska Department of Natural Resources Alaska Coastal Zone Management Program 550 W. 7th Ave., Suite 705 Anchorage, Alaska 99501-3559

Leon C. Lynch State of Alaska Department of Natural Resources Northern Alaska Area, Division of Mining, Land, and Water 3700 Airport Way Fairbanks, Alaska 99709-4699

Kathleen Sheehan-Dugan State of Alaska Department of Natural Resources 550 W. 7th Ave, Suite1260 Anchorage, Alaska 99501-3557

Mark Fink State of Alaska Department of Fish & Game 333 Raspberry Road, Anchorage, Alaska 99518

Stefanie Ludwig State of Alaska Department of Natural Resources Office of History and Archaeology, 550 W. 7th Ave. Suite 1310, Anchorage Alaska 99501-3565

Patty Burns DNR, Division of Geological and Geophysical Surveys 3354 College Road Fairbanks, Alaska 99709 Lydia M. Miner State of Alaska Department of Environmental Conservation Division of Spill Prevention and Response (SPAR) 555 Cordova St. Anchorage, Alaska 99501-2617

Alan Kukla State of Alaska Department of Environmental Conservation Division of Water 555 Cordova St. Anchorage, Alaska 99501

Gary Mendivil State of Alaska Department of Environmental Conservation 410 Willoughby Ave., Ste 303 P.O. Box 111800 Juneau, Alaska 99811-1800

Commissioner's Office State of Alaska Department of Environmental Conservation 410 Willoughby Ave., Ste 303 Juneau, Alaska 99801

Bill Walker State of Alaska Department of Environmental Conservation Air Permits Program Division of Air Quality 410 Willoughby Ave., Ste 303 Juneau, Alaska 99801

Sharmon Stambaugh State of Alaska Department of Environmental Conservation Division of Water 555 Cordova Street Anchorage, Alaska 99501-2617

Bruce Campbell State of Alaska Department of Transportation and Public Facilities 2301 Peger Road Fairbanks, Alaska 99709

64

Bruce Anders Department of Natural Resources Division of Oil and Gas 550 W 7th Avenue, Suite 800 Anchorage Alaska 99501-3560

Jack Winters State of Alaska Department of Natural Resources Office of Habitat Management and Permitting 1300 College Rd Fairbanks, Alaska 99701-1599

Bob Crandall State of Alaska Alaska Oil & Gas Conservation Commission 333 W. 7<sup>th</sup>. Ave. Suite 100 Anchorage, Alaska 99501

Regional Director U.S Fish & Wildlife Service Region 7 1011 East Tudor RD. Anchorage, Alaska 99503

Steve Lewis US Fish & Wildlife Service Northern Alaska Ecological SVCS 101 12<sup>th</sup> Ave., Box 19, RM 110 Fairbanks, Alaska 99701

Pamela Bergmann Department of the Interior Office of Environmental Policy & Compliance 1689 C St. Room - 119 Anchorage, Alaska 99501

Robert Schneider Bureau of Land Management 1150 University Avenue Fairbanks, Alaska 99709

Regional Administrator, Alaska Region National Marine Fisheries Service Alaska Region PO Box 21668 Juneau, Alaska 99802-1668

Brad Smith National Marine Fisheries Service 222 W 7<sup>th</sup> Avenue, Box 43 Anchorage, Alaska 99513

#### Chief

US Army Corps of Engineers Regulatory Branch Alaska District PO Box 898 Anchorage, Alaska 99506-0898

Anita Frankel U.S. Environmental Protection Agency Region X 1200 Sixth Avenue, WCM-128 Seattle, Washington 98101

Marcia Combs Environmental Protection Agency Alaska Office 222 West 7<sup>th</sup> Ave. Box 19 Anchorage, Alaska 99513

Sector Commander U.S. Coast Guard 510 L Street, Suite 100 Anchorage, Alaska 99501-1946

Commander (oan) U.S. Coast Guard P.O. Box 25517 Juneau, Alaska 99802

Glen Yankus National Park Service 240 West 5th Avenue, Room 114, Anchorage, Alaska, 99501

Honorable Nate Olemaun, Jr., Mayor of Barrow P.O. Box 629 Barrow, Alaska 99723

Mr. Thomas Olemaun, President Native Village of Barrow Inupiat Traditional Government P.O. Box 1130 Barrow, Alaska 99723

Honorable Edward Itta Mayor of North Slope Borough PO Box 570 Barrow, Alaska 99723

Johnny Aiken North Slope Borough P.O. Box 69 Barrow, Alaska 99723

65

North Slope Borough Dept of Wildlife Management P.O. Box 69 Barrow, Alaska 99723

Tom Lohman North Slope Borough Department of Wildlife Management 4011 Winchester Loop Anchorage, Alaska 99507

Honorable Lon Sonsalla Mayor of Kaktovik PO Box 27 Kaktovik, Alaska 99747

Mr. Isaac Akootchook, President Native Village of Kaktovik PO Box 130 Kaktovik, Alaska 99747

Honorable Karl Brower Mayor of Nuiqsut PO Box 89148 Nuiqsut, Alaska 99789

Mr. Leonard Lampe, Sr., President Native Village of Nuiqsut PO Box 89169 Nuiqsut, Alaska 99789

Ms. Maggie Ahmaogak Executive Director Alaska Eskimo Whaling Commission PO Box 570 Barrow, Alaska 99723

Mr. Arnold Brower, Jr., President Inupiat Community of the Arctic Slope P.O. Box 934 Barrow, Alaska 99723

Honorable Martha Whiting Mayor of the Northwest Arctic Borough P.O. Box 1110 Kotzebue, Alaska, 99752

Honorable George Kingik Mayor of Point Hope P.O. Box 169 Point Hope, Alaska 99766-0169 Honorable John Hopson, Jr., Mayor of Wainwright P.O. Box 9 Wainwright, Alaska 99782

Honorable Elizabeth Hollingsworth Mayor of Atqasuk P.O. Box 91119 Atqasuk, Alaska 99791

Lanston Chinn Kuukpik 825 West 8th Ave., Suite 206 Anchorage, Alaska 99501

Brian Boyd Kuukpik 825 W. 8<sup>th</sup> Ave, Suite 206 Anchorage, Alaska 99501

Gordon Brown Kuukpik Subsistence Oversight Board P.O. Box 89187 Nuiqsut, Alaska 99789

Isaac Nukapigak, President Kuukpik Corporation P.O. Box 89187 Nuiqsut, Alaska 99789

Judith Brady State of Alaska Alaska Oil and Gas Conservation Commission 121 W. Fireweed Lane, Suite 207 Anchorage, Alaska 99503-2035

Audubon Alaska 715 L Street, Suite 200 Anchorage, Alaska 99501

Eleanor Huffines The Wilderness Society 430 W. 7th Ave. #210 Anchorage, Alaska 99501-3550

Northern Alaska Environmental Center 830 College Road Fairbanks, Alaska 99708

Trustees for Alaska 1026 W. 4th Ave., Suite 201 Anchorage, Alaska 99501

#### **Government to Government Meeting 1/29/07 Native Village of Kaktovik**

#### **Tribal council representatives:**

Eddie RexfordSGeorge KaleakFRoy AkootchookFCarla

Susie Akootchook Fenton Rexford Ida

#### MMS:

Jeff Walker, Regional Supervisor, FO Albert Barros, Community Liaison

#### **AEWC:**

Dorcas Rock

The NV Kaktovik received the Shell EP on 1/22/07.

Will there be consultation for the on ice seismic? Where is the seismic activity going to occur? It will be closer to Prudhoe Bay.

It was stated that the SSCD was the only type of rig that can be used in the Beaufort. So, how can these proposed ships (Frontier Discoverer & Kulluk) be used?

What kind of contact has there been with allotment holders near Flaxman Island?

When reviewing the maps of the proposed area there was a concern expressed about the helicopter route near shore. Suggested that it be moved further south on shore to avoid spooking the caribou and the oogarook.

One of the council members recounted how sportsman hunting and recreation are impacting subsistence harvesting. A cub airplane was circling while they were hunting. Brought up the need to protect other subsistence harvesting besides bowhead whales.

The tribe and/or MMS needs a computer program that transcribes the human voice for note taking.

Action item: Susie would like to see tapes of offshore activities (off shore report) pertaining to Hurricane Katrina.

**Appendix II** 

Oil Spill Assumptions for the Shell Offshore Inc. Beaufort Sea Outer Continental Shelf Lease Exploration Plan 2007 - 2009 Environmental Assessment 2007. Assumptions for the Analysis of Accidental Oil Spills in this EA. For purposes of this EA analysis, no large spills or very large crude oil spills are assumed from exploration activities. This assumption is based on the low rate of exploratory drilling blowouts per well drilled and the history of exploration spills on the Arctic OCS discussed below. It is likely a small spill could occur. For purposes of analysis we chose a 48 bbl fuel transfer spill as identified in Shell Offshore Inc.'s Beaufort Sea Oil Discharge Prevention and Contingency Plan Summary of Potential Discharges.

Table II-1 shows the Shell Offshore Inc. Beaufort Sea Outer Continental Shelf Lease Exploration Plan 2007 - 2009 summary of fuel supply information in Table 13 b on page 49.

#### Table II-1 Diesel Fuel Oil Supply Vessel

Size of Fuel Supply Vessel	Capacity of Fuel Supply Vessel	Frequency of Fuel Transfers	Route Fuel Supply Vessel Will Take
400-foot length	150,000 bbls	Once per season	Vessel will transit from South Alaska, following coastline

**Modeling Simulations of Oil Weathering.** To judge the effect of an oil spill, we estimate information regarding how much oil evaporates, how much oil is dispersed and how much oil remains after a certain time period. We derive the weathering estimates of diesel fuel oil from modeling results from the SINTEF Oil Weathering Model (OWM) Version 3.0 (Reed et al., 2005) for up to 30 days. Table I-2 summarizes the results we assume for the fate and behavior of a 48 bbl diesel fuel spill.

	Summer S	pill <sup>1</sup>				And Koley	San Ande
Time After Spill in Hours	1	2	3	6	12	24	48
Oil Remaining (%)	96	91	84	65	31	4	0
Oil Dispersed (%)	3 ·	7	12	28	57	79	83
Oil Evaporated (%)	1	2	• 4	7	12	. 17	17
Thickness (mm)	0.7	0.5	0.5	0.3	0.1	0.1	0

#### Table II-2 Fate and Behavior of a Hypothetical 48 -Barrel Diesel Fuel Oil Spill

Note: For the EA the assumed spill size is a 48 bbl diesel spill

#### Notes:

Calculated with the Sintef oil-weathering model Version3.0 of Reed et al. (2005) and assuming diesel fuel no 2. <sup>1</sup> Summer (July through September), 12-knot wind speed, 2 degrees Celsius, 0.4-meter wave height.

#### **Summary of Potential Discharges**

Oil spills are an issue of great public concern in relation to the offshore oil and gas industry. Table II-3 shows the Shell Offshore Inc. Beaufort Sea Oil Discharge Prevention and Contingency Plan summary of potential discharges in Table 2-1 on page 2-17.

#### **Table II-3 Summary of Potential Discharges**

ТУРЕ	CAUSE	PRODUCT	SIZE	DURATION	PREVENT POTENTIAL DISCHARGE
Transfer from fuel barge to drill rig	Hose rupture	Diesel	Approximately 2,000 gallons (48 bbl) (Section 1.6)	5.5 minutes (Section 1.6)	Transfer procedures in place; Note: This scenario will be addressed as part of USCG approval of Vessel Response Plans by individual vessel owners.
Diesel	Tank rupture	Diesel	1,555 bbl	Minutes to hours	Note: The diesel tanks are internal to each drilling vessel rather than deck- mounted, where the potential for marine spills is much greater. As a result, a scenario involving tank rupture has not been included in the oil spill response plan, but will be monitored as part of an ongoing tank inspection program.
Blowout	Uncontrolled flow at the mudline	Crude oil	287,100 bbl including emulsion and free water	30 days (Section 1.0)	Blowout prevention equipment and related procedures for well control.

Historical Exploration Spills on the Beaufort and Chukchi Outer Continental Shelf and Canadian Beaufort. The MMS estimates the chance of a large ( $\geq$ 1,000 bbl) oil spill from exploratory activities to be very low. On the Beaufort and Chukchi OCS, the oil industry drilled 35 exploratory wells. During the time of this drilling, industry has had 35 small spills totaling 26.7 bbl or 1,120 gallons (gal). Of the 26.7 bbl spilled, approximately 24 bbl were recovered or cleaned up. Table II-4 shows the exploration spills on the Beaufort and Chukchi OCS. Small (25 bbl or less) operational spills of diesel, refined fuel, or crude oil may occur. The MMS estimates this could be a typical scenario during exploratory drilling in the Beaufort and Chukchi seas. These small spills often are onto containment on platforms, facilities or gravel islands or onto ice and may be cleaned up. One large exploration spills occurred in the Canadian Beaufort Sea from an exploration well site when the island eroded during a storm and a facility tank was damaged spilling approximately 2,440 bbls of diesel P-50 fuel oil (Hart Crowser, Inc., 2000).

Historical Exploration Blowouts: Information on the Beaufort, Chukchi and U.S. Outer Continental Shelf and Canadian Beaufort. No exploratory drilling blowouts have occurred on the Alaskan OCS. Since 1971-2005, industry has drilled approximately 172 exploration wells in the Pacific OCS, 51 in the Atlantic OCS, 13,142 in the Gulf of Mexico OCS, and 98 in the Alaska OCS, for a total of 13,463 exploration wells. From 1971-2005, there were 66 blowouts during exploration drilling. Four exploration blowout oil spills, 200, 100, 11, and 0.8 bbl, respectively, have occurred from drilling those wells (Table II-3). No large spills ( $\geq$ 1,000 bbl) have occurred from 1971-2005 during exploration drilling. Therefore, approximately 13,000 wells have been drilled, and four spills resulted in crude reaching the environment from blowouts during exploration. The U.S. Gulf of Mexico OCS exploration drilling blowout frequencies as reported by Holland (1997) are 5.9 x 10<sup>-3</sup> blowouts per well drilled. One exploration drilling blowout of gas has occurred on the Canadian Beaufort. Up to 1990 85 exploratory wells have been drilled in the Canadian Beaufort Sea and 1 shallow gas blowout has occurred. A second incident was not included at the Amaluligak wellsite with the Molikpaq drill platform. This resulted in a gas flow through the diverter, with some leakage around the flange. The incident does not qualify as a blowout by the definition used in other databases and therefore was excluded (Devon Canada Corporation,2004).

The blowout record for the Alaska North Slope remains the same as previously reported in USDOI, MMS (2003) and is summarized. Of the 10 blowouts, 9 were gas and 1 was oil. The oil blowout in 1950 resulted from drilling practices that would not be relevant today. A third study confirmed that no crude oil spills  $\geq$ 100 bbl from blowouts occurred from 1985-1999 (Hart Crowser, Inc., 2000). Scandpower (2001) used statistical blowout frequencies modified to reflect specific field conditions and operative systems at Northstar. This report concludes that the blowout frequency for drilling the oil-bearing zone is  $1.5 \times 10^{-5}$  per well drilled. This compares to a statistical blowout frequency of  $7.4 \times 10^{-5}$  per well (for an average development well). This same report estimates that the frequency of oil quantities per well drilled for Northstar for a spill greater than (>)130,000 bbl is  $9.4 \times 10^{-7}$  per well.

**Previous Analysis of Very Large and Large Accidental Oil Spills.** The chance of a very large spill ( $\geq$ 150,000) is very low, but its potential effects were analyzed in USDOI, MMS (2003) Section IV.I Low-Probability, Very Large Oil Spill. The spill scenario was based on a 15,000 bbl flow-rate for 15 days totaling 225,000 bbl. In the unlikely event of a very large accidental oil spill the potential for significant impacts exist as was identified in USDOI, MMS (2003). No new significant effects are identified from this proposal. A summary of conclusions is provided in Appendix III.

The chance of a large spill is low ( $\geq$ 1,000), but the potential consequences were analyzed in USDOI, MMS (2003) section IV.C. and USDOI, MMS (2006). For purposes of analysis MMS assumed 1,500 bbl diesel or crude oil spill from a facility or a 4,600 bbl crude oil spill from a pipeline. The conditional probabilities estimated by the OSRA model (expressed as percent chance) of a spill  $\geq$ 1,000 bbl contacting environmental resource areas or land segments within a given time frame from launch areas (LA1-18) and pipeline segments (P1-11) are discussed in USDOI, MMS (2003), USDOI, MMS (2004) or USDOI, MMS (2006). In the unlikely event of a large accidental oil spill the potential for significant impacts exist as identified in USDOI, MMS (2003) or USDOI, MMS (2006). No new significant effects are identified from this proposal.

The conditional probabilities (expressed as percent chance) from Launch Area (LA) 10, 15, 17 and 18 (USDOI, MMS 2003 Tables A2-1 – A2-54 and A2-73-A2-90) are generally representative of the lease blocks cited in the Shell Offshore Inc. Beaufort Sea Outer Continental Shelf Lease Exploration Plan 2007 – 2009 (Figure II-1). The chance of a large spill contacting assuming a large spill occurs is summarized specifically for the LAs 10, 15, 17, and 18 and is inclusive in the conditional probability discussions in USDOI, MMS (2003), USDOI, MMS (2004) or USDOI, MMS (2006) cited above.

#### **Summer Conditional Probabilities**

Probabilities in the following discussion, unless otherwise noted, are summer conditional probabilities estimated by the OSRA model (expressed as percent chance) of a spill  $\geq$ 1,000 bbl contacting environmental resource areas (ERA) or land segments (LS) within a given time frame from LAs 10, 15, 17 or 18 (USDOI, MMS, 2003: Tables A2-19, A2-20, A2-21, A2-25, A2-26, A2-27 and A2-85-A2-87).

#### 3 Days

The OSRA model estimates a <0.5-24% chance of a spill  $\geq$ 1,000 bbl contacting ERAs 29-37 (mean distance from coast of migration corridor). The chance of contacting ERA 6 (Cross and No Name Islands is <0.5%. The chance of contacting ERAs 15-16 (Arey and Barter Islands, Bernard, Jago and Tapkaurak Spits) is <0.5-5%. The chance of contacting ERA 43 (Nuiqsut Subsistence Area) is <0.5-1%. The chance of contacting ERA 44 (Kaktovik Subsistence Area) is <0.5-20%. The chance of contacting ERA 69 (Harrison Bay/Colville Delta) is <0.5-2%. The chance of contacting individual LSs 46 (Arey Island, Barter Island) 47 (Kaktovik) or 48 (Griffin Point, Oruktalik Lagoon) is <0.5-3%. The chance of contacting LS 43-51 (Arctic National Wildlife Refuge) is <0.5-14%.

#### 10 Days

The OSRA model estimates a <0.5-24% chance of a spill  $\geq$ 1,000 bbl contacting ERAs 29-37 (mean distance from coast of migration corridor). The chance of contacting ERA 6 (Cross and No Name Islands) is <0.5-1 %. The chance of contacting ERAs 15-16 (Arey and Barter Islands, Bernard, Jago and Tapkaurak Spits) is <0.5-11%. The chance of contacting ERA 43 (Nuiqsut Subsistence Area) is <0.5-5%. The chance of contacting ERA 44 (Kaktovik Subsistence Area) is <0.5-26%. The chance of contacting ERA 69 (Harrison Bay/Colville Delta) is <0.5-8%. The chance of contacting ERA 3 (Thetis and Jones Islands) is <0.5-16%. The chance of contacting individual LSs 46 (Arey Island, Barter Island) 47 (Kaktovik) or 48 (Griffin Point, Oruktalik Lagoon) is <0.5-7%. The chance of contacting LS 43-51 (Arctic National Wildlife Refuge) is <0.5-36%.

#### 30 Days

The OSRA model estimates a <0.5-35% chance of a spill  $\geq$ 1,000 bbl contacting ERAs 29-37 (mean distance from coast of migration corridor). The chance of contacting ERA 6 (Cross and No Name Islands) is <0.5-4%. The chance of contacting ERAs 15-16 is <0.5-15%. The chance of contacting ERA 43 (Nuiqsut Subsistence Area) is <0.5-9%. The chance of contacting ERA 44 (Kaktovik Subsistence Area) is <0.5-33%. The chance of contacting ERA 69 (Harrison Bay/Colville Delta) is <0.5-16%. The chance of contacting ERA 3 (Thetis and Jones Islands) is <0.5-23%. The chance of contacting individual LSs 46 (Arey Island, Barter Island) 47 (Kaktovik) or 48 (Griffin Point, Oruktalik Lagoon) is <0.5-12%. The chance of contacting LS 43-51 (Arctic National Wildlife Refuge) is <0.5-49%.

#### Winter Conditional Probabilities

Probabilities in the following discussion, unless otherwise noted, are winter conditional

probabilities estimated by the OSRA model (expressed as percent chance) of a spill  $\geq$ 1,000 bbl contacting environmental resource areas or land segments within a given time frame from launch areas (LA) 10, 15, 17 or 18 (USDOI, MMS, 2003: Tables A2-37, A2-38, A2-39, A2-43, A2-44, A2-45 and A2-73-75).

#### 3 Days

The OSRA model estimates a <0.5-7% chance of a spill  $\geq$ 1,000 bbl contacting ERAs 29-37 (mean distance from coast of migration corridor). The chance of contacting ERA 6 (Cross and No Name Islands is <0.5%. The chance of contacting ERAs 15-16 (Arey and Barter Islands, Bernard, Jago and Tapkaurak Spits) is <0.5-1%. The chance of contacting ERA 43 (Nuiqsut Subsistence Area) is <0.5%. The chance of contacting ERA 44 (Kaktovik Subsistence Area) is <0.5-3%. The chance of contacting ERA 69 (Harrison Bay/Colville Delta) is <0.5%. The chance of contacting individual LSs 46 (Arey Island, Barter Island) 47 (Kaktovik) or 48 (Griffin Point, Oruktalik Lagoon) is <0.5-1%. The chance of contacting LS 43-51 (Arctic National Wildlife Refuge) is <0.5-3%.

#### 10 Days

The OSRA model estimates a <0.5-7% chance of a spill  $\geq$ 1,000 bbl contacting ERAs 29-37 (mean distance from coast of migration corridor). The chance of contacting ERA 6 (Cross and No Name Islands) is <0.5 %. The chance of contacting ERAs 15-16 (Arey and Barter Islands, Bernard, Jago and Tapkaurak Spits) is <0.5-2%. The chance of contacting ERA 43 (Nuiqsut Subsistence Area) is <0.5-1%. The chance of contacting ERA 44 (Kaktovik Subsistence Area) is <0.5-3%. The chance of contacting ERA 69 (Harrison Bay/Colville Delta) is <0.5-1%. The chance of contacting individual LSs 46 (Arey Island, Barter Island) 47 (Kaktovik) or 48 (Griffin Point, Oruktalik Lagoon) is <0.5-1%. The chance of contacting LS 43-51 (Arctic National Wildlife Refuge) is <0.5-7%.

#### 30 Days

The OSRA model estimates a <0.5-8% chance of a spill  $\geq$ 1,000 bbl contacting ERAs 29-37 (mean distance from coast of migration corridor). The chance of contacting ERA 6 (Cross and No Name Islands) is <0.5%. The chance of contacting ERAs 15-16 (Arey and Barter Islands, Bernard, Jago and Tapkaurak Spits) is <0.5-3%. The chance of contacting ERA 43 (Nuiqsut Subsistence Area) is <0.5-1%. The chance of contacting ERA 44 (Kaktovik Subsistence Area) is <0.5-4%. The chance of contacting ERA 69 (Harrison Bay/Colville Delta) is <0.5-2%. The chance of contacting individual LSs 46 (Arey Island, Barter Island) 47 (Kaktovik) or 48 (Griffin Point, Oruktalik Lagoon) is <0.5-2%. The chance of contacting LS 43-51 (Arctic National Wildlife Refuge) is <0.5-11%.

### Table II-4. Exploration Spills on the Arctic OCS

Lease No.	Sale Area	Operator	Date	Time 24 Hr	Facility	Substance	Amt. (Gal)	Cause of Spill	Response Action	Amour Recov
0344	71	Sohio	7/22/1981	11:00	Mukluk Island	Diesel	0.50	Leaking line on portable fuel trailer	Sorbents used to remove spill. Contaminated gravel removed.	0.05
0344	71	Sohio	7/22/1981	14:00	Mukluk Island	Diesel	1.00	Overfilled fuel tank on equipment	Sorbents used to remove spill. Contaminated gravel removed.	1.00
0280	71	Exxon	8/7/1981		Beaufort Sea I	Hydraulic Fluid	1.00	Broken hydraulic line on ditch witch.	Fluid picked up with shovels.	1.00
0280	71	Exxon	8/8/1981		Beaufort Sea I	Trans. Fluid	0.25	Overfilling of transmission fluid.	Fluid picked up and placed in plastic bags.	0.25
0280	71	Exxon	1/11/1982		Beaufort Sea I	Hydraulic Fluid	0.50	Broken hydraulic line.	Fluid picked up and stored in plastic bags.	0.50
0280	71	Exxon	1/11/1982		Alaska Beaufort Sea I	Diesel	3.00	Overfilled catco 90-3 tank.	Fluid picked up.	3.00
0280	71	Exxon	1/17/1982		Beaufort Sea I	Diesel	1.00	Tank on catco 90-14 overfilled.	Fluid picked up and stored in plastic bags.	1.00
0280	71	Exxon	1/21/1982		Beaufort Sea I	Hydraulic Fluid	0.25	Broken hydraulic line on ditch witch.	Fluid picked up.	0.25
0371	71	Amoco	3/16/1982	N/A	Sandpiper Gravel Island	Unknown	1.00	Seeping from Gravel Island.	Sorbent pads.	Unknow
0849	87	Union Oil	9/4/1982	14:00	Canmar Explorer II	Unknown	1.00	Transfer of test tank from drillship to barge.	None	None
0871	87	Shell Western	9/5/1982	18:55	Canmar Explorer II	Light Oil	0.50	Washing down cement unit, drains not plumbed to oil/water seperator.	None	None
N/A	87	Shell	9/14/1982	19:00	Canmar II Drillship	Diesel	30.00	Tank vent overflowed during fuel transfer.	Deployed sorbent pads and pump.	30.00
0191	BF	Exxon	11/11/1982	.10:00	Beechey Pt. Gravel Is.	Lube Oil	1.00	Loader tipped over lube oil drum	Oil cleaned up with sorbents. Contaminated gravel removed	1.00
0191	BF	Exxon	1/15/1983	10:00	Beechey Pt. Gravel Is.	Diesel	0.12	Fuel truck spilled diesel as it climbed a 40 degree ramp to island	Sorbents used and contaminated gravel removed	0.12
0191	BF	Exxon	1/23/1983	9:00	Beechey Pt. Gravel Is.	Hydraulic Fluid	2.50	Hydraulic line on backhoe broke	1 gallon in water. Boom deployed with sorbents, Contaminated gravel removed	2.50
0191	BF	Exxon	8/29/1983	6:30	Beechey Pt. Gravel Is.	Hydraulic Fluid	0.20	Hydraulic line on backhoe broke	Spill contained on island surface. Sorbents used and contaminated gravel removed.	0.25
0196	BF	Sheil	8/30/1983	· ·	Ice Road to Tern Island	Hydraulic Fluid	10.0	Broken hydraulic line on rollogon	Unknown	Unkno
0191	BF	Exxon	2/26/1985	17:30	Beechey Pt. Gravel Is.	Hydraulic Fluid	0.37	Hydraulic line broke	Contaminated Snow Removed	0.37
0196	BF	Shell	3/1/1985	1:30	Ice Road to Tern Island	Hydraulic Fluid	3.00	Hydraulic line broke	Unknown	3.00
0191	BF	Exxon	3/2/1985		Beechey Pt. Gravel Is.	Gasoline	0.01	Operational Spill	Snow shoved into plastic bag.	0.01
0191	BF	Exxon	3⁄4/1985		Beechey Pt. Gravel Is.	Waste Oil	2.00	Drum of waste oil punctured	Snow recovered	2.00
0196	BF	Shell	34/1985	15:30	Tern Gravel Island	Crude Oil	1.00	Well Separator overflowed, crude oil escaped	Line boom deployed	Unknov

74

## Table II-4 (Continued) Exploration Spills on the Arctic OCS

Lease No.	Sale Area	Operator	Date	Time 24 Hr	Facility	Substance	Amt. (Gal)	Cause of Spill	Response Action	Amount Recove
0196	BF	Shell	3/6/1985	16:30	Tern Gravel Island	Crude Oil	15.00	Test burner was operating poorly	Containment Boom deployed	Unknow
0196	BF	Shell	9/24/1985	16:00	Tern Gravel Island	Crude Oil	2.00	Oil released from steam heat coil when Halliburton tank moved	Sorbents and hand shovel used	2.00
0191	BF	Shell	10/4/1985	8:45	Enroute to Tern Gravel	Jet fuel B	800.0	Wire sling broke during helicopter transport of fuel blivits	Contaminated Snow Removed. Test holes drilled with no fuel below snow.	Unknow
0196	BF	Shell	10/29/1985	14:00	Tern Gravel Island	Crude Oil	2.00	Test oil burner malfunction	Contaminated snow removed	2.00
0196	BF	Shell	6/27/1986	13:30	Tern Gravel Island	Crude Oil	3.00	Test oil burner malfunction	Spray picked up with sorbents. Bladed up dirty snow.	2.00
1482	109	SWEPI	7/7/1989	3:00	Explorer III Drillship	Hydraulic fluid	10.0	Hydraulic line connector	Sorbent pads	0.84
1092	97	AMOCO	10/1/1991	2:00	CANMAR Explorer	Hydraulic fluid	2.00	Hydraulic line rupture	None	None
0865	87	ARCO	7/24/1993		Beaudril Kulluk	Diesel	0.06	Residual fuel in bilge water	None	None
0866	87	ARCO	9/8/1993	18:30	CANMAR Kulluk	Hydraulic fluid	1.26	Seal on shale shaker failed	None	None
0866	87	ARCO	9/24/1993		CANMAR Kulluk	Fuel	4.00	Fuel transfer in rough weather	3 gallons on deck of barge recovered, none in sea	3.00
1597	124	ARCO	10/31/1993		CANMAR Kulluk	Fuel	0.50	Released during emptying of disposal caisson	None	None
0943	87	Tenneco	1/24/1998	13:00	SSDC/MAT	Gear oil	220.0	Helicopter sling failure during transfer of drums to SSDC	Scooped up contaminated snow and ice	220.0
1585	124	BP Alaska	1/20/1997		Ice Road to Tern Island	Diesel, Hydraulic Fluid	10.5	Truck went through ice; fuel line ruptured	Scooped up contaminated snow and ice. Some product entered water	Unknow

# Table II-5Number of Blowouts per Year in the Gulf of Mexico and Pacific OCS Regions

Total with Condensate/ Oil			A Con	Production Drilling								Workover/. Completion	Wells Drilled		
Year	Number of Blowouts		Development	Exploration	Total Exploration and Development	Total	Fire	Hurricane	Other	Total	Exploration	Development	Unknown	Total	Total
1956	1	0			0					_		-			_
1957	1	0	<del></del>	·	· 0 ·			<u> </u>	-	·		_	_		_
1958	2	1	Minimal		1	1	1	_		_	1	_	_		
1959	1	0			0	<u> </u>	<u> </u>	—			1-	-			_
1960	2	0		—	0	—	—	—	—		- 1	1		·	-
1961	0	0	_	—	0	—	·	_		-	_	1	1	—	_
1962	1	0		—	0	<u> </u>	—	—	-			1	-		-
1963	1	0	-	_	0	—	—	—	_		_			—	-
1964	7	3	10,380	-	10,380	3	1	2		_	_	_	_		_
1965	5	2	1688		1,688	1		1		1	- 1	-	1		_
1966	2	2	Minimal	—	1	—	· -	-	<u> </u>	1		-	1	_	_
1967	1	. 1	Minimal	_	1	1	_	_	1			+		-	_
1968	9	0	_		0		_	_					_		_
1060	3	3	82500	_	82500	2			2	1		1		· · · · · · · · · · · · · · · · · · ·	
1070	22		82000		82000	5	2		-			4			
1070	20	3	00000		03000	2	2								-
1971	9	1	450		450	1	1	<u> </u>	-		-				851
1972	5	1	Minimal		1.			—		1			1	—	845
1973	3	11	Minimal		1		-	_		1		1		<u> </u>	820
1974	6	2	275		275	2		2							802
1975 .	7	1	Minimal	_	1									1	842
1976	6	0	<u> </u>	—	0	—	—	—	-		_		_		1078
1977	10	0	_		0	<u>,                                     </u>	_	—		-	_	_	_	_	1240
1978	12	1	Minimal	—	1	-	-	ŀ		-	_			1.	1164
1979	5	2	Minimal		-1		—	—	_	2	_	2	_	. —	1140
1980	8	2	1	—	1	1	-	—	1	1		1	—	<u></u>	1158
1981	<u>10</u>	4	64		64					2		2		2	1208
1982	9	. 2	Minimai							1		1		1	1255
1984	5	0	\		0		_	=			$\pm$			·	1352
1985	6	1 1	40		40	1	_	_	1	_		_	—	_	1169
1986	2	0	·		0			—			-		—	—	694
1987	. 13	1	60	—	60	-		—	-	1	_	1	-	—	845
1988	3	0	`		0		_	—			_	_		'	950
1989	12	0			0					—	<u> </u>	-			947
1990	<u> </u>	3	20.5	0.9	20.5					1			-	2	726
1992	1	1	<u> </u>	100	100	<u> </u>				1					431
1993	2	0.			0		_			<u> </u>	<u>t</u>	_			879
1994	0	0	_		0		_	—				_	_	—	845
1995	1	0			0	_	. —	·		_	_	_	_		798
1996	4	0		<u> </u>	0	_	—		_		[		—		889
1997	5	0	<u> </u>		0	—	-	_		—		—	—	—	954
1998	1 7	1	1.5		1.5	1		-	11	-					993

76

	n international Anna international Anna international	Total with		mount		19.00 C		المەنبەتۇنى ئە 1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-			y na si	ing ye Qirah	184		
		Condensate/ Oil	Con	densat Barrels	e/Oil	Pr	oduc	tion			Drill	ing		Workover/ Completion	Wells Drilled
Year	Number of Blowouts		Development	Exploration	Total Exploration and Development:	Total	Fire	Hurricane	Other	Total	Exploration	Development	Unknown	Total	Total
1999	· 5	0	—		0	—	-	—				-	—		962
2000	9	3	_	200	200	—		-		2	2			1	1315
2001	10	1	1		1	<u> </u>	_			_			—	1	1261
2002	6	1	350	1	350	1		1				1	-	_	929
2003	5	1	10	1	10	-	1	1	Τ	_	1	1		1	886
2004	4	2	5.4	11	16.4	1		-	1		-	1	—	1	894
2005	4	0	-					—	_	—				·	659
Total	278	43	178,480	311.8		17		—	_	17		_	—	9	33979

Source: USDOI, MMS, Alaska OCS Region (2006).

## **Bibliography**

Alaska Native Health Board. 2002. Alaska Pollution Issues Update. Anchorage, AK: ANHB.

- Amstrup, S.C. and D.P. DeMaster. 1988. Polar Bear. In: Selected Marine Mammals of Alaska: Species Accounts with Research and Management Recommendations, J.W. Lentfer, ed. Washington, DC: Marine Mammal Commission, pp. 39-56.
- Amstrup, S.C. and C. Garner. 1994. Polar Bear Maternity Denning in the Beaufort Sea. Journal Wildlife Management 58(1):1-10.
- Amstrup, S.C., G.M. Durner, I. Stirling, and T.L. McDonald. 2005. Allocating Harvests among Polar Bear Stocks in the Beaufort Sea. *Arctic* 58:247-259.
- Angliss, R.P. and R. Outlaw. 2005. Draft Alaska Marine Mammal Stock Assessments 2005. Report SC-CAMLR-XXIV. Juneau, AK: National Marine Mammal Laboratory, Alaska Fisheries Science Center.
- Ashjian, C.J., S.R. Braund, R.G. Campbell, C. George, J.A. Kruse, S.E. Moore, C.R. Nicolson, S.R. Okkonen, B.F. Sherr, and E.B. Sherr. 2007. Environmental Variability Relative to Bowhead Whale Distribution and Prey Availability near Barrow, Alaska. Abstract. *In*: Alaska Marine Science Symposium, Anchorage, Ak., Jan. 21-24, 2007. Anchorage, AK: ARCO Alaska, Inc., 80 pp. plus appendices.
- Braham, H.W., J.J. Burns, G.A. Fedoseev, and B. Krogman. 1984. Habitat Partitioning by Ice-Associated Pinnipeds: Distribution and Density of Seals and Walruses in the Bering Sea, April 1976. *In*: Soviet-American Cooperative Research on Marine Mammals. Vol. I Pinnipeds, F.M. Fay and G.A. Fedoseev, eds. NOAA Technical Report NMFS 12. Seattle, WA: USDOC, NOAA, OCSEAP, pp. 25-47.
- Brewer, K., M. Gallagher, P. Regos, P. Isert, and J. Hall. 1993. Kuvlum #1 Exploration Prospect, Site Specific Monitoring Program Final Report. Anchorage, AK: ARCO Alaska, Inc., 80 pp. plus appendices.
- Bunnell, F.L. and D.E.N. Tait. 1981. Population Dynamics of Bears Implications. In: Dynamics of Large Mammal Populations, C.W. Fowler and T.D. Smith, eds. New York: Wiley and Sons, 477 pp.
- Burgess, W.C. and C.R. Greene, Jr. 1999. Physical Acoustic Measurements. *In*: Marine Mammal and Acoustical Monitoring of Western Geophysical's Open-Water Seismic Program in the Alaskan Beaufort Sea, 1998, W.J. Richardson, ed. LGL Report TA2230-3. Houston, TX, Silver Spring, MD, and Anchorage, AK: Western Geophysical and USDOC, NMFS, 390 pp.

- Burns, J.J. and B.P. Kelly. 1982. Studies of Ringed Seals in the Alaskan Beaufort Sea during Winter: Impacts of Seismic Exploration. Annual Report. Juneau, AK: USDOC, NOAA, OCSEAP.
- Caron, L.M.J. and T.G. Smith. 1990. Philopatry and Site Tenacity of Belugas, *Delphinapterus leucas*, Hunted by the Inuit at the Nastapoka Estuary, Eastern Hudson Bay. *Can. Bull. Fish. Aquat. Sci.* 224:69-79.
- Clark, K., C. Hetherington, C. O'Neil, and J. Zavitz. 1997. Breaking Ice with Finesse: Oil & Gas Exploration in the Canadian Arctic. Calgary, Alb., Canada, The University of Calgary, The Arctic Institute of North America, 248 pp.
- Clarke, J.T., S.E. Moore, and M.M. Johnson. 1993. Observations on Beluga Fall Migration in the Alaskan Beaufort Sea, 1982-87, and Northeastern Chukchi Sea, 1982-91. Report of the IWC 43. Cambridge, UK: IWC, pp. 387-396.
- Comiso, J. 2005. Overview Satellite Observed Variability of the Arctic Ice Cover. *In*: MMS Chukchi Sea Science Update, Anchorage, Ak., Oct. 31, 2005. Anchorage, AK: USDOI, MMS, Alaska OCS Region.

Comiso, J. 2006. Arctic Warming Signals from Satellite Observations. Weather 61(3):70-76.

- Cronin, M.A., S.C. Amstrup, and K.T. Scribner. 2006. Microsatellite DNA and Mitochondrial DNA Variation in Polar Bears (*Ursus maritimus*) from the Beaufort and Chukchi Seas, Alaska. Can. J. Zool. 84(5):655-660.
- Cummings, W.C., D.V. Holliday, W.T. Ellison, and B.J. Graham. 1983. Technical Feasibility of Passive Acoustic Location of Bowhead Whales in Population Studies off Point Barrow, Alaska. Report T-83-06-002. Barrow, AK: North Slope Borough.
- Dau, C.P. and W.W. Larned. 2004. Aerial Population Survey of Common Eiders and Other Waterbirds in Near Shore Waters and along Barrier Islands of the Arctic Coastal Plain of Alaska, 24-27 June 2004. Anchorage, AK: USDOI, FWS.
- Dau, C.P. and W.W. Larned. 2005. Aerial Population Survey of Common Eiders and Other Waterbirds in Near Shore Waters and along Barrier Islands of the Arctic Coastal Plain of Alaska, 24-27 June 2005. Anchorage, AK: USDOI, FWS.
- Davies, J.R. 1997. The Impact of an Offshore Drilling Platform on the Fall Migration Path of Bowhead Whales: A GIS-Based Assessment. M.S. Thesis. Seattle, WA: Western Washington University.
- Derocher, A.E., O. Wiig, and G. Bangjord. 2000. Predation of Svalbard Reindeer by Polar Bears. *Polar Biology* 23:675-678.

- Devon Canada Corporation. 2004. Devon Beaufort Sea Exploration Drilling Program. Devon Canada Corporation, Calgary Alberta, Canada.
- Durner, G.M. and S.C. Amstrup. 2000. Estimating the Impacts of Oil Spills on Polar Bears. Arctic Research 14:33-37.
- Durner, G.M., S.C. Amstrup, R. Neilson, and T. McDonald. 2004. The Use of Sea Ice Habitat by Female Polar Bears in the Beaufort Sea. OCS Study MMS 2004-014. Anchorage, AK: USDOI, MMS, Alaska OCS Region, 41 pp.
- Engas, A., S. Lokkeborg, E. Ona, and A.V. Soldal. 1996. Effects of Seismic Shooting on Local Abundance and Catch Rates of Cod (*Gadus morhua*) and Haddock (*Melanogrammus aeglefinus*). Can. J. Fish. Aquat. Sci. 53:2238-2249.
- Finley, K.J. 1982. The Estuarine Habitat of the Beluga or White Whale, *Delphinapterus leucas*. *Cetus* 4:4-5.
- Fischer, J.B. and W.W. Larned. 2004. Summer Distribution of Marine Birds in the Western Beaufort Sea. *Arctic* 57:143-159.
- K.J. Frost and L.F. Lowry. 1990. Distribution, Abundance, and Movements of Beluga Whales, Delphinapterus leucas, in Coastal Waters of western Alaska. In: Advances in Research on the Beluga Whale, T.G. Smith, D.J. St. Aubin, and R. Geraci, eds. Canadian Bulletin of Fisheries and Aquatic Sciences 224:39-57.
- Frost, K.J., L.F. Lowry, J.R. Gilbert, and J.J. Burns. 1989. Ringed Seal Monitoring: Relationships of Distribution and Abundance to Habitat Attributes and Industrial Activities. OCS Study MMS 89-0026. Anchorage, AK: USDOI, MMS, Alaska OCS Region, pp. 345-445.
- Frost, K.J., L.F. Lowry, G. Pendleton, and H.R. Nute. 2004. actors Affecting the Observed Densities of Ringed Seals, *Phoca hispida*, in the Alaskan Beaufort Sea, 1996-99. *Arctic* 57:115-128.
- Galginaitis, M. and D.W. Funk. 2004. Annual Assessment of Subsistence Bowhead Whaling near Cross Island, 2001 and 2002. ANIMIDA Task 4 Final Report. Anchorage, AK: USDOI, MMS, Alaska OCS Region.
- Galginaitis, M. and D.W. Funk. 2005. Annual Assessment of Subsistence Bowhead Whaling near Cross Island. ANIMIDA Task 4 Annual Report. Anchorage, AK: USDOI, MMS, Alaska OCS Region.

- Galginaitis, M. and D.W. Funk. 2006a. Annual Assessment of Subsistence Bowhead Whaling near Cross Island, 2004: ANIMIDA Task 7 Annual Report. Anchorage, AK: USDOI, MMS, Alaska OCS Region.
- Galginaitis, M. and D.W. Funk. 2006b. Annual Assessment of Subsistence Bowhead Whaling near Cross Island, 2005. ANIMIDA Task 7 Preliminary Report. Anchorage, AK: USDOI, MMS, Alaska OCS Region.
- Gallagher, M., K. Brewer, and J. Hall. 1992. Galahad Exploration Prospect, Site Specific Monitoring Plan. Final Report. Walnut Creek, CA: Amoco Production Co.
- Gausland, I. 1998. Physics of Sound in Water. In: Proceedings of the Seismic and Marine Mammals Workshop, London, Jun. 23-25, 1998, M.L. Tasker and C. Weir, eds. Chapter 3. Published on the Web.
- Hall, J., M.Gallagher, K. Brewer, P. Regos, and P. Isert. 1994. 1993 Kuvlum Exploration Area, Site Specific Monitoring Program, Final Report. Anchorage, AK: ARCO Alaska, Inc.
- Hart Crowser Inc. 2000. Estimation of Oil Spill Risk from Alaska North Slope, Trans Alaska Pipeline and Arctic Canada Oil Spill Data Sets. OCS Study, MMS 2000-007. Anchorage Alaska: USDOI, MMS, Alaska OCS.
- Harwood, L.A. and I. Stirling. 1992. Distribution of Ringed Seals in the Southeastern Beaufort Sea during Late Summer. *Can. J. Zool.* 70(5):891-900.
- Hazard, K. 1988. Beluga Whale, *Delphinapterus leucas*. In: elected Marine Mammals of Alaska: Species Accounts with Research and Management Recommendations, J.W. Lentfer, ed. Washington, DC: Marine Mammal Commission,
- Holland, P. 1997. Offshore Blowouts Causes and Control. Houston, TX: Gulf Publishing Company.
- Kelly, B.P. 1988. Ringed Seal. In: Selected Marine Mammals of Alaska: Species Accounts with Research and Management Recommendations, J.W. Lentfer, ed. Washington, DC: Marine Mammal Commission, pp. 57-77.
- LGL Alaska Research Assocs., Inc. 2006. Draft Environmental Assessment of a Marine Geophysical Survey by the USCG *Healey* of the Western Canada Basin, Chukchi Borderland, and Mendeleev Ridge, Arctic Ocean, July-August 2006. LGL Report TA4285-1. Washington, DC: National Science Foundation.
- Larned, W.W., R. Stehn, and R. Platte. 2006. Eider Breeding Poulation Survey Arctic Coastal Plain, Alaska 2006. Anchorage, AK: USDOI, FWS.

- Larsen, T. 1985. Polar Bear Denning and Cub Production in Svalbard, Norway. J. Wildlife Management 49(2):320-326.
- Laws, E.A. 1987. Water Pollution and Toxicology. In: Encyclopedia of Physical Science and Technology, R.A. Meyers, ed. Vol. 14. Orlando, FL: TRW, Inc. Academic Press, pp. 523-556.
- Ljungblad, D.K., S.E. Moore, and D.R. Van Schoik. 1984. Aerial Surveys of Endangered Whales in the Northern Bering, Eastern Chukchi and Alaskan Beaufort Seas, 1983: With a Five Year Review, 1979-1983. NOSC Technical Report 955. Anchorage, AK: USDOI, MMS, Alaska OCS Region, 357 pp.
- Lunn, N.J., S.L. Schliebe, and E.W. Born. 2002. Polar Bears: Proceedings of the 13<sup>th</sup> Working Meeting of the IUCN/SSC Polar Bear Specialist Group, Nuuk, Greenland, Jun. 23-28, 2001. Occasional Paper of the IUCN Species Survival Commission No. 26. Gland, Switzerland: IUCN, The World Conservation Union, 153 pp.
- Mallek, E.J., R. Platte, and R. Stehn. 2005. Aerial Breeding Pair Surveys of the Arctic Coastal Plan of Alaska 2004. Fairbanks, AK: USDOI, FWS.
- Mallek, E.J., R. Platte, and R. Stehn. 2006. Aerial Breeding Pair Surveys of the Arctic Coastal Plain of Alaska 2005. Fairbanks, AK: USDOI, FWS.
- McLaren, P.L., C.R. Greene, W.J. Richardson, and R.A. Davis. 1986. Bowhead Whales and Underwater Noise near a Drillship Operation in the Alaskan Beaufort Sea, 1985. Los Angeles, CA: UNOCAL, 137 pp.
- Miller, G.W., R.E. Elliott, and W.J. Richardson. 1998. Whales. *In*: Marine Mammal and Aoustical Monitoring of BP Exploration (Alaska)'s Open-Water Seismic Program in the Alaskan Beaufort Sea, 1997, LGL and Greeneridge, eds. LGL Report TA 2150-3. King City, Ont., Canada: LGL Ecological Research Associates, Inc., 124 pp.
- Miller, S., S. Schliebe, and K. Proffitt. 2006. Demographics and Behavior of Polar Bears Feeding on Whale Carcasses at Barter and Cross Islands, Alaska. OCS Study MMS 2006-014. Anchorage, AK: USDOI, MMS, Alaska OCS Region, 29 pp.
- Moore, S.E., D.P. DeMaster, and P.K. Dayton. 2000. Cetacean Habitat Selection in the Alaskan Arctic during Summer and Autumn. *Arctic* 53(4):432-447.
- Murphy, S.M., F.J. Mueter, S.R. Braund, and L.L. Moulton. 2007. Factors Affecting the Subsistence Harvest of Arctic Cisco in the Colville River. Abstract. Presentation at the 2007 Alaska Marine Science Symposium, Anchorage, Ak., Jan. 21-24, 2007. Access online Feb. 13, 2007 at http://doc/nprb.org/web/symposium/2007/Abstract%20book\_2007.pdf

- NASA. 2005. Arctic Sea Ice Continues to Decline, Arctic Temperatures Continue to Rise in 2005. <u>http://www.nasa.gov/centers/goddard/news/topstory/2005/arcticice\_decline.html</u>
- NMFS. 2006. Biological Opinion for Federal Oil and Gas Leasing and Exploration by the Minerals Management Service (MMS) within the Alaskan Beaufort and Chukchi Seas. http://www.mms.gov/alaska/ref/BioOpinions/ARBO-2.pdf
- North Slope Borough. 1999. North Slope Borough 1998/99 Economic Profile and Census Report. Vol. VIII. Barrow, AK: NSB, Dept. of Planning and Community Services.
- Petersen, M.R., W.W. Larned, and D.C. Douglas. 1999. At-Sea Distribution of Spectacled Eiders: A 120-Year-Old Mystery Resolved. Auk 116:1009-1020.
- Petroleum News. 2006a. Shell on Fast Forward: Purchases Arctic Drilling Platform, Doing Geogechnical Coring at Hammerhead. Petroleum News 116:1009-1020.
- Petroleum News. 2006b. Setting the Stage for Arctic Offshore Oil, Gas Exploration. Petroleum News 11(18).
- Petroleum News. 2006c. Shell Plans 4 Beaufort Wells in '07: Two Wells at Sivullig and Two at Another Location North of Camden Bay: Seismic Planned for the Chukchi and Beaufort. Petroleum News 11(44).
- Phillips, L. 2005. Migration Ecology and Distribution of King Eiders. MS Thesis. Fairbanks, AK: University of Alaska, Fairbanks.
- Powell, A.N., L. Phillips, E.A. Rexstad, and E.J. Taylor. 2005. Importance of the Alaskan Beaufort Sea to King Eiders (*Somateria spectabilis*). OCS Study MMS 2005-087. Anchorage, AK: USDOI, MMS, Alaska OCS Region.
- Rahn, K.A. 1982. On the Causes, Characteristics and Potential Environmental Effects of Aerosol in the Arctic Atmosphere. In: The Arctic Ocean: The Hydrographic Environment and the Fate of Pollutants, L. Ray, ed. New York: John Wiley and Sons, pp. 163-195.
- Ramsay, M.A. and I. Stirling. 1988. Reproductive Biology and Ecology of Female Polar Bears (Ursus maritimus). Journal of Zoology 214:601-634.
- Reed, M., N. Ekrol, P. Daling, O. Johansen, and M.K. Ditlevsen. 2005. SINTEF Oil Weathering Model User's Manual Version 3.0. Trondheim, Norway: SINTEF Applied Chemistry 39 pp.
- Richard, P.R., A.R. Martin, and J.R. Orr. 2001. Summer and Autumn Movements of Belugas of the Eastern Beaufort Sea Stock. *Arctic* 54(3):223-236.

- Richard, P.R., M.P. Heide-Jorgensen, and D. St. Aubin. 1997. Fall Movements of Belugas (*Delphinapterus leucas*) with Satellite-Linked Transmitters in Lancaster Sound, Jones Sound, and Northern Baffin Bay. *Arctic* 51(1):5-16.
- Richard, P.R., J.R. Orr, R. Dietz, and L. Dueck. 1998. Sightings of Belugas and Other Marine Mammals in the North Water, Late March 1993. Arctic 5(1):1-4.
- Richardson, W.J. and C.I. Malme. 1993. Man-Made Noise and Behavioral Responses. *In: The Bowhead Whale*, J.J. Burns, J.J. Montague, and C.J. Cowles, eds. Lawrence, KS: The Society for Marine Mammalogy, pp. 631-700.
- Richardson, W.J. and D.H. Thomson. 2002. Bowhead Whale Feeding in the Eastern Alaskan Beaufort Sea: Update of Scientific and Traditional Information. Anchorage, AK: USDOI, MMS, Alaska OCS Region.
- Richardson, W.J., C.R. Greene, C.I. Malme, D.H. Thomson, S.E. Moore, and B. Wursig. 1990. Effects of Noise on Marine Mammals. OCS Study MMS 90-0093. Anchorage, AK: USDOI, MMS, Alaska OCS Region, 462 pp.
- Richardson, W.J., C.R. Greene, C.I. Malme, and D.H. Thomson. 1995. *Marine Mammals and Noise*. San Diego, CA: Academic Press, Inc.
- Ritchie, R.J., J.E. Shook, R.M. Burgess, and A.A. Stickney. 2006. Surveys for Nesting and Brood-Rearing Brant and Lesser Snow Geese, Barrow to Fish Creek Delta, and Lesser Snow Goose Banding near Ikpikpuk River Delta, Alaska, 2005. Annual Report. Barrow, AK: North Slope Borough, Dept. of Wildlife Management, 36 pp.
- Rosing-Asvid, A. 2006. The Influence of Climate Variability on Polar Bear (Ursus maritimus) and Ringed Seal (Pusa hispida) Population Dynamics. Can. J. Zool. 84:357-364.
- Scandpower. 2001. Blowout Frequency Assessment of Northstar. 27.83.01/R1. Prepared for BP Exploration (Alaska). Kjeller, Norway: Scandpower, 40 pp. plus appendices.
- Schliebe, S., T.J. Evans, S. Miller, C.J. Perham, J.M. Wilder, and L.J. Lierheimer. 2005. Polar Bear Management in Alaska, 2000-2004. Anchorage, AK: USDOI, FWS, 25 pp.
- Serreze, M.C., J.A. Maslanik, T.A. Scambos, F. Fetterer, J.C. Stroeve, K. Knowles, S. Drobot, R.G. Barry, and T.M. Haran. 2003. A Record Mininum Arctic Sea Ice Extent and Area in 2002. *Geophysical Research Letters* doi:10.1029/2002GL016406.
- Shell. 2007. Shell Exploration & Production Company's Request of January 2007 to the National Marine Fisheries Service for Approval Incidental Harassment Authorization for Non-Lethal Taking of Whales and Seals in the Beaufort Sea, Alaska during 2007 Open-Water Drilling Program.

- Simpkins, M.A., L.M. Hiruki-Raring, G. Sheffield, J.M. Grebmeier, and J.L. Bengston. 2003. Habitat Selection by Ice-Associated Pinnipeds near St. Lawrence Island, Alaska in March 2001. Polar Biology 26:577-586.
- Smith, A.E. and M.R.J. Hill. 1996. Polar Bear, Ursus maritimus, Depredation of Canada Goose, Branta canadensis, Nests. The Canadian Field-Naturalist 110:339-340.
- Smith, T.G. 1985. Polar Bears, Ursus maritimus, as Predators of Belugas, Delphinapterus leucas. The Canadian Field-Naturalist 99:71-75.
- State of Alaska, Dept. of Natural Resources. 1997. Oil and Gas Lease Sale 86, Central Beaufort Sea: Final Finding of the Director. Anchorage, AK: State of Alaska, DNR.
- Stirling, I. and E.H. McEwan. 1975. The Caloric Value of Whole Ringed Seals (*Phoca hispida*) in Relation to Polar Bear (*Ursus maritimus*) Ecology and Hunting Behavior. Can. J. Fish. Aquat. Sci. 53(8):1021-1027.
- Stirling, I., M.C.S. Kingsley, and W. Calvert. 1981. The Distribution and Abundance of Ringed and Bearded Seals in the Eastern Beaufort Sea, 1974-1979. Edmonton, Alb., Canada: Dome Petroleum Limited, ESSO Resources Canada Limited and the Department of Indian and Northern Affairs, 70 pp.
- Stroeve, J.C., M.C. Serreze, F. Fetterer, T. Arbetter, W. Meier, J. Maslanik, and K. Knowles. 2005. Tracking the Arctic's Shrinking Ice Cover: Another Extreme Minimum in 2004. *Geophysical Research Letters* L040501.
- Suydam, R.S., L.F. Lowry, K.J. Frost, G.M. O'Corry-Crowe, and D. Pikok, Jr. 2001. Satellite Tracking of Eastern Chukchi Sea Beluga Whales into the Arctic Ocean. *Arctic* 54(3):237-243.
- Suydam, R.S., J.C. George, C. Hanns, and G. Sheffield. 2005. Subsistence Harvest of Bowhead Whales (*Balaena mysticetus*) by Alaskan Eskimos during 2004. Scientific Report of the IWC 57. Cambridge, UK: IWC.
- Thomson, D.H. and W.J. Richardson. 1987. Integration. *In*: Importance of the Eastern Alaskan Beaufort Sea to Feeding Bowhead Whales, 1985-86, W.J. Richardson, ed. OCS Study, MMS 87-0037. Reston, VA: USDOI, MMS, pp. 449-511.
- Treacy, S.D. 1994. Aerial Surveys of Endangered Whales in the Beaufort Sea, Fall 1993. OCS Study, MMS 94-0032. Anchorage, AK: USDOI, MMS, Alaska OCS Region, 78 pp.
- Treacy, S.D. 2002. Aerial Surveys of Endangered Whales in the Beaufort Sea, Fall 2001. OCS Study, MMS 2002-0061. Anchorage, AK: USDOI, MMS, Alaska OCS Region, 117 pp.

- USDOC, Bureau of the Census. 2000. http://quickfacts.census.gov/qfd/index.html. Washington, DC.
- USDOC, Bureau of the Census. 2002. Area Boroughs, Cities and U.S. Census Places. Washington, DC: USDOC, Bureau of the Census.
- USDOI, FWS. 2002. Biological Opinion for Minerals Management Service's Proposed Beaufort Sea Natural Gas and Oil Lease Sale 186. Fairbanks, AK: USDOI, FWS, Endangered Species Branch.
- USDOI, FWS. 2006. Letter received Jan. 5, 2006, from USDOI, FWS; subject: species list for Chukchi and Beaufort Seas.
- USDOI, MMS. 2003. Beaufort Sea Planning Area Sales 186, 195, and 202 Oil and Gas Lease Sale Final Environmental Impact Statement. OCS EIS/EA MMS 2003-001. Anchorage, AK: USDOI, MMS, Alaska OCS Region.
- USDOI, MMS. 2004. Proposed Oil and Gas Lease Sale 195 Beaufort Sea Planning Area Environmental Assessment. OCS EIS/EA 2004-028. Anchorage, AK: USDOI, MMS, Alaska OCS Region.
- USDOI, MMS. 2005. Tenth Information Transfer Meeting, Barrow Information Update Meeting, Anchorage, Ak., Mar. 14-16, 2005. OCS Study MMS 2005-036. Anchorage, AK: USDOI, MMS, Alaska OCS Region.
- USDOI, MMS. 2006a. Proposed Oil and Gas Lease Sale 202 Beaufort Sea Planning Area Environmental Assessment. OCS EIS/EA 2006-001. Anchorage, AK: USDOI, MMS, Alaska OCS Region.
- USDOI, MMS. 2006b. Programmatic Environmental Assessment Arctic Outer Continental Shelf Seismic Surveys – 2006. OCS EIS/EA 2006-038. Anchorage, AK: USDOI, MMS, Alaska OCS Region.
- USDOI, MMS. 2006c. Biological Evaluation of the Potential Effects of Oil and Gas Leasing and Exploration in the Alaska OCS Beaufort Sea and Chukchi Sea Planning Areas on Endangered Bowhead whales (*Balaena mysticetus*), Fin Whales (*Balaenoptera physalus*), and Humpback Whales (*Megaptera novaeangliae*). Anchorage, AK: USDOI, MMS, Alaska OCS Region.
- Wainwright, P. 2002. GIS Geospatial Database of Oil-Industry and Other Human Activity (1979-1999) in the Alaskan Beaufort Sea. Vol. I. OCS Study, MMS 2002-071. Anchorage, AK: USDOI, MMS, Alaska OCS Region.

Wisniewski, J. 2005. Subsistence and Sociocultural Resources. In: MMS Chukchi Sea Science

- USDOC, Bureau of the Census. 2000. http://quickfacts.census.gov/qfd/index.html. Washington, DC.
- USDOC, Bureau of the Census. 2002. Area Boroughs, Cities and U.S. Census Places. Washington, DC: USDOC, Bureau of the Census.
- USDOI, FWS. 2002. Biological Opinion for Minerals Management Service's Proposed Beaufort Sea Natural Gas and Oil Lease Sale 186. Fairbanks, AK: USDOI, FWS, Endangered Species Branch.
- USDOI, FWS. 2006. Letter received Jan. 5, 2006, from USDOI, FWS; subject: species list for Chukchi and Beaufort Seas.
- USDOI, MMS. 2003. Beaufort Sea Planning Area Sales 186, 195, and 202 Oil and Gas Lease Sale Final Environmental Impact Statement. OCS EIS/EA MMS 2003-001. Anchorage, AK: USDOI, MMS, Alaska OCS Region.
- USDOI, MMS. 2004. Proposed Oil and Gas Lease Sale 195 Beaufort Sea Planning Area Environmental Assessment. OCS EIS/EA 2004-028. Anchorage, AK: USDOI, MMS, Alaska OCS Region.
- USDOI, MMS. 2005. Tenth Information Transfer Meeting, Barrow Information Update Meeting, Anchorage, Ak., Mar. 14-16, 2005. OCS Study MMS 2005-036. Anchorage, AK: USDOI, MMS, Alaska OCS Region.
- USDOI, MMS. 2006a. Proposed Oil and Gas Lease Sale 202 Beaufort Sea Planning Area Environmental Assessment. OCS EIS/EA 2006-001. Anchorage, AK: USDOI, MMS, Alaska OCS Region.
- USDOI, MMS. 2006b. Programmatic Environmental Assessment Arctic Outer Continental Shelf Seismic Surveys – 2006. OCS EIS/EA 2006-038. Anchorage, AK: USDOI, MMS, Alaska OCS Region.
- USDOI, MMS. 2006c. Biological Evaluation of the Potential Effects of Oil and Gas Leasing and Exploration in the Alaska OCS Beaufort Sea and Chukchi Sea Planning Areas on Endangered Bowhead whales (*Balaena mysticetus*), Fin Whales (*Balaenoptera physalus*), and Humpback Whales (*Megaptera novaeangliae*). Anchorage, AK: USDOI, MMS, Alaska OCS Region.
- Wainwright, P. 2002. GIS Geospatial Database of Oil-Industry and Other Human Activity (1979-1999) in the Alaskan Beaufort Sea. Vol. I. OCS Study, MMS 2002-071. Anchorage, AK: USDOI, MMS, Alaska OCS Region.

Wisniewski, J. 2005. Subsistence and Sociocultural Resources. In: MMS Chukchi Sea Science Update, Anchorage, Ak., Oct. 31, 2005. Anchorage, AK: USDOI, MMS, Alaska OCS Region.

87

and the second second



Figure 1. Beaufort Sea area showing the -30 meter isobath and the leases listed in Shell Oil's exploration plan, and Shell's Sivullig Prospect.



Figure 2. Beaufort Sea area showing the -30 meter isobath, the leases in the plan held by Shell Oil between Cross Island and the Canadian border, and the Location of Previous Wells in Camden Bay.



Figure 3. Shell's *Kullu* drilling vessel, which is the former *Kulluk*.



Figure 4. Shell's Frontier Discoverer drillship



Figure 5. The Vladimir Ignatyuk icebreaker, which was formerly the Arctic Kalvik.



Figure 6. The Kapitan Dranitsyn icebreaker.



Figure 7. The geotechnical coring vessel, Fugro Explorer.



Figure 8. Beaufort Sea area showing proposed drill sites and all bowhead sightings in the years 1982 - 2005.





Figure 10. Depth of Bowhead Whale Sightings, 1982 to 2005 for a Restricted Area of the Beaufort Sea.



Figure 11. Beaufort Sea area showing previous drill sites and all bowhead sightings in the years 1985, 1986, 1992 and 1993.

.



Historia Rowhood Strikes	1027-2001

Location ID	······Year
1	1937
2 ·	1940
101	1973
102	1982
103	1983
104	1985
105	1986
106	1990
107	. 1991
109	1992
110	1992

Figure 12 Bowhead Whale Harvest Locations Near Cross Island. Sources: Long (1996); North Slope Borough Planning Dept. (1993); Bowhead Strikes 1937-2001



Bowhead Strikes 1988-1995

O North Slope Borough Bowhead Strikes 1989-2001

- Location Id	- Harvest-Date
1	9-17-1988
2	10-02-1988
3	10-02-1988
4	10-52-1988
5	10-02-1988
6	9-27-1991
7	9-28-1991
e	10-02-1991
9	10-04-1991
10	8-31-1992
11	9-1-1992
12	9-2-1992
13	9-1-1992
14	9-1-1992
15	9-3-1992
16	9-12-1992
17	9-17-1992
19	9-19-1992
19	9-23-1992
20	9-24-1992
21	9-26-1992

S Location Id	3. Barvest'Date
<u>· 22</u>	9-26-1992
23	10-8-1992
24	10-5-1993
25	10-7-1993
26	10-13-1993
27	10-18-1993
28	10-19-1993
2.9	10-20-1993
30	10-13-1993
31	10-1-1994
. 32	9-5-1995
. 33	9-6-1995
34	9-11-1995
35	9-16-1995
36	9-16-1995
37	9-18-1995
38	9-20-1995
39	9-20-1995
40	10-16-1995
41	10-17-1995
42	10-17-1995

Sources: Kaleak (1996); North Slope Borough Planning Dept. (1993); North Slope Borough (2001).

Figure 13. Bowhead Whale Harvest Locations near Kaktovik



Figure 14. Acoustic levels during the 1993 Kuvlum operations in very light ice (Hall et al., 1994). The figure illustrates that, in spite of the open water conditions and relative inactivity of the icebreakers, the 120 dB isopleth at a depth of 20m extended to the shoreline.







Figure 16. 1993 Bowhead whale sighting distribution from aerial sighting in the Distant and Proximal survey areas. This is a copy of Figure 9 in Hall et al., 1994.



Figure 17. Bowhead sightings near the Corona drilling and icebreaking operation during the middle and final stages of the 1985 migration in moderate ice. (This is a combination of Figs. 27 and 28 in McLaren et al. (1986).)



Figure 18. Aerial sightings of bowhead whales near the 1986-Hammerhead operations during the middle and final portions of the migration in mild-ice conditions. (Copy of Fig. 6 in LGL and Greeneridge (1987).)



Figure 19. Sightings and movements of whales in the initial state of the migration through relatively open-water conditions during the 1985-Hammerhead operations. A tug and dredge were operating also during this period at the Erik prospect near the eastern edge of the monitoring grid. (Copy of Figure 26 in McLaren et al. (1986).)



Figure 20. Bowhead sightings near the Galahad drilling and icebreaking operation during the 1991 migration in heavy ice. The whales were sighted on October 2nd during flight number "gal1002" (Gallaher et al., 1992). The two symbols labeled "FV" indicate the location of fishing vessels. or subsistence whaling vessels.