ALASKA WILDERNESS LEAGUE, CANADIAN PARKS AND WILDERNESS SOCIETY-NATIONAL, CANADIAN PARKS AND WILDERNESS SOCIETY-YUKON CHAPTER, CENTER FOR BIOLOGICAL DIVERSITY, DEFENDERS OF WILDLIFE, EARTHJUSTICE, ENVIRONMENT AMERICA, EYAK PRESERVATION COUNCIL, FAIRBANKS CLIMATE ACTION COALITION, FRIENDS OF ALASKA NATIONAL WILDLIFE REFUGES, GWICH'IN STEERING COMMITTEE, LEAGUE OF CONSERVATION VOTERS, NATIONAL AUDUBON SOCIETY, NATIONAL WILDLIFE REFUGE ASSOCIATION, NATIVE CONSERVANCY LAND TRUST, NATIVE MOVEMENT, NATURE CANADA, NORTHERN ALASKA ENVIRONMENTAL CENTER, SIERRA CLUB, THE OCEAN FOUNDATION, THE WILDERNESS SOCIETY, TRUSTEES FOR ALASKA, WILDERNESS WATCH, WORLD WILDLIFE FUND

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Submitted via email

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Attn: Coastal Plain Oil and Gas Leasing Program EIS
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Scoping Comments re: Notice of Intent to Prepare an Environmental Impact Statement for the Coastal Plain Oil and Gas Leasing Program

Dear Ms. Hayes,

On behalf of the above-listed organizations and our many millions of members and supporters nationwide and internationally, we submit the following comments in response to the public notice from April 20, 2018, Notice of Intent to Prepare an Environmental Impact Statement for the Coastal Plain Oil and Gas Leasing Program, Alaska, 83 Fed. Reg. 17562 (Apr. 20, 2018).

We oppose all oil and gas activities on the Coastal Plain of the Arctic National Wildlife Refuge. We stand with the Gwich'in Nation and support their efforts to protect their human rights and food security by protecting the Coastal Plain. Our organizations have dedicated decades to defending the Coastal Plain from oil and gas exploration and development, and we will continue to do so. These unparalleled public lands, and the wildlife that depend on them, are an international treasure that must be conserved for future generations.

While we oppose any attempts to allow oil and gas activities on the Coastal Plain, we provide detailed comments outlining many issues that the Bureau of Land Management (BLM) must address in the National Environmental Policy Act (NEPA) review process as it considers holding a lease sale on the Coastal Plain of the Arctic Refuge. As the agency responsible for administering the oil and gas program, the BLM must ensure the planning process complies with NEPA, the Alaska National Interest Lands Conservation Act, the Wilderness Act, Title II of the Tax and Jobs Act, the Naval Petroleum Reserves Production Act, the Federal Land Policy and Management Act, the National Wildlife Refuge System Administration Act, the Endangered Species Act, and the Marine Mammal Protection Act, in addition to other substantive laws, treaties, and regulations as well as the management and permitting requirements of its cooperating agencies. We believe that any valid scientific review will show that oil and gas activities on the Coastal Plain will have unavoidable and un-mitigatable destructive impacts on Arctic Refuge wildlife and habitat and on the climate.

Department of the Interior (DOI) officials have stated that they will move the environmental review process forward at a very fast pace and have outlined a timeline to complete the NEPA review and hold a lease sale by next summer. A rushed process is not consistent with DOI's legal obligations when considering an issue as important and controversial as destructive oil and gas exploration and development on the Coastal Plain. Reckless decision-making is not what the Arctic Refuge — the crown jewel of our National Wildlife Refuge System — deserves. Instead of rushing to lease the Coastal Plain, DOI should listen to the millions of Americans and the Gwich'in Nation who support protection for the Coastal Plain and refrain from holding a hasty, ill-considered lease sale. Simply put, the Coastal Plain is no place for any oil and gas activities.

Sincerely,

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Alaska Wilderness League

Aran O'Carroll, Executive Director
Canadian Parks and Wilderness Society-National

Chris Rider, Executive Director
Canadian Parks and Wilderness Society-Yukon

Kristen Monsell, Oceans Legal Director
Center for Biological Diversity

Robert Dreher, Senior Vice President, Conservation Programs
Defenders of Wildlife

Marissa Knodel, Associate Legislative Counsel
Earthjustice

Eric DuMont, Stop Drilling Campaign Director
Environment America

Carol Hoover, Executive Director
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Jessica Girard, Council Member
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Native Movement

Graham Saul, Executive Director
Nature Canada

Lisa Baraff, Program Director
Northern Alaska Environmental Center

Lena Moffitt, Senior Director, Our Wild American Campaign
Sierra Club

Richard Charter, Coastal Coordination Program
The Ocean Foundation

Nicole Whittington-Evans, Alaska Director
The Wilderness Society

Victoria Clark, Executive Director
Trustees for Alaska

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World Wildlife Fund

CC:
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I. OVERVIEW OF COMMENTS

Our organizations have dedicated decades to defending the Coastal Plain of the Arctic National Wildlife Refuge (Arctic Refuge or Refuge) from oil and gas development, and we will continue to do so. These unparalleled public lands, and the wildlife that depend on them are an international treasure that must be conserved for future generations. While we oppose any attempts to allow oil and gas activities on the Coastal Plain, we provide detailed comments outlining many of the issues that the Bureau of Land Management (BLM) must address in the National Environmental Policy Act (NEPA) review process as it attempt to evaluate the impacts of an oil and gas program and considers holding a lease sale on the Coastal Plain of the Arctic Refuge.

These comments set out in detail the history of conservation of the Coastal Plain, its current management, the tax legislation that allows for an oil and gas program on the Coastal Plain, issues that the BLM will need to consider in the development of the leasing environmental impact statement (EIS), the impacts that BLM will need to analyze, and the evaluation that BLM must undertake pursuant to section 810 of the Alaska National Interest Lands Conservation Act (ANILCA). At the outset, we note that there are many information and data gaps; BLM must not proceed in the face of incomplete or out-of-date information. BLM must address the topics discussed herein to ensure compliance with legal mandates. BLM must not shirk its duties or rush this process.

II. THE ARCTIC REFUGE AND ITS COASTAL PLAIN HAVE BEEN PROTECTED FOR DECADES BECAUSE OF THEIR EXCEPTIONAL ECOLOGICAL VALUES.

The Arctic Refuge is the crown jewel of the National Wildlife Refuge System. Because of the remoteness of its intact ecosystems, the Arctic Refuge is unique in the entire National Wildlife Refuge System. It functions as a model for wild nature and for what it contributes to the entire National Wildlife Refuge System, especially in protecting and fostering the health and productivity of migratory species.

Long before it was ever designated as a protected public land unit by the Federal government, Alaska Native peoples used and relied on the Coastal Plain and the resources it supports. They continue to do so today. Alaska Natives living both north and south of the Brooks Range as well as Canadian First Nations depend on the fish and wildlife species that the Coastal Plain supports. Leading up to Alaska's statehood, the celebrated conservationists Olaus and Margaret Murie and U.S. Supreme Court Justice William O. Douglas visited the area that is now the Arctic Refuge, recognized its outstanding biological values and wilderness qualities, and upon their return, embarked on an effort to protect the area.[1] As a result of their and others' efforts, President Eisenhower's Secretary of the Interior designated the Coastal Plain and a large area to its south as the Arctic National Wildlife Range ("Range") in 1960.[2] The Range was protected specifically "for the purpose of preserving unique wildlife, wilderness and recreational values" of the area.[3] Designation of the Range "was unique among Alaska conservation units because it was the first for which ecological thinking and concern for maintaining natural processes were significant factors in its establishment."[4] These protections stood for two decades before additional protections were added.

Considering it "one of the most important pieces of conservation legislation ever passed," President Carter signed ANILCA into law in 1980.[5] In passing ANILCA, Congress "preserve[d] for the benefit, use, education and inspiration of present and future generations certain lands and waters in the State of Alaska that contain nationally significant natural, scenic, historic, archeological, geological, scientific, wilderness, cultural, recreational, and wildlife values."[6] Through ANILCA, Congress re-designated the Range as the Arctic Refuge.[7] Congress added acreage south and west of the Range to the newly designated Arctic Refuge.[8] In addition to the purposes previously recognized for the Range, Congress identified additional purposes for this unique and spectacular areas of America's Arctic. The ANILCA purposes for the Arctic Refuge are:

(i) to conserve fish and wildlife populations and habitats in their natural diversity including, but not limited to, the Porcupine caribou herd (including participation in coordinated ecological studies and management of this herd and the Western Arctic caribou herd), polar bears, grizzly bears, muskox, Dall sheep, wolves,

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[1] WILLIAM O. DOUGLAS, MY WILDERNESS: THE PACIFIC WEST 10–31 (Doubleday & Co., Inc. 1960).

[2] Public Land Order 2214, Establishing the Arctic National Wildlife Range at 1 (Dec. 6, 1960) [hereinafter PLO 2214].

[3] PLO 2214 at 1.

[4] Arctic National Wildlife Refuge, Fairbanks, AK, 75 Fed. Reg. 17,763, 17,764 (Apr. 7, 2010).

[5] Alaska National Interest Lands Conservation Act: Remarks on Signing H.R. 39 into Law, Dec. 2, 1980, 16 WEEKLY COMP. PRES. DOCS. 2755 (Dec. 8, 1980).

[6] ANILCA § 101(a), 16 U.S.C. § 3101(a).

[7] ANILCA § 303(2).

[8] *Id.* § 303.

wolverines, snow geese, peregrine falcons and other migratory birds and Arctic char and graying;

(ii) to fulfill the international treaty obligations of the United States with respect to fish and wildlife and their habitats;

(iii) to provide, in a manner consistent with the purposes set forth in subparagraphs (i) and (ii), the opportunity for continued subsistence uses by local residents, and

(iv) to ensure, to the maximum extent practicable and in a manner consistent with the purposes set forth in paragraph (i), water quality and quantity within the refuge.[9]

These four purposes, along with the original three purposes set out in PLO 2214, apply to the Coastal Plain.[10]

Under ANILCA, the U.S. Department of the Interior (DOI) was required to conduct studies and provide a recommendation to Congress regarding whether the Coastal Plain should be opened to oil and gas development.[11] ANILCA did not open the Coastal Plain to oil and gas. In the 1987 Report to Congress, DOI stated that the Coastal Plain "area is the most biologically productive part of the Arctic Refuge for wildlife and is the center of wildlife activity."[12] Despite the many flaws with the analysis in the Report, it nevertheless concluded that oil and gas production would likely have major effects on the Porcupine Caribou Herd and muskoxen. Specifically with regards to caribou, those effects include "widespread, long-term change in habitat availability or quality which would likely modify natural abundance or distribution of species."[13] The Report also found that full or even limited leasing would have major impacts on water resources, subsistence for residents of Kaktovik, and recreation, wilderness, and esthetics.[14] Despite these findings, the Secretary of the Interior (Secretary) recommended leasing the entire Coastal Plain area.[15] For decades, Congress and the President declined to do so.

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[9] *Id.* § 303(2)(B).

[10] ANILCA § 305; FWS Refuge Management Part 601 National Wildlife Refuge System, 601 FW 1 at 1.16 (July 26, 2006); U.S Fish and Wildlife Service, Arctic National Wildlife Refuge, Revised Comprehensive Conservation Plan Final Environmental Impact Statement, Chapter 1 at 1-21 [hereinafter CCP Final EIS].

[11] 16 U.S.C. § 3142.

[12] U.S. Dep't of the Interior, Arctic National Wildlife Refuge, Alaska, Coastal Plain Resource Assessment, Report and Recommendation to the Congress of the United States and Final Legislative Environmental Impact Statement at 46 (Apr. 1987) [hereinafter LEIS].

[13] LEIS at vii, 123, 187.

[14] LEIS at 166.

[15] LEIS at vii, 188-89, 192.

III. CURRENT MANAGEMENT OF THE COASTAL PLAIN AND THE WILDERNESS RECOMMENDATION TO PROTECT ITS RESOURCES.

The U.S. Fish and Wildlife Service (FWS) currently manages the entire Arctic Refuge — including the Coastal Plain — under the Comprehensive Conservation Plan (CCP) adopted on April 3, 2015.[16] The CCP establishes "management goals and objectives," "define[s] compatible use," "[u]date[s] management direction related to national and regional policies and guidelines used to implement Federal laws governing Refuge management," and "[e]stablish[es] broad management direction for Refuge programs and activities" among other things.[17] Currently, the Coastal Plain is managed under the Minimal Management category as set out in the CCP.[18]

In the CCP, FWS articulated the vision for the Arctic Refuge as follows:

> This untamed arctic landscape continues to sustain the ecological diversity and special values that inspired the Refuge's establishment. Natural processes continue and traditional cultures thrive with the seasons and changing times; physical and mental challenges test our bodies, minds, and spirit; and we honor the land, the wildlife, and the native people with respect and restraint. Through responsible stewardship, this vast wilderness is passed on, undiminished, to future generations.[19]

Throughout the CCP process, whether to recommend Wilderness for the Coastal Plain was one of the main issues considered by the agency and commented on by the public. In 2015, following a multi-year process where nearly one million people submitted comments in support of protecting the Coastal Plain as Wilderness, the FWS recommended Wilderness for the Coastal Plain.[20] In adopting Alternative E (which included a Wilderness recommendation for the majority of the Coastal Plain and the lands to the south added by ANILCA), FWS stated that Wilderness for the Coastal Plain:

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[16] U.S Department of the Interior, Fish and Wildlife Service, Region 7, Record of Decision, Revised Comprehensive Conservation Plan, Arctic National Wildlife Refuge (Apr. 3, 2015) [hereinafter CCP ROD].

[17] CCP Final EIS, Summary at S-9.

[18] CCP Final EIS, Chapter 3 at 3-34; CCP ROD at 5.

[19] CCP ROD at 4.

[20] CCP ROD at 3.

> [B]est meets the Service's purpose and need to manage the Arctic Refuge to achieve the mission of the National Wildlife Refuge System and to meet the purposes for which the Refuge was established. This alternative conserves the fish, wildlife and habitats of the Arctic Refuge and facilitates subsistence and recreation in settings that emphasize natural, unaltered landscapes and natural processes.[21]

The agency also stated that:

> [The] Arctic Refuge is nationally recognized for its unique and wide range of arctic and subarctic ecosystems that retain a high degree of biological integrity and natural diversity. The Refuge exemplifies the idea of wilderness embodying tangible and intangible values including natural conditions, natural quiet, wild character, and exceptional opportunities for solitude, adventure, and immersion in the natural world. The Refuge represents deep-rooted American cultural values about frontiers, open spaces, and wilderness. It is one of the finest representations of the wilderness that helped shape our national character and identity.[22]

In advancing the Wilderness recommendation to Congress, the President stated that the Arctic Refuge "is one of the most beautiful, undisturbed places in the world. It is a national treasure and should be permanently protected through legislation for future generations."[23]

Throughout the CCP revision process, FWS properly declined to consider oil and gas development on the Coastal Plain.[24] Specifically regarding the management of the Arctic Refuge and the lack of consideration of oil and gas development in the CCP process, the CCP states:

> Until Congress takes action to change the provision of ANILCA 1003 or to implement the 1987 report, the Service will not and cannot permit oil and gas leasing in the Refuge under any of the alternatives in the Plan. When Congress makes a management decision, that action will be incorporated into the Plan and implemented.[25]

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[21] CCP ROD at 3–4, *see also id.* at 12.

[22] CCP ROD at 11–12.

[23] Ltr. From the President to the Speaker of the House of Representatives and the President of the Senate (Apr. 3, 2015).

[24] *See, e.g.*, CCP Final EIS, Chapter 3 at 3-6.

[25] CCP Final EIS, Chapter 1 at 1-1; *see also* Arctic National Wildlife Refuge, Comprehensive Conservation Plan, Environmental Impact Statement, Wilderness Review, Wild

Oil and gas leasing and any related activities on the Coastal Plain are, therefore, inconsistent with the CCP and present management of the Coastal Plain. The draft EIS must acknowledge this inconsistency.[26]

IV. TITLE II OF THE TAX CUTS AND JOBS ACT (PUB. L. 115-97, H.R. 1) AND AN OIL AND GAS PROGRAM FOR THE COASTAL PLAIN.

Despite decades of support for protecting the Arctic Refuge's Coastal Plain from oil and gas, Congress included a provision in the Tax Cuts and Jobs Act (Tax Act) to open the Coastal Plain to oil and gas development. This law was adopted through the budget reconciliation process under restrictive Senate procedures that only required a simple majority vote. Senator Murkowski was clear that she only used this legislative vehicle because there was not the support necessary to open the Refuge through the normal legislative process.[27] Throughout the legislative process, Senator Murkowski clearly stated that no laws would be waived or bypassed, no process would be short-cut, that the agencies would take their time and go through the process step-by-step to ensure the protection of the wildlife, fish, habitat, and other values of the Coastal Plain. BLM must uphold these commitments.

In 2013, the State of Alaska (State) submitted an "application" to conduct seismic exploration on the Coastal Plain. DOI and the Secretary rejected the application three times, each time asserting that ANILCA no longer allows exploration. Following a lawsuit by the State, the court upheld the Secretary's decision and interpretation of ANILCA: exploration under ANILCA was no longer permitted. The legislation opening up the Coastal Plain to oil and gas development does not specifically mention exploration when it authorizes an oil and gas program. In addition

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River Plans Final, Dear Reader Letter at 2 (Sept. 1988) (stating, "[w]hen Congress makes a management decision [re: oil and gas], that action will be incorporated into the Plan implemented").

[26] The Notice of Intent (NOI) indicates that "[t]he EIS will appropriately consider the surface management of the Coastal Plain." 83 Fed. Reg. at 17,563. It is unclear if this language is intended to indicate that FWS will update the CCP. If FWS is going to undertake an update to the CCP, it must be clearly stated and FWS must provide adequate notice and undertake a comprehensive NEPA process to do so.

[27] Margaret Kriz Hobson, *Road map for ANWR drilling gets clearer*, E&E NEWS, Mar. 12, 2018 [hereinafter Hobson I].

to considering the impacts from exploration,[28] BLM must explain whether and how exploration may be allowed and under what statutory and regulatory authority it will be regulated.

V. DEVELOPMENT OF THE LEASING EIS

A. The EIS Process Must be Given an Appropriate Amount of Time and Study.

The BLM needs to fully analyze the impacts of oil and gas activities and should not truncate the topics to be addressed, the analysis performed, or the timeframe necessary to undertake the analysis and public outreach. During the past few weeks, DOI has made statements indicating that it will proceed with an aggressive plan for implementing an oil and gas program on the Coastal Plain of the Arctic National Wildlife Refuge. The timeline for holding a lease sale given by both agency officials and Alaska's congressional delegation is very fast. The stated goal is to hold a lease sale by the summer of 2019.[29] A recent statement by Senator Lisa Murkowski illustrates why the agency is moving so quickly to hold a lease sale: "They are working fairly and aggressively to put in place, to lay the groundwork for what comes next . . . because once you get those leases out into the hands of those who can then move forward, it's tougher to throw the roadblocks in place."[30] Based on statements by the administration and Alaska's Congressional delegation, it is clear that the goal is to hold a lease sale before any potential change in administration.[31] Creating a timeline based on blatant political considerations is patently unreasonable.

Recently issued Executive Order 13807 and DOI Secretarial Order 3355 seek to speed up and slim down the National Environmental Policy Act (NEPA) review and process. Such limits

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[28] *See infra* Part VI.E.1.

[29] *See* Bureau of Land Management, Scoping Meeting Boards, Board 6 (setting out project timeline and showing a Record of Decision being signed in the spring/summer of 2019), *available at*: https://eplanning.blm.gov/epl-front-office/projects/nepa/102555/145749/179458/Coastal_Plain_Scoping_Boards.pdf; *see also* Ben Lefebvre, *ANWR Oil Lease Sale Could Start Early Next Year*, POLITICOPRO, Mar. 14, 2018; Michael Doyle, *Assistant Secretary Says Department Is Open for Business*, E&E NEWS, Mar. 14, 2018 [hereinafter Doyle]; Alan Bailey, *Interior plans to begin environmental review for lease sale in 1002 area*, PETROLEUM NEWS, Mar. 18, 2018 [hereinafter Bailey].

[30] Hobson II, *supra*.

[31] Margaret Kriz Hobson, *Road map for ANWR drilling gets clearer*, E&E News, Mar. 12, 2018 ("There is a strong commitment to work with us to get these leases out before the end of this term.").

are inappropriate for many projects in Alaska, where affected communities are geographically dispersed, there are long subsistence gathering seasons, and projects and their environmental impacts are often complex. It is particularly inappropriate for an oil and gas program for the Coastal Plain.

The Secretarial Order imposes limitations for environmental impact statements (EIS) for all DOI projects, including a page limit of 150 pages, with the exception of a 300-page maximum for “unusually complex projects.” Approval from high-level agency officials is required prior to going over these limits.[32] These arbitrary page limits are unrealistic, as the majority of EISs are well over 300 pages in length because of the need to evaluate the project and its impacts as required by law. The purpose of an EIS is to “provide full and fair discussion of significant environmental impacts and [to] inform decision makers and the public of the reasonable alternatives which would avoid or minimize adverse impacts or enhance the quality of the human environment.”[33] An oil and gas program for the Coastal Plain is unprecedented and has a huge scope of potential impacts and other issues that BLM needs to take into consideration, as BLM must consider all of the impacts from all phases of oil and gas activities.[34] Adhering to arbitrary limits will lead to less transparency in the analysis, more mistakes, and missing key data and analysis. It is inappropriate for BLM to adhere to these limits when it comes to a project of this scale.

Further, the Secretarial Order adds a target to complete all NEPA reviews within one year. The Deputy Secretary indicated that the agency will follow the arbitrary timeline of one year to meet the directive given in Secretarial Order 3355.[35] To achieve this arbitrarily-imposed timeline, the order mandates that much of the work on developing the EIS be completed prior to the NOI being published. The Council on Environmental Quality (CEQ) recognizes that “universal time limits for the entire NEPA process are too inflexible” and agencies should base timing for NEPA analyses as “appropriate to individual actions.”[36] The proposed project must consider input from a variety of federal, state and local agencies as well as tribes and many local

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[32] Office of the Deputy Secretary of the Interior, Memo re: Additional Direction for Implementing Secretary’s Oder 3355 (Apr. 27, 2018) (further explaining the one-year timeline and page-limit requirements and outlining how the Deputy Secretary expects agencies to comply, and setting out proposed page limits and a timeline).

[33] 40 C.F.R. § 1502.1.

[34] *See infra* Part VI.E.1.

[35] Secretary of the Interior, Order No. 3355, Streamlining National Environmental Policy Reviews and Implementation of Executive Order 13807 (Aug. 31, 2017).

[36] 40 C.F.R. § 1501.8.

communities. A one-year timeline will not be sufficient time for consultation with affected tribal entities or to solicit input from remote communities that will be affected, or from the nation's public. Further, BLM will not have adequate time to do new studies to fill gaps or even fully consider existing data. This overly strict timeline limits the chance for multiple-year surveys that are needed to understand impacts to wildlife populations and habitat, surface resources, recreational use trends, economic impacts, adverse health impacts on local communities, and subsistence impacts inherent in this proposed project. We are also concerned that, if the agency is doing much of the work on the EIS prior to the public comment and engagement opportunities, BLM will have already selected its course of action and is merely going through the motions of inviting the public to participate on a preordained decision. NEPA cannot be applied in this manner. As explained by the former FWS Regional Director for the Alaska Region, "Procedural integrity, not political expedience, must drive the timeline of this unprecedented effort."[37] BLM should request a waiver for the time and page limits of Secretarial Order 3355.

B. BLM MUST COORDINATE AND CONSULT WITH ALASKA NATIVES AND TRIBES.

FLPMA, federal regulations, and BLM policy all require the agency to coordinate planning with affected Indian tribes. FLPMA requires coordinating BLM planning and resource management with tribes and tribal land resource management programs, where appropriate and consistent with federal law.[38] The Council on Environmental Quality (CEQ), in interpreting NEPA, instructed federal agencies to involve tribes early in planning processes that are likely to affect tribal interests.[39] The BLM's NEPA Manual[40] and Land Use Planning Handbook[41] further describe the agency's duty to tribes. The BLM has also adopted robust and detailed guidance on involving tribes in BLM planning "to help assure (1) that federally recognized tribal governments and Native American individuals, whose traditional uses of public land might be

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[37] Ltr. from Geoffrey Haskett, President, National Wildlife Refuge Association, to Ryan Zinke, Secretary, U.S. Dep't of the Interior (May 23, 2018).

[38] 43 U.S.C. § 1712(b)(9).

[39] 40 C.F.R. § 1501.7(a)(1).

[40] BUREAU OF LAND MANAGEMENT, BLM LAND USE PLANNING MANUAL (1601) (2000).

[41] BUREAU OF LAND MANAGEMENT, BLM LAND USE PLANNING HANDBOOK (H-1601-1) (2005).

affected by a proposed BLM action, will have sufficient opportunity to contribute to the decision, and (2) that the decision maker will give tribal concerns proper consideration."[42]

DOI and BLM must also adhere to the requirements found in Executive Order 13175, Consultation and Coordination with Indian Tribal Governments.[43] It is critically important to honor the government-to-government relationship with all tribal entities that may be affected by leasing on the Coastal Plain, meaning all tribes that rely upon the Coastal Plain's resources for subsistence. There has been a lack of early tribal involvement in the design of a process that would meaningfully involve all tribal interests, including the Gwich'in, who have strong cultural, spiritual, and subsistence ties to the Coastal Plain and the health of the Porcupine Caribou Herd. DOI and BLM need to engage appropriate tribal members in all future steps the agencies plan to take, and ensure effective communication and informed Federal decision making that takes tribal concerns into consideration.

The BLM must adhere to these mandates to coordinate with and consult with tribes. BLM must take a broad and inclusive approach in doing so. Many tribes and Alaska Natives could be affected by an oil and gas program on the Coastal Plain, even if the tribe or tribal members are geographically distant from the Coastal Plain. This is because in Alaska, subsistence use regions span large geographic areas and subsistence resources include many migratory species like caribou and waterfowl.

The Gwich'in people live in fourteen small villages scattered across a vast area extending from northeast Alaska to the northern Yukon and Northwest Territories in Canada. It is unclear which communities have been contacted by BLM for consultation. Though the Inupiat community of Kaktovik is the only community located on the Coastal Plain, other villages such as Arctic Village, Fort Yukon, Venetie, Chalkyitsik, Beaver, and Canadian villages such as Old Crow and Fort McPherson, are located within the range for the Porcupine Caribou Herd and will be impacted by any oil and gas activities on the Coastal Plain.[44] All of these villages should be

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[42] BUREAU OF LAND MANAGEMENT, GENERAL PROCEDURAL GUIDANCE FOR NATIVE AMERICAN CONSULTATION (H-8120-1) (2004) at I-1.

[43] *See* Executive Order EO 13175, Consultation and Coordination with Indian Tribal Governments (Nov. 6, 2000).

[44] Gwich'in Steering Committee, Primary Habitat of the Porcupine Caribou Herd Map, *available at*: http://ourarcticrefuge.org/wp-content/uploads/2012/10/mappch.pdf.

contacted for government-to-government consultation. Likewise, DOI should contact and hold hearings for scoping and on the Draft EIS in all villages that desire a hearing.[45] Limiting public participation and public comment to only the submission of written comments may unfairly exclude and limit the ability of tribal entities and individuals to fully participate in this process, as some individuals such as elders may be limited in their ability to provide written comments or even verbal comments in the absence of a translator. It is also inappropriate for BLM to limit the length of public comment periods when tribal entities ask for additional time. The reality in Alaska is that subsistence and other activities may make it difficult for individuals to fully participate and engage during short timeframes and during certain times of the year. BLM should accommodate requests for additional time to ensure that tribal entities are able to fully engage in this important process. BLM should also grant any additional requests by affected tribes for cooperating agency status under NEPA.[46] Tribes have significant special expertise that makes them particularly suited to serve as cooperating agencies.

C. BLM MUST PROPERLY DEFINE THE SCOPE OF THE EIS AND ADDRESS AND RESOLVE NUMEROUS LEGAL ISSUES PRIOR TO LEASING.

In its Notice of Intent to Prepare an Environmental Impact Statement for the Coastal Plain Oil and Gas Leasing Program, Alaska,[47] BLM stated that it was "undertaking a Coastal Plain Oil and Gas Leasing EIS to implement the leasing program pursuant to the Tax Act (Pub. L. 115-97, Dec. 22, 2017)." According to the NOI, the EIS "will inform BLM's implementation of the Tax Act" and "may also inform post-lease activities, including seismic and drilling exploration, development, and transportation." BLM specifically identified that the EIS will "consider and analyze" various leasing alternatives (areas to lease, stipulations and best management practices (BMPs) for leases and subsequent activities) and the 2,000-acre restriction in the Tax Act.[48] The NOI identified five criteria for development of the EIS: (1) it will consider all Federal lands, (2) it will address oil and gas leasing, (3) the Tax Act mandates at least two

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[45] Gwich'in Steering Committee, Primary Habitat of the Porcupine Caribou Herd Map, *available at*: http://ourarcticrefuge.org/wp-content/uploads/2012/10/mappch.pdf.
[46] *See* 40 C.F.R. § 1501.6; 43 C.F.R. § 1601.0-5(d)(2).
[47] 83 Fed. Reg. 17562 (Apr. 20, 2018) [hereinafter NOI].
[48] NOI, 83 Fed. Reg. 17562.

lease sales of at least 400,000 acres based on the highest hydrocarbon potential,[49] (4) subsistence use and resources and the requirements under ANILCA section 810 to avoid and minimize any impacts on subsistence, and (5) "surface management of the Coastal Plain."[50] According to the NOI, on-the-ground activities will not be authorized by the record of decision for this EIS; additional analysis and permits and authorizations will be required. As set out, these issues to be addressed are too narrow. As explained below, there are numerous legal questions and considerations that BLM, DOI, and FWS must address in this process that are critical to resolve before a lease sale takes place or any activities are authorized.

The NOI also creates much confusion about what BLM is considering and analyzing, how this evaluation will relate to subsequent activities and how it will evaluate resources on the Coastal Plain. DOI and BLM must be absolutely clear about what the agency is evaluating and what activities could be authorized based on the EIS. As explained below, the proper scope of the EIS is broad, covering all oil and gas activities that follow from the Tax Law's provisions, including those on non-federal lands, and through all phases, and all associated impacts.[51]

1. BLM Must Consider Refuge Law and Policy in Developing an Oil and Gas Program.

The Coastal Plain is part of the Arctic National Wildlife Refuge, the largest and wildest unit of the National Wildlife Refuge System. In developing the EIS, BLM and FWS must pay particular attention to refuge law and polices that govern both the Arctic Refuge specifically and the National Wildlife Refuge System more broadly. This includes addressing the conservation purposes of the Arctic Refuge, Refuge System management laws and policies, and the management role of FWS.

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[49] There is an ongoing dispute between the State of Alaska and BLM concerning the western boundary of the Arctic Refuge. *Appeal of the State of Alaska*, IBLA No. 2016-109, 2017-55.

[50] *Id*.

[51] *See infra* Part VI.E.

a. BLM Must Acknowledge the U.S. Fish and Wildlife Service's Role as the Primary Management Agency of the Coastal Plain

The U.S. Fish and Wildlife Service is the management agency for the entire Arctic Refuge. Under the National Wildlife Refuge System Administration Act (NWRAA), FWS is the agency tasked with managing all refuges in the national wildlife refuge system, including the Arctic Refuge.[52] While the Tax Act instructed that the Secretary, acting through the BLM, will establish and manage the oil and gas program on the Coastal Plain,[53] the legislation did not otherwise alter or supplant the FWS management role and obligations for the Coastal Plain or for the entire Arctic Refuge. FWS is the science and resource expert for the Arctic Refuge and the Coastal Plain. The Secretary cannot abdicate any management authority to the BLM beyond the limited role provided for in the Tax Act to establish and manage an oil and gas program in the Coastal Plain.[54] BLM must appropriately acknowledge the FWS's lead role in Coastal Plain and Arctic Refuge management. The EIS must also fully take into account FWS's obligations to manage the resources of the Coastal Plain and the Arctic Refuge under ANILCA, the NWRAA, the Wilderness Act, the Marine Mammal Protection Act, and other applicable laws, policies, and treaties and demonstrate how a leasing program will satisfy these obligations.[55]

b. BLM Must Address the Original Conservation Purposes of the Arctic Refuge.

Prior to the passage of the tax bill, there were seven articulated purposes for the Coastal Plain: those from the original 1960 Range designation and the additional four added by ANILCA.[56] Those seven purposes include (1) preserving wildlife values, (2) preserving wilderness values, (3) preserving recreation values, (4) conserving fish and wildlife and habitat, (5) meeting international treaty obligations regarding fish, wildlife, and habitat, (6) continuing to

[52] 16 U.S.C. § 668dd(a)(1); ANILCA § 304(a).
[53] Pub. L. 115-97, Title II, sec. 20001(a)(2), (b)(2)(A), (3).
[54] *Trustees for Alaska v. Watt*, 524 F. Supp. 1303, 1309–10 (D. Alaska 1981).
[55] *See infra* Part V.C.1.b. In this capacity, FWS should approve all Refuge activities, including oil and gas activities.
[56] ANILCA §§ 303, 305; CCP Final EIS, Chapter 1 at 1-21.

provide for subsistence, and (7) protecting water quantity and quality needed to meet fish, wildlife, and habitat needs.[57]

The Tax Act added an additional purpose for the Coastal Plain: "to provide for an oil and gas program on the Coastal Plain."[58] Including an oil and gas program as a statutory purpose of a national wildlife refuge is unprecedented and on its face in conflict with the purposes of the Refuge System as a whole. No other national wildlife refuge in our nation has oil and gas as a statutory purpose. It is important to note that the Tax Act did not provide priority for the oil and gas purpose over any of the pre-existing purposes. Accordingly, FWS policy instructs that the oil and gas purpose of the Coastal Plain is subservient to the seven conservation purposes. FWS policy's manual states the following regarding refuges with multiple purposes and priority of purposes:

> **1.15 If a refuge has multiple purposes, do some purposes take priority over others?** Purposes dealing with the conservation, management, and restoration of fish, wildlife, and plants and the habitats on which they depend take precedence over other purposes in the management and administration of a refuge unless otherwise indicated in the establishing law, order, or other legal document. The Improvement Act states that "compatible wildlife-dependent recreational uses are the priority general public uses of the System and shall receive priority consideration in refuge planning and management."[59]

Consistent with this policy, the EIS must recognize that the seven conservation purposes are the priority purposes for the Coastal Plain and BLM must address how these existing purposes will continue to be met. In its analysis, the EIS must specifically evaluate whether the existing purposes will be met by each alternative, and must demonstrate based on a factual record, not conjecture, that the conservation purposes can indeed be met. This will require a rigorous analysis of any stipulations, best management practices, or other proposed measures

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[57] PLO 2214 at 1; ANILCA § 303(2)(B). There are numerous other purposes that apply as well from broader management statutes and policies, like the National Wildlife Refuge Administration Act and the Wilderness Act.

[58] Pub. L. 115-97, Title II, sec. 20001(b)(2)(B)(iii).

[59] U.S. Fish and Wildlife Service, 601 FW 1, 1.15, National Wildlife Refuge System Mission and Goals and Refuge Purposes (July 26, 2006), *available at:* https://www.fws.gov/policy/601fw1.html. Congress is presumed to know these policies when it passes laws.

relied upon to avoid, minimize, mitigate, or compensate for harm. Moreover, as described further below, BLM must engage with the FWS in that analysis. A thorough analysis of the impacts of an oil and gas program based on up-to-date science will likely demonstrate that an oil and gas program is irreconcilable with these conservation purposes.

c. DOI must Address the Refuge Compatibility Mandate and Refuge Management Policies.

Compatibility is a cornerstone of refuge management.[60] Section 304(b) of ANILCA adopted the compatibility standard for refuges in Alaska. The compatibility requirement obliges FWS to determine whether proposed "uses are compatible with the major purposes for which such areas were established."[61] FWS policy describes a "compatible use" as "[a] proposed or existing wildlife-dependent recreational use or any other use of a national wildlife refuge that, based on sound professional judgment, will not materially interfere with or detract from the fulfillment of the National Wildlife Refuge System mission or the purposes of the national wildlife refuge."[62] "Refuge use" is defined as "[a] recreational use (including refuge actions associated with a recreational use or other general public use), refuge management economic activity, or other use of national wildlife refuge by the public or other non-National Wildlife Refuge System entity."[63]

In the development of the CCP for the Arctic Refuge, FWS developed and issued numerous compatibility determinations for uses.[64] Existing compatibility determinations for the Arctic Refuge cover various activities, including subsistence activities, recreational activities like hunting and fishing, and wildlife observation. DOI and FWS must address how they will apply the compatibility requirements to uses associated with an oil and gas program. In doing so, the agencies must consider and make mandatory any stipulations required to ensure that the use is compatible with Coastal Plain purposes. Relatedly, DOI should address how it will ensure that any oil and gas program is consistent with FWS's Biological Integrity, Diversity, and

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[60] 16 U.S.C. § 668dd(d).
[61] *Id.* § 668dd(d)(1)(A).
[62] U.S. Fish and Wildlife Service, Compatibility, 603 FW 2, 2.6.B. A (Nov. 17, 2000), *available at*: https://www.fws.gov/policy/603fw2.html.
[63] 603 FW 2 2.6.Q.
[64] CCP Final EIS at Appendix G.

Environmental Health Policy.[65] This policy was adopted to ensure that the refuge system mission is met and individual refuge purposes achieved.

2. BLM Must Explain How It Intends to Administer a Lease Sale and Oil and Gas Program Consistent with Existing Legal Obligations.

There are important legal obligations — statutory, regulatory, policy, and treaty based — that DOI must adhere to before it can consider leasing any portion of the Coastal Plain. The Tax Act did not waive any environmental laws. During the short legislative process to adopt the bill, Senator Lisa Murkowski, section 20001 of the Tax Law's sponsor, made multiple statements that no laws would be shortcut or environmental reviews truncated.[66] BLM must ensure that every law is fully complied with.

In defining the scope of the EIS and evaluating the impacts of oil and gas activities as required by NEPA, BLM must describe how it plans to implement a leasing program that complies with all laws and policies meant to ensure protection and conservation of the land and resources of the Coastal Plain and its place in the public lands systems of the United States. These laws include, but are not limited to: ANILCA and its regulations,[67] the Naval Petroleum Reserves Production Act (NPRPA) and its regulations,[68] the Federal Land Policy and

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[65] U.S. Fish and Wildlife Service, Biological Integrity, Diversity, and Environmental Health, 601 FW 3 (Apr. 16, 2001), *available at*: https://www.fws.gov/policy/601fw3.html.

[66] Chairman Lisa Murkowski, Opening Statement, Full Committee Reconciliation Markup, U.S. Senate Committee on Energy and Natural Resources (Nov. 15, 2017) ("I think it's also important to understand that we have not preempted the environmental review process in this legislation. We have not preempted the environmental review, nor have we limited the consultation process with Alaska Natives in any way. All relevant laws, all regulations, and executive orders will apply under this language."), available at: https://www.energy.senate.gov/public/index.cfm/files/serve?File_id=5B08FB7E-B82C-488F-9627-D78DEAF2EBC1, *see also* Cong. Rec. S7697 (daily ed. Dec. 1, 2017) (statement of Sen. Carper stating that Senator Murkowski "assured members of the committee that, if the legislation became law, it would require such development be subject to the full scope of environmental review required by the National Environmental Policy Act, or NPEA, as well as other environmental laws. Indeed, earlier in this floor debate, the Senator from Alaska reiterated an assurance that the environmental and local wildlife will always be a concern and a priority and that this legislation does not waive NEPA or any other environmental law.")).

[67] *See supra* Part V.C.1.b.

[68] 42 U.S.C. § 6501, et seq.

Management Act (FLPMA) and its regulations, the NWRAA and regulations,[69] the Endangered Species Act, the Marine Mammal Protection Act, the Migratory Bird Treaty Act, the Bald and Golden Eagle Protection Act, and other applicable statutes and regulations concerning oil and gas programs on federal public lands, and in national wildlife refuges and preservation systems. These laws impose both substantive and procedural requirements on actions and activities for the Coastal Plain and the land, wildlife, water, and other resources, and each must be addressed. Where there is potential conflict, BLM must explain how it is resolving that conflict and ensure that conservation mandates are met.

Described below are four species-specific laws that must be complied with. Additional relevant legal obligations like ANILCA, NWRAA, and the National Historic Preservation Act are describe elsewhere.

a. The Oil and Gas Program Must Comply with the Marine Mammal Protection Act.

Many marine mammals protected by the Marine Mammal Protection Act (MMPA)[70] use coastal and nearshore waters of the Arctic Refuge, including spotted, ringed, and bearded seals; beluga and bowhead whales; and polar bears.[71] Under the MMPA, it is unlawful to "take," or "harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal."[72] An activity that has the potential to incidentally take a small number of marine mammals may be permitted by regulation if it will have no more than a "negligible impact on the species or stock and will not have an unmitigable adverse impact on the availability of such species or stock for taking for subsistence uses."[73] Oil and gas activities on the Coastal Plain may result in the taking of protected marine mammals. The National Marine Fisheries Service has not issued incidental take regulations for taking of seals and whales on or near the Refuge by oil and gas

[69] *See supra* Part V.C.1.
[70] 16 U.S.C. §§ 1361–1407.
[71] U.S. Fish and Wildlife Service, Arctic National Wildlife Refuge, Mammal List, *available at*: https://www.fws.gov/refuge/arctic/mammlist.html.
[72] 16 U.S.C. §§ 1362(13), 1372(a).
[73] 16 U.S.C. § 1371(a)(5).

development.[74] FWS has issued incidental take regulations for the taking of polar bears and walruses by oil and gas activities in the Beaufort Sea and along the coast, but these regulations exclude and do not take into consideration potential oil and gas activities in the Arctic Refuge.[75] Thus, there is currently no MMPA authorization for oil and gas activities in the Arctic Refuge. BLM must address how it will ensure compliance with the MMPA for the oil and gas program.

b. The Oil and Gas Program Must Comply with the Endangered Species Act.

Several species protected under the Endangered Species Act (ESA)[76] inhabit the Arctic Refuge and its nearshore waters, including bowhead whales, ringed and bearded seals, spectacled eider, and polar bears.[77] Threatened polar bears den on the Coastal Plain and are using it with increasing frequency for other activities. The majority of the Coastal Plain (approximately 77 percent) is designated as critical habitat for the species.[78] Under the ESA, BLM has a duty to ensure "that any action authorized, funded, or carried out by [BLM] is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of [critical habitat]."[79] BLM cannot authorize any action that may affect a protected species or its designated critical habitat without first consulting with either FWS (for polar bears and spectacled eider) or the National Marine Fisheries Service (for whales and seals). BLM must address how it will ensure compliance with the ESA for the oil and gas program.

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[74] *See* NOAA Fisheries, Incidental Take Authorization for Oil and Gas, *available at*: https://www.fisheries.noaa.gov/national/marine-mammal-protection/incidental-take-authorizations-oil-and-gas.

[75] 81 Fed. Reg. 52276 (Aug. 5, 2016).

[76] 16 U.S.C. § 1531 *et seq*.

[77] *See* U.S. Fish and Wildlife Service, Arctic National Wildlife Refuge, Mammal List, *available at*: https://www.fws.gov/refuge/arctic/mammlist.html; U.S. Fish and Wildlife Service, Arctic Refuge, Bird List, *available at:* https://www.fws.gov/refuge/arctic/birdlist.html; *see also* 35 Fed. Reg. 18319 (Dec. 1, 1970) (bowhead whale listing); 77 Fed. Reg. 76706 (Dec. 28, 2012) (ringed seal listing); 77 Fed. Reg. 76740 (bearded seal listing); 73 Fed Reg. 28212 (May 15, 2008) (polar bear listing); 58 Fed Reg. 27474 (May 10, 1993) (spectacled eider listing).

[78] 75 Fed. Reg. 76086 (Dec. 7, 2010).

[79] 16 U.S.C. § 1536(a)(2).

c. The Oil and Gas Program Must Comply with the Migratory Bird Treaty Act.

BLM must comply with the Migratory Bird Treaty Act (MBTA) in the development of the oil and gas program for the Coastal Plain.[80] More than 200 bird species found on the Arctic Refuge are migratory birds protected under the MBTA.[81] Congress enacted the MBTA in 1918 to implement a 1916 convention with Canada to protect migratory birds.[82] The United States later signed three more bilateral conventions with Mexico, Japan, and Russia to protect migratory birds.[83] After each convention, Congress amended the MBTA to cover the species addressed in the new convention. The MBTA makes it unlawful "at any time, by any means or in any manner, to pursue, hunt, take, capture, kill, attempt to take, capture, or kill, [or] possess . . . any migratory bird" unless otherwise permitted by regulation.[84] Any oil and gas activities that take or kill migratory birds on the Coastal Plain without authorization would violate the MBTA.[85] BLM must address how it will ensure compliance with the MBTA for an oil and gas program on the Coastal Plain, in particular with regards to the identification of the tracts to offer for lease.

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[80] 16 U.S.C. §§ 703–712.

[81] *See* U.S. Fish and Wildlife Service, Arctic National Wildlife Refuge, Bird List, *available at*: https://www.fws.gov/refuge/arctic/birdlist.html.

[82] Convention between United States and Great Britain for the Protection of Migratory Birds, 39 Stat. 1702 (Aug. 16, 1916) (Canada Convention); *see also infra* Part V.G.3.

[83] Convention for the Protection of Migratory Birds and Game Mammals, 50 Stat. 1311 (Feb. 7, 1936) (Mexico Convention); Convention for the Protection of Migratory Birds and Birds in Danger of Extinction, and Their Environment, 25 U.S.T. 3329, T.I.A.S. No. 7990 (Mar. 4, 1972) (Japan Convention); Convention Concerning the Conservation of Migratory Birds and Their Environment, T.I.A.S. No. 9073 (Russia Convention).

[84] 16 U.S.C. § 703.

[85] The recent contrary M-Opinion (M-37050) conflicts with the longstanding Department of the Interior interpretation and multiple circuit court rulings on application and enforcement of the MBTA. *See* Solicitor Opinion M-37041, "Incidental Take Prohibited Under the Migratory Bird Treaty Act" (Jan. 10, 2017).

d. The Oil and Gas Program Must Comply with the Bald and Golden Eagle Protection Act.

Both bald eagles and golden eagles occur in the Refuge, including on the Coastal Plain.[86] Golden eagles are described as a "[c]asual visitor [on the] coastal plain."[87] Both species are protected under the Bald and Golden Eagle Protection Act (BGEPA).[88] Project proponents must apply for a permit for any activities that might take or disturb eagles.[89] BLM lands are important to bald eagle persistence.[90] FWS has developed national guidelines for managing bald eagles.[91] The BLM must assess whether and how leasing and oil and gas development on the Coastal Plain might affect eagles. Although written for renewable energy development, a current BLM instruction memorandum on implementing BGEPA would be useful guidance for the current planning process, including a recommendation that the BLM coordinate with FWS.[92]

D. BLM MUST EXPLAIN HOW IT INTENDS TO ADMINISTER AN OIL AND GAS PROGRAM AND LEASE SALE CONSISTENT WITH DIRECTIVES IN THE TAX ACT.

BLM must also explain how it will interpret and administer an oil and gas program and hold a lease sale in light of specific directives in the Tax Act. These directives include the requirement to manage the oil and gas program similar to BLM's management of the National Petroleum Reserve in Alaska (NPRA) under the Naval Petroleum Reserves Production Act (NPRPA), the "2,000-acre limitation" on surface development, and the right-of-way provision.

1. BLM Must Address Multiple Elements of Administering an Oil and Gas Program and Lease Sales "Similar to" Those Under the NPRPA and Its Regulations.

The Tax Act directs the Department of Interior to "manage the oil and gas program on the Coastal Plain in a manner similar to the administration of lease sales under the Naval Petroleum Reserves Production Act of 1976 (42 U.S.C. 6501, et seq.) (including regulations)."[93] This

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[86] CCP Final EIS, Append. F, at F-4–F-5.
[87] *Id.* at F-5.
[88] 16 U.S.C. §§ 668–668c.
[89] 50 C.F.R. §§ 22.1–22.32.
[90] 72 Fed. Reg. 37361.
[91] U.S. Fish and Wildlife Service (2007) National Bald Eagle Management Guidelines.
[92] Bureau of Land Management, California State Director. Bald and Golden Eagle Protection Act – Take Permit Guidance for Renewable Energy. Instruction Memorandum, IM-CA-2013-030. (Jul. 25, 2013).
[93] Pub. L. 115-97, Title II, sec. 20001(b)(3).

direction guides both the manner in which BLM can proceed to leasing as well as the approach the agency must take in structuring an oil and gas program. Additionally, BLM should explain in the EIS its interpretation as to what regulatory framework(s) will govern the various phases of an oil and gas program and how BLM will apply those frameworks to the Coastal Plain. BLM should also explain what additional regulatory authorities it believes are necessary for an oil and gas program on the Coastal Plain and outline what steps it may take to adopt any necessary regulations, such as engaging in formal rulemaking.

a. BLM must not conflate the NEPA process with the NPRPA-specific lease sale process, and must provide opportunities for public input at each stage.

Under the Tax Act, BLM has to manage the oil and gas leasing program similar to how it manages leasing in the NPRA under the NPRPA. BLM has indicated that it may publish a call for lease sale nominations and public comment on the lease sale at the same time that it publishes the draft EIS for the leasing program. BLM would then issue the lease sale notice for the first lease sale at the same time that it issues a record of decision for the leasing EIS.[94] This process is inconsistent with how BLM interprets and applies the NPRPA and its regulations in the NPRA, where the agency approaches the development of the programmatic plan and individual lease sales as two distinct steps. It is also inconsistent with how Senator Lisa Murkowski, the sponsor for Title II of the Tax Act, explained the leasing process contained in the bill, where she outlined that these would occur as distinct steps.[95]

For the NPRA, BLM develops a programmatic EIS called an Integrated Activity Plan (IAP), finalizing that document and completing the NEPA process prior to beginning the lease-

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[94] U.S. Department of the Interior, Bureau of Land Management, Frequently Asked Questions, *available at*: https://eplanning.blm.gov/epl-front-office/eplanning/planAndProjectSite.do?methodName=dispatchToPatternPage&currentPageId=152117 (last visited April 19, 2018).

[95] *See Business Meeting to Consider Reconciliation Legislation*, 115th Cong. at 1:04:44-1:05:37, remarks of Sen. Murkowski, Chairmen, U.S. Senator Committee on Energy & Natural Resources (Nov. 15, 2017) (explaining that first an IAP is developed, than there's a leasing process, followed by later phases of oil and gas, and there is environmental review and public participation at each step), *available at*: https://www.energy.senate.gov/public/index.cfm/hearings-and-business-meetings?ID=5AB53058-9594-4A00-8F0F-AF559530A32E.

sale specific process and holding a lease sale.[96] At a minimum, the agency should engage in a programmatic planning process for leasing in the Coastal Plain together with any necessary draft regulations, and only once that process is complete, conduct a lease-sale-specific process for determining when, where, and whether to hold lease sales. These processes ask different questions and make different decisions. Both require NEPA review and full public participation. We note that the development of the programmatic IAP and the lease-sale specific process for the first lease sale after the IAP was adopted took approximately three years and three months, well within the four-year timeframe allotted in the tax act for holding the first lease sale in the Coastal Plain.[97] Further, BLM will need to survey the boundaries for the tracts contemplated for lease before it can issue a Call for Nominations, and must account for this in its timelines for leasing, as well as analyze potential impacts from survey crews in the EIS. In sum, incorporating the lease-sale specific process into the programmatic leasing EIS is inadequate and inconsistent with how BLM has and currently conducts the leasing program in the NPRA.

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[96] U.S. Department of the Interior, Bureau of Land Management, National Petroleum Reserve-Alaska, Integrated Activity Plan, Record of Decision (Feb. 21, 2013); Department of the Interior, Bureau of Land Management, Call for Nominations and Comments for the 2013 National Petroleum Reserve in Alaska Oil and Gas Lease Sale, 78 Fed. Reg. 33103 (June 3, 2013); *see* also National Petroleum Reserve-Alaska, Final Integrated Activity Plan/Environmental Impact Statement at iv, 9–10 9 (explaining the multi-step process for adopting a leasing-program IAP and holding a lease sale); *see also* U.S. Department of Interior, Bureau of Land Management, Anchorage, Alaska, Northeast National Petroleum Reserve-Alaska, Final Supplemental Integrated Activity Plan/Environmental Impact Statement at ES-7 (May 2008) (noting that after completing the leasing EIS, the BLM "may conduct one or more lease sales in the planning area"); U.S. Department of the Interior, Bureau of Land Management, Northwest National Petroleum Reserve-Alaska, Final Integrated Activity Plan/Environmental Impact Statement at I-9–I-10 (Nov. 2003) (noting that the lease sale will be held after the ROD is issued).

[97] *See* Department of the Interior, Bureau of Land Management, Notice of Intent to Prepare an Integrated Activity Plan and Environmental Impact Statement for the National Petroleum Reserve-Alaska, 75 Fed. Reg. 44277 (July 28, 2010); Bureau of Land Management, NPR-A Sale 2013 Bid Recap (Nov. 6, 2013), *available at*: https://www.blm.gov/sites/blm.gov/files/uploads/Oil_Gas_Alaska_2013_NPR-A_Bid_Recap_v2.pdf.

b. BLM must consider the protection of other values in determining where and how to lease in the Coastal Plain.

BLM's programmatic planning document must consider a broader range of oil and gas management considerations not limited to evaluating leasing. For example, in the NPRA, BLM describes the IAP's function and approach for protecting its values:

> Taken together, the provisions of the plan provide important protections for areas critical to numerous subsistence species - calving and insect relief areas of both caribou herds; riverine, lake, and coastal fish habitat; nesting and breeding areas for tens of thousands of birds; and bays, inlets, and coastlines important for marine mammals - as well as the coastal waters and river routes critical for North Slope residents to access hunting, fishing, berry picking, and trapping grounds.[98]
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> To provide protections in the NPRA pursuant to the NPRPA, BLM:
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> - manages some areas to protect surface resources as a priority;
> - designates some areas as "unavailable for leasing or exploratory drilling";
> - designates some areas as "unavailable for leasing and no new non-subsistence infrastructure or exploratory drilling";
> - commits to "protecting critical areas for sensitive bird populations from all seven continents and for the roughly 400,000 caribou";
> - commits to "manage twelve rivers or river segments to protect their free flow, water quality, and outstandingly remarkable values"; and
> - provides Best Management Practices to avoid and minimize impacts to subsistence.

BLM should consider these and other management approaches and surface protection provisions as part of a larger oil and gas planning process for the Coastal Plain. Additionally, NEPA and the NPRPA require BLM to evaluate mitigation as part of this EIS and any leasing program. Protective measures must include the full range of mitigation options, including required and unwaivable best management practices (BMPs), stipulations, and required operating procedures (ROPs), as well as other avoidance, minimization, and compensatory mitigation measures. These measures must account for the exceptional surface biological values and resources of the Coastal Plain, ensure their protection, and be based on updated information and scientific data.

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[98] BLM IAP ROD at iv.

c. BLM Must Address How It Will Administer Lease Sales and an Oil and Gas Program Taking Into Account the 2,000-Acre Limitation and Right-of-Way Directives in the Tax Act.

In setting out the legal framework and obligations that BLM must satisfy, the agency must explain how it interprets the 2,000-acre limitation on surface development in the Tax Act and how it will address and apply this limitation on surface activities.[99] In the proceedings leading up to bill passage, this provision was described as providing a cap on all surface development on the Coastal Plain.[100] BLM must also explain how it interprets this limitation to apply to the private lands on the Coastal Plain (i.e., the KIC/ASRC lands and Native Allotments). BLM must also clearly list all of the structures and facilities that will fall under this limit and those that will not. The agency must explain, in detail, what mechanism it will adopt (including regulations and lease provisions) to ensure that the agency has the ability to regulate surface development to keep any development below this cap, as well as the enforcement authority available to the agency to ensure compliance if development begins.

Fully addressing this mandate and accounting for all phases of oil and gas activities and development in doing so is important given that oil and gas resources, to the extent that there are any, are likely to be unevenly distributed throughout the Coastal Plain, potentially leading to a high number and dispersed distribution of fields.[101] Addressing this limitation requires BLM to consider a broad spectrum of possible restrictions on facilities and ground-disturbing activities that it could impose under the limitation and ensure that it is issuing leases that provide the agency the authority to impose any necessary restrictions to comply with the 2,000-acre limitation whenever specific activities are proposed and approved. BLM should also consider whether it must adopt regulations to implement this provision.

The Tax Act also states that the "Secretary shall issue any rights-of-way or easements across the Coastal Plain for the exploration, development, production, or transportation necessary

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[99] Pub. L. 115-97, Title II, section 20001(c)(3).

[100] Chairman Lisa Murkowski, Opening Statement, Full Committee Reconciliation Markup, U.S. Senate Committee on Energy and Natural Resources (Nov. 15, 2017) ("We have also limited surface development to just 2,000 federal acres."), *available at*: https://www.energy.senate.gov/public/index.cfm/files/serve?File_id=5B08FB7E-B82C-488F-9627-D78DEAF2EBC1.

[101] CCP Final EIS at Chapter 4, 4-35–4-36; *see also infra* Part VI.E.1–2.

to carry out this section."[102] The BLM must explain how it will address and apply the rights-of-way provision in the Tax Act**,** particularly in light of other statutory obligations for rights-of-way under ANILCA Title XI, and FLPMA.

E. BLM MUST CONSIDER A NO-ACTION ALTERNATIVE AND PROTECTIVE ALTERNATIVES.

The EIS must "[r]igorously explore and objectively evaluate all reasonable alternatives[.]"[103] The alternatives requirement is "the heart" of the EIS.[104] It is vital to an agency's informed decision making, a core goal of NEPA.[105] Every alternative must be given "substantial treatment . . . in detail . . . so that reviewers may evaluate their comparative merits."[106] BLM must consider both a no-action alternative (and do so thoroughly) and a range of protective alternatives to meet its NEPA duties. To be clear, commenters do not support any action alternative.

1. BLM Must Thoroughly and Accurately Consider a No-Action Alternative.

As part of the requirement that the agency consider alternatives, NEPA and CEQ regulations mandate that the agency consider a no-action alternative in all environmental reviews.[107] The NOI states that BLM will consider various leasing alternatives.[108] To comply with NEPA, the BLM must consider a no-action alternative, i.e., a no-leasing alternative. This alternative must be based on accurate and robust baseline data and describe the exceptional values of the Coastal Plain and the importance of the area to the national wildlife refuge system and our public lands national heritage. Absent an accurate and thorough presentation of a no action alternative that reflects baseline conditions, "there is simply no way to determine what effect the proposed [action] will have on the environment, and, consequently, no way to comply with NEPA."[109] To meet BLM's NEPA obligations, consideration of the no-action alternative must be vigorous and far-reaching.

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[102] Pub. L. 115-97, Title II, section 20001(c)(2).
[103] 40 C.F.R. § 1502.14.
[104] *Id*.
[105] *Id.* § 1500.1.
[106] *Id.* § 1502.14(b).
[107] 42 U.S.C. § 4332(2); 40 C.F.R. § 1502.14(d).
[108] 83 Fed. Reg. 17,562.
[109] *Half Moon Bay Fisherman's Marketing Ass'n v. Carlucci v. Carlucci*, 857 F.2d 505, 510 (9th Cir. 1988).

2. BLM Must Consider A Range of Alternatives That Are Protective of Coastal Plain Resources, Even if Development May Be Precluded.

In addition to the no-action alternative, NEPA requires BLM to develop alternatives that avoid or minimize harm to the environment or enhance the quality of the environment.[110] BLM must therefore develop and fully analyze a robust range of alternatives that would ensure adequate protection of Coastal Plain resources and compliance with all applicable laws and policies. This includes alternatives that would potentially preclude development at later stages.

BLM should analyze a range of alternatives that would encompass both conditional and deferred leasing options. BLM must evaluate a series of heavily stipulated leasing alternatives that include a range of mandatory, non-waivable stipulations, BMPs, and ROPs. Stipulations that should be evaluated, for example, include those developed for the NPRA and other sensitive areas throughout the National Wildlife Refuge System, as well as the broader system of federal public lands that have been leased or developed, in addition to creating Coastal Plain specific prescriptions based on the unique biology and resources of the area. As part of this, BLM must consider stipulations that would ensure the agency retains full authority to deny permits for development based on site-specific considerations and analyses and clearly place the burden on the lessee to affirmatively demonstrate that values and purposes of the Refuge will not be impaired or degraded. BLM must also evaluate alternatives where development is contingent on FWS determining, among other things, that development can occur without compromising the original purposes of the Arctic Refuge. Further, BLM must analyze lease stipulation alternatives that would allow the agency to completely preclude development at later stages or confine development to very limited areas (e.g., a contiguous 2,000-acre footprint) based on concerns about impacts to resources. BLM should also consider alternatives that would forestall development of leases until such time as development would not compromise the conservation purposes of the Refuge (e.g., when leases can be developed in a manner that fully avoids adverse direct and indirect impacts to the Refuge), when economic conditions ensure that development will be cost-effective, or when critical information gaps are addressed. Commenters believe that oil and gas development in the Coastal Plain will necessarily compromise the original purposes of the Refuge and cannot rationally be reconciled with those values.

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[110] 40 C.F.R. § 1502.1; *see also Native Ecosystems Council v. U.S. Forest Serv.*, 418 F.3d 953, 965 (9th Cir. 2005).

The Tax Act leaves BLM with ample discretion to make development contingent on circumstances that may ultimately delay or preclude it. The obligations imposed by numerous other statutes require that BLM exercise its discretion in a manner consistent with all applicable legal mandates. In addition, BLM has the authority to place leases into suspension in the interest of conservation of natural resources, which can include both preventing harm to the environment and preventing loss of mineral resources and can be structured to suspend expiration of lease terms and obligations to pay rent. BLM must therefore analyze alternatives for the leasing stage that preserve and reflect its authority to preclude development. In addition to a wide range of alternatives that would condition leasing in a way that may preclude development, BLM should analyze alternatives that would defer leasing to the end of the 4-year window provided in the Tax Act to allow additional time for necessary actions to ensure compliance with all relevant legal obligations. The development of alternatives must be guided by the analysis of the cumulative impacts analysis.[111]

F. DOI Must Identify and Obtain Missing Information.

For the purpose of evaluating significant impacts in the EIS, if there is incomplete information relevant to reasonably foreseeable significant adverse impacts and the information is "essential to a reasoned choice among alternatives and the overall costs of obtaining it are not exorbitant," the information must be gathered and included in the EIS.[112] This requirement helps "insure the professional integrity, including scientific integrity, of the discussions and analyses" in an EIS.[113] It also ensures that the agency has necessary information before it makes a decision, preventing the agency from acting on "incomplete information, only to regret its decision after it is too late to correct."[114] "[T]he very purpose of NEPA's requirement that an EIS be prepared for all actions that may significantly affect the environment is to obviate the need for [ ] speculation by insuring that available data is gathered and analyzed prior to the implementation of the

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[111] *See infra* Part VI.F.
[112] 40 C.F.R. § 1502.22(a); *see also* 43 C.F.R. § 46.125.
[113] 40 C.F.R. § 1502.24.
[114] *Churchill County v. Norton*, 276 F.3d 1060, 1072–73 (9th Cir. 2001) (quoting *Blue Mountains Biodiversity Project v. Blackwood*, 161 F.3d 1208, 1216 (9th Cir. 1998)).

proposed action."[115] Accordingly, NEPA's missing information regulation "clearly contemplates original research if necessary."[116]

There is a substantial amount of baseline data missing or out of date that must be gathered and reviewed before BLM can meaningfully evaluate and comply with DOI's numerous statutory mandates for managing and protecting the Arctic Refuge and the public can fully understand the potential impacts from oil and gas activities on the Coastal Plain.[117] Additional information is required in many critical areas to fully evaluate the impacts of oil and gas activities on the Coastal Plain and to develop necessary stipulations or BMPs for leasing or subsequent oil and gas activities. These areas include, but are not limited to:

- Polar bears, including use, feeding, denning, and population distribution;[118]
- Air quality, including modeling and monitoring;[119]
- Bird usage, including breeding, staging, feeding, habitat use, population and abundance, and distribution, for raptors, resident species, migratory birds, and waterfowl;[120]
- Fish inventories and distribution;[121]
- Water resources, including water chemistry/quality information, and water quantity availability;[122]
- Snow cover and variation across terrain;[123]

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[115] *Found. for N. Am. Wild Sheep v. U.S. Dep't of Agric.*, 681 F.2d 1172, 1179 (9th Cir. 1982).

[116] *Save Our Ecosystems v. Clark*, 747 F.2d 1240, 1244 n.5 (9th Cir. 1984).

[117] *See* John M. Pearce, et al., U.S. Department of the Interior, U.S. Geological Survey, Summary of Wildlife-Related Research on the Coastal Plain of the Arctic National Wildlife Refuge, Alaska, 2002-17, Open-File Report 2018-1003 [2018 USGS Report] (2018) (providing a simply survey of current information and identifying some necessary updates or additional studies); *see also* Janet C. Jorgenson, et al., U.S. Department of the Interior, U.S. Geological Survey, Arctic Refuge Coastal Plain Terrestrial Wildlife Research Summaries, USGS/BRD/BSR-2002-0001 (2002).

[118] *See, infra* Part VI.A.2.

[119] *See infra* Part VI.B.2.

[120] *See infra* Part VI.A.4.

[121] *See infra* Part VI.A.7.

[122] *See infra* Part VI.B.1.

[123] *See infra* Part VI.B.7.

- Predator distribution within the Coastal Plain and adjacent areas, including for wolves, wolverines, brown bears, and golden eagles;[124]
- Caribou use, including calving and post-calving habitat, seasonal ranges, and migration routes, and impacts of oil and gas activities on herd behavior and population dynamics;[125]
- Cultural resources and an inventory;[126]
- Wetlands distribution and coverage, including updated mapping;[127]
- Vegetation distribution and coverage, permafrost, and soils, including updated mapping;[128]
- Human health and food security;[129]
- Acoustic and soundscape data;[130]
- Subsistence use patterns;[131] and
- The impacts on Coastal Plain resources from climate change.[132]

BLM must obtain missing and/or updated information about these issues and other issues before proceeding with the EIS. BLM needs to obtain this information to ensure it has adequate baseline information for evaluating the existing conditions and future changes to the region. Additionally, much of the existing information for the Arctic Refuge is likely out of date to due climate change; the environment and resources of the Arctic Refuge are not the same as they were 30, 20, or even 10 years ago because of climate change, and will not be the same in 5 or 10 years, or the timespan of a lease and oil and gas project. As such, even existing information may be of limited utility. Absent updated and new information, including additional missing information BLM or the public identifies, BLM cannot meaningfully evaluate the impacts of oil and gas activities, formulate or evaluate alternatives, or take necessary measures to protect important biological resources on the Coastal Plain. BLM's artificially imposed one-year timeline for EIS completion is not a sufficient basis to fail to obtain necessary missing information.

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[124] *See infra* Part VI.A.5.
[125] *See infra* Part VI.A.1.
[126] *See infra* Part VI.C.6.
[127] *See infra* Part VI.B.4, VI.B.7.
[128] *See infra* Part VI.B.4, VI.B 7.
[129] *See infra* Part VI.C.4.
[130] *See infra* Part VI.B.5.
[131] *See infra* Part VI.C.1, VII.
[132] *See infra* Part VI.D.

G. BLM Must Consider and Satisfy International Treaty Obligations

Numerous treaties govern the management of the wildlife that use and rely on the Coastal Plain, including treaties related to caribou, polar bears, and migratory birds. Fulfilling international treaty obligations is a purpose of the Arctic Refuge.[133] BLM must ensure that it complies with all treaty duties and obligations in the development of the EIS and management of an oil and gas leasing program on the Coastal Plain. It is critically important for BLM to cooperate and coordinate closely on all treaty issues with relevant government officials, agencies, and indigenous peoples — including with the FWS, the U.S. State Department, other federal and state agencies, the Canadian government, and Gwich'in representatives from both the U.S. and Canada and other affected Alaska Natives, and First Nations peoples.

1. International Porcupine Caribou Herd Agreement

The International Porcupine Caribou Herd Agreement (the Agreement) was signed in 1987 by the United States and Canada to conserve the Porcupine Caribou herd and its habitat.[134] The Agreement recognizes that "the Porcupine Caribou Herd regularly migrates across the international boundary between Canada and the United States of America and that caribou in their large free-roaming herds comprise a unique and irreplaceable natural resource of great value which each generation should maintain and make use of so as to conserve them for future generations."[135] The Agreement also recognizes that the Porcupine Caribou Herd is important for the "nutritional, cultural, and other essential needs" and for "customary and traditional uses" by Canadian First Nations and Alaska Natives.[136] The Agreement recognizes the importance of conserving habitat on an ecosystem level to the conservation of the herd, "including such areas as calving, post-calving, migration, wintering and insect relief habitat."[137] The Agreement specifically defines the herd's habitat as "the whole or any part of the ecosystem, including

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[133] ANILCA, Sec. 303(2)(B)(ii).

[134] Agreement Between the Government of Canada and the Government of the United States of America on the Conservation of the Porcupine Caribou Herd, U.S.-Can. July 17, 1987, E100687-CTS 1987 No. 31, *available at* http://www.treaty-accord.gc.ca/text-texte.aspx?id=100687.

[135] *Id.*

[136] *Id.*

[137] *Id.*

summer, winter and migration range, used by the Porcupine Caribou Herd during the course of its long-term movement patterns."[138]

The Agreement imposes multiple mandates on the two nations, including "tak[ing] appropriate action to conserve the Porcupine Caribou Herd and its habitat," a consultation opportunity if one country is going to take an action that "is determined to be likely to cause significant long-term adverse impact" on the herd or habitat, which can require mitigation, and avoidance of activities that disrupt migration or other "important behavior patterns" like calving and insect relief.[139] To meet the obligations in the Agreement, the Agreement establishes a Board that is able to make recommendations on any activities that "could significantly affect the conservation of the Porcupine Caribou Herd or its habitat."[140] The Party undertaking the action is then required to consider the Board's recommendations and respond in writing to any that it rejects.[141]

BLM must ensure that it adheres to all substantive and procedural requirements of the Agreement during the development of the leasing EIS. The EIS should explain the treaty obligations and discuss how BLM will ensure that they are met. BLM should also convene the Board on a timeline and in a manner that allows the Board to make recommendations that would inform the BLM's draft EIS.

2. Agreements on the Conservation of Polar Bears

The United States, along with Canada, Denmark (on behalf of Greenland), Norway and the Russian Federation, is a party to the 1973 Agreement on the Conservation of Polar Bears. The Agreement requires these Polar Bear Range States to take appropriate action to conserve polar bears and protect their habitat.[142] Specifically, this multilateral agreement commits each associated country to sound conservation practices by protecting the ecosystem of polar bears, with special attention to denning areas, feeding sites, and migration corridors based on best available science through coordinated research. The agreement was signed by the United States

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[138] *Id.*
[139] *Id.*
[140] *Id.*
[141] *Id.*
[142] Agreement on the Conservation of Polar Bears (Nov. 15, 1973), *available at* http://pbsg.npolar.no/en/agreements/agreement1973.html.

on November 15, 1973, in Oslo, Norway; ratified on September 30, 1976; and entered into force in this country on November 1, 1976.[143] The Polar Bear Range States approved a collaborative Circumpolar Action Plan (CAP) in 2015, which emphasizes reduction of threats (especially climate change and human caused mortality), cooperation among member parties, monitoring and adaptive management.[144] The 1973 Agreement also relies on the efforts of each party to implement a conservation plan for polar bears within their jurisdiction. The FWS Polar Bear Conservation Plan serves as the United States contribution to the CAP. Accordingly, the BLM must consider our country's international obligations under the 1973 Agreement in the EIS.

We note that the Coastal Plain of the Arctic Refuge provides very important habitat for polar bears, in particular the Southern Beaufort Sea population (SBS). The Coastal Plain has the highest density of on-shore polar bear dens found anywhere in America's Arctic, and more and more bears are using on-shore habitat as sea ice diminishes due to climate change. The EIS should address how BLM will ensure adequate coordination with Canada, Denmark, Norway, and Russia to protect polar bears that could be affected by oil and gas leasing in the Arctic Refuge Coastal Plain. Additionally, BLM should address how the proposed oil and gas leasing program and alternatives affect polar bear denning areas, feeding sites, and migration corridors, including corridors between Alaska and Canada.

The Inuvialuit Game Council and the North Slope Borough Fish and Game Management Committee signed the Inuvialuit-Inupiat Polar Bear Management Agreement in the Southern Beaufort Sea (I-I Agreement) in 1988 and reaffirmed it in 2000.[145] Polar bears harvested from the communities of Barrow, Nuiqsut, Kaktovik, Wainwright and Atqasuk are considered part of the SBS population and are thus subject to the terms of this voluntary Native-to-Native agreement between the Inupiat from Alaska and the Inuvialuit in Canada. The I-I Agreement provides for annual quotas and recommendations concerning protection of denning female polar bears, family groups and methods of harvest. Quotas are based on estimates of population size and age-specific estimates of survival and recruitment. The I-I Agreement established a Joint

[143] *Id.*

[144] Polar Bear Range States, Circumpolar Action Plan: Conservation Strategy for Polar Bear (2015) (a product of the representatives of the parties to the 1973 Agreement for the Conservation of Polar Bears (Norway, Canada, Greenland, the Russian Federation and the United States)).

[145] Inuvialuit-Inupiat Polar Bear Management Agreement in the Southern Beaufort Sea, Mar. 4, 2000.

Commission to implement it, and a Technical Advisory Committee, consisting of biologists from agencies in the U.S. and Canada involved in polar bear research and management, to collect and evaluate scientific data and make recommendations to the Joint Commission.[146] BLM must consider how an oil and gas program in the Coastal Plain and its impacts on SBS polar bears will affect the quotas and management protocols established through the I-I Agreement.

3. Migratory Bird Treaties

All bird species that utilize the Arctic Refuge, with the exception of grouse and ptarmigan, are covered by the Migratory Bird Treaty Act of 1918 (MBTA) and its amendments.[147] Key amendments to the act include the Migratory Bird Treaty with the Soviet Union of 1978 (USSR Treaty). Migratory bird management must also comply with the Convention on Nature Protection and Wild Life Preservation in the Western Hemisphere of 1940 (Convention).

The Convention and the MBTA provide a variety of management provisions relevant to the Coastal Plain that the EIS must consider, including:

- A prohibition on the disturbance of nesting colonies (USSR Treaty, Article II).
- Direction for each nation to undertake, to the maximum extent possible, measures necessary to protect and enhance migratory bird environments and to prevent and abate pollution or detrimental alteration of their habitats (USSR Treaty, Article IV).
- A requirement that each nation provide immediate notification to the other when pollution or destruction of habitats occurs or is expected (USSR Treaty, Article IV).
- A stipulation that each nation shall, to the extent possible, establish preserves, refuges, protected areas, and facilities for migratory birds and their habitats and manage them to preserve and restore natural ecosystems (Convention).
- An allowance that protective measures under the treaty may be applied to species and subspecies not listed in the specific convention but that belong to one of the families containing listed species (USSR Treaty, Article VIII).

4. UNESCO World Heritage Site Designation

Under the 1972 World Heritage Convention, an international treaty, the United Nations Educational, Scientific and Cultural Organization (UNESCO) evaluates and designates natural and cultural heritage sites with "outstanding universal value"[148] that are nominated by a country

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[146] *Id.*

[147] 16 U.S.C. §§ 703–712.

[148] U.N. Educational, Scientific and Cultural Org. (UNESCO), The Criteria for Selection, https://whc.unesco.org/en/criteria/ (last visited June 5, 2018).

or by multiple countries. The United States and other State Parties which are part of the convention provide UNESCO with a Tentative List of sites from which they nominate sites for the World Heritage List. As of June 4, 2018, there are 1073 World Heritage List sites, with 23 in the United States including one transboundary natural site in Alaska shared with Canada: Kluane/Wrangell-St. Elias/Glacier Bay/Tatshenshini-Alsek.

The United States was the first country to sign onto the World Heritage Convention in 1973. The U.S. stopped paying its UNESCO and World Heritage dues in 2011 when Palestine was admitted as a member state.[149] Even while not paying dues, the U.S. remains a party to the World Heritage Convention and can nominate sites to the World Heritage List.[150] The U.S. has continued to submit nominations to the World Heritage List and two U.S. sites have been added since 2011.[151]

The Arctic National Wildlife Refuge was included on the U.S.'s 1982 Indicative Inventory, a precursor to, and generally similar to, the Tentative List.[152] On January 22, 2008, Secretary of the Interior Dirk Kempthorne announced a new Tentative List for the U.S. of 14 sites that were meant to serve as the basis of US World Heritage List nominations for the next 10 years.[153] This new Tentative List did not include the Arctic National Wildlife Refuge.

On the Canadian side of the border, Canada included Ivvavik National Park and Vuntut National Park (adjacent to the Arctic Refuge in Canada) on its Tentative List in 2004 as a natural and cultural heritage, or mixed, World Heritage Site.[154] The UNESCO link for this site states that this is "a land rich in wildlife, in variety of landscape and in vegetation,"[155] and mentions the

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[149] Nat'l Park Serv., Q & As on US Withdrawal from UNESCO and US involvement with the World Heritage program (Mar. 20, 2018), *available at:* https://www.nps.gov/subjects/internationalcooperation/unesco-q-a.htm.

[150] *Id.*

[151] *Id.*

[152] George Wright Soc'y, Revision of the U.S. World Heritage Tentative List Completed, http://www.georgewright.org/tentativelist.html (last visited June 5, 2018).

[153] *Id.*

[154] Herschel Island (Qikiqtaruk) Territorial Park, an Arctic island in the Beaufort Sea, is also included in this nomination. *See* U.N. Educational, Scientific, and Cultural Org., Ivvavik / Vuntut / Hershel Island (Qikiqtaruk), *available at*: http://whc.unesco.org/en/tentativelists/1939 (last visited June 5, 2018).

[155] *Id.*

Porcupine [Caribou] Herd. The site description also states that "[t]his is the land of the Inuvialuit and Vuntut Gwitchin, who have hunted, fished and traded in the region for thousands of years. The cultural landscape's rich and complex human history is expressed through archaeological evidence and oral history."[156] On December 17, 2017, the Government of Canada announced its updated Tentative List adding eight new sites but retaining six sites from when the Tentative List was updated in 2004 including the Ivvavik/Vuntut/Herschel Island (Qikiqtaruk) site.[157] On December 17, 2017, the Government of Canada announced its updated Tentative List adding eight new sites but retaining six sites from when the Tentative List was updated in 2004 including the Ivvavik/Vuntut/Herschel Island (Qikiqtaruk) site.[158]

Like the Canadian nomination of the adjacent Ivvavik/Vuntut/Herschel Island (Qikiqtaruk) site, the Arctic National Wildlife Refuge would meet at least half of the ten Criteria for qualification on the World Heritage List: potentially Criteria iv-v and vii-x.[159] As one example of these likely impact of designation, Royal Dutch/Shell in 2003 stated it would "avoid exploring or drilling on sites that carry the United Nation's World Heritage designation."[160] If oil development occurred on the Coastal Plain, however, the potential for the Arctic National Wildlife Refuge to be recognized as a World Heritage Site for its "outstanding universal value" and for its ability to meet multiple qualifying criteria for a mixed site may be affected. In the EIS, BLM should consider whether the Arctic Refuge and its Coastal Plain should be included on the United States' Tentative List.

VI. BLM MUST CONSIDER A BROAD RANGE OF IMPACTS IN THE EIS.

An EIS must take a hard look at the direct, indirect, and cumulative effects of the proposed project on the human environment, as well as means to mitigate adverse environmental

[156] *Id.*

[157] Parks Canada, Canada's Tentative List, *available at*: https://www.pc.gc.ca/en/culture/spm-whs/indicative-tentative (last visited June 5, 2018).

[158] Parks Canada, Canada's Tentative List, *available at*: https://www.pc.gc.ca/en/culture/spm-whs/indicative-tentative (last visited June 5, 2018).

[159] UNESCO, The Criteria for Selection, https://whc.unesco.org/en/criteria/ (last visited June 5, 2018).

[160] Heather Timmons, *Shell to Avoid Oil Drilling at Sites Listed By UNESCO*, NEW YORK TIMES (Aug. 31, 2003), available at: https://www.nytimes.com/2003/08/31/world/shell-to-avoid-oil-drilling-at-sites-listed-by-unesco.html.

impacts.[161] The effects and impacts to be analyzed include ecological, aesthetic, historical, cultural, economic, social, and health impacts.[162] Direct effects are those that are caused by the project and that occur in the same time and place.[163] Indirect effects are those that are somewhat removed in time or distance from the project, but nonetheless reasonably foreseeable.[164] As the lead agency responsible for developing the EIS, BLM is obligated to obtain necessary baseline data for the project area[165] and do a thorough analysis of potential impacts from the proposed project. The impacts that BLM must consider and evaluate in the EIS include: wildlife impacts, surface resource impacts, social systems and use impacts, climate change impacts, impacts from all phases of oil and gas activities on both Federal and private lands, cumulative impacts, cross border and transboundary impacts, and economic impacts. Each category is addressed below.

Additionally, Federal agencies are required under the National Environmental Policy Act to use "high quality" information in planning.[166] The BLM's Land Use Planning Handbook commits the agency to "mak[ing] decisions using the best information available."[167] The agency's NEPA handbook further specifies that the agency "[u]se the best available science to support NEPA analyses, and give greater consideration to peer reviewed science and methodology over that which is not peer-reviewed."[168]

BLM has adopted additional guidance for planning and management of special status species. The agency's manual on special status species stipulates that "[w]hen administering the Bureau sensitive species program, all information shall conform to the standards and guidelines established under the Information Quality Act" (IQA).[169] DOI's guidelines for implementing the IQA state that "[t]he Department will: (a) Use the best available science and supporting studies

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[161] *Id*. §§ 1502.16, 1508.25(c).
[162] *Id*. § 1508.8.
[163] *Id*. § 1508.8(a).
[164] *Id*. § 1508.8(b).
[165] *See infra* Part V.F.
[166] 40 C.F.R. § 1500.1(b).
[167] BUREAU OF LAND MANAGEMENT, BLM LAND USE PLANNING HANDBOOK (H-1601-1) (2005) at 2.
[168] BUREAU OF LAND MANAGEMENT, BLM NATIONAL ENVIRONMENTAL POLICY ACT HANDBOOK (H-1790-1) (2008) at 6.8.1.2.
[169] BUREAU OF LAND MANAGEMENT, SPECIAL STATUS SPECIES MANAGEMENT MANUAL (6840) (2008) at 6840.06.2 (SPECIAL STATUS SPECIES MANAGEMENT MANUAL).

conducted in accordance with sound and objective scientific practices, including peer-reviewed studies where available."[170] The BLM has also adopted guidelines for complying with the IQA, which incorporates the Department's guidelines and describes processes for ensuring the quality of information contained in agency documents.[171] These IQA guidelines apply to the current planning process, as it will include "information disseminated to the public for conducting BLM business."[172] BLM must adhere to these directives when evaluating the impacts of oil and gas program on Coastal Plain resources.

A. BLM MUST ANALYZE AND FULLY DISCLOSE THE IMPACTS OF AN OIL AND GAS PROGRAM ON NUMEROUS WILDLIFE SPECIES.

1. BLM Must Analyze and Fully Disclose the Impacts of an Oil and Gas Program on Caribou

Caribou (*Rangifer tarandus*) are the most abundant large terrestrial herbivore in the circumpolar arctic[173] Known as reindeer in some countries, caribou populations stretch across North America, Europe, and Asia.[174] Although widely distributed, caribou and wild reindeer populations worldwide have faced strong declines, likely due to global changes in climate and anthropogenic landscape change.[175] Four caribou herds occupy arctic Alaska, having their calves on the coastal plain and foothills of Alaska's North Slope. These caribou are renowned for their long-distance migrations, covering hundreds to thousands of kilometers each year in some of the longest overland movements in the world.[176] These migrations allow caribou to take advantage of spatiotemporally varying resources, such as moving to areas with greater winter food availability and shelter and then returning to their calving ground habitats with lower densities of predators and rich food sources.[177] As plant browsers and prey species for golden eagles,[178]

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[170] U.S. DEPARTMENT OF THE INTERIOR, INFORMATION QUALITY GUIDELINES PURSUANT TO SECTION 515 OF THE TREASURY AND GENERAL GOVERNMENT APPROPRIATIONS ACT FOR FISCAL YEAR 2001 (undated) at 2; available at https://forms.doioig.gov/docs/InformationQualityGuidelines.pdf.

[171] BUREAU OF LAND MANAGEMENT, INFORMATION QUALITY GUIDELINES (2018).

[172] *Id.* at 3.

[173] Brathen et al. 2007. (Materials cited in this section are cited in full in Appendix 3.)

[174] Vors and Boyce 2009.

[175] Vors and Boyce 2009; Russell et al. 2015.

[176] Fancy et al. 1989, Bergman et al. 2000, Schaefer and Mahoney 2013.

[177] Person et al. 2007, Dau 2011, Joly 2012, Fancy and Whitten 1991.

[178] Whitten et al. 1992.

brown bears[179] and wolves,[180] caribou also strongly influence the ecology of the coastal plain, an ecological function that must be evaluated within the leasing EIS.

The Arctic National Wildlife Refuge is used, with varying frequency, by three of the four caribou herds that calve on the North Slope of Alaska. Portions of the Central Arctic Herd use the Arctic Refuge year round, and the Coastal Plain primarily during summer.[181] The Teshekpuk Caribou Herd occasionally uses parts of the Arctic Refuge as winter range.[182] The Porcupine Caribou Herd uses the Arctic Refuge throughout the year, with the Coastal Plain providing essential calving, post-calving, insect relief, and other summer habitat.[183] While Porcupine Caribou Herd calving grounds have shifted in concentration between the Arctic Refuge and Canadian Yukon over time in response to year-to-year variation in plant quality and quantity[184] and weather conditions, the majority of the herd has calved on the Arctic Refuge Coastal Plain in most years since the 1970s, including recently.[185] Even in years in which calving was concentrated in Canada, the herd has used the Arctic Refuge Coastal Plain for food and insect relief while raising their young after calving.[186]

The Coastal Plain also is critical for caribou post-calving as it provides greater concentrations and prolonged availability of plant nitrogen, a limiting resource for caribou that allows them to gain weight during the brief summer months, increasing winter survival and subsequent-year reproduction.[187] These factors make the Porcupine caribou herd's calving and post-calving habitats, which are most sensitive to disturbance, also the most important to herd growth and sustainability.[188] The EIS must study and fully disclose any negative effects, including on calving success and population growth, of caribou being potentially displaced into the Brooks Range, where predator densities are higher, plant nitrogen is lower and available for a

[179] Reynolds et al. 1987, Mowat and Heard 2006.
[180] Dale et al. 1994, Ballard et al. 1997.
[181] Arthur and Del Vecchio 2009, Lenart 2015.
[182] Person et al. 2007.
[183] Caikoski 2015.
[184] Griffith et al. 2002.
[185] Clough et al. 1987, International Porcupine Caribou Board 1993, Douglas et al. 2002, McFarland et al. 2017.
[186] Griffith et al. 2002.
[187] Barboza et al. 2018.
[188] International Porcupine Caribou Board, 1993, Russell and McNeil 2002.

shorter amount of time. Furthermore, key limiting minerals needed by caribou appear to be more available on the Coastal Plain than in other seasonally-used areas.[189]

Due to its ecological, cultural, and subsistence importance, conservation of the Porcupine Caribou Herd and its habitat in its natural diversity is a primary purpose of the Arctic National Wildlife Refuge.[190] Under the current management in the CCP, the Refuge has positive effects on caribou habitat and persistence, and the EIS must evaluate changes to caribou conservation and management against this no-action baseline. Furthermore, the Porcupine Caribou Herd is one of the largest herds in North America and ranges over a vast area of northeast Alaska and northwest Canada. The EIS must also address the potential ecological impacts over this large area resulting from development on the coastal plain. ANILCA also makes fulfillment of international obligations — including the 1987 Porcupine Caribou Herd Conservation Agreement between the United States and Canada — and providing the opportunity for continued subsistence uses of the caribou and other Refuge resources purposes of the Refuge.[191] This must be considered.

a. Development impacts on caribou

The EIS must analyze and disclose the direct, indirect, and cumulative impacts of the lease sales and resulting activities (including exploration) on caribou, including the effects of facilities such as gravel pads, roads, airstrips and low flying aircraft, and pipelines on caribou movement, migration, and calving. Risks of spills must also be assessed. Caribou movement corridors and calving areas must be identified for analysis. The EIS must evaluate the functional loss of habitat associated with caribou avoidance of development, not simply the immediate footprint. The EIS must also disclose the additive and synergistic effects of climate change and leasing activities on caribou habitat and population trends, as well as related impacts to the abundance of predators such as wolves, bears and wolverines. BLM must fully analyze these and other reasonably foreseeable direct, indirect, and cumulative impacts of all phases of oil and gas development on the Porcupine Caribou Herd, utilizing the best available scientific information. These and other impacts are described in more detail below.

i. Calving

[189] Oster et al. 2018.
[190] ANILCA § 303(2)(B)(i).
[191] *Id.* § 303(2)(B)(ii)-(iii); *see supra* Part V.G.1, *infra* Part VI.C.1, VII.

Studies of the Central Arctic Herd in relation to development of the Prudhoe Bay development area and expansions to the west provide a cautionary tale about possible effects of energy development on caribou within the Coastal Plain and Arctic Refuge and should be applied to the effects analysis within the EIS.

The Central Arctic Herd historically used two calving grounds, one in the west between the Colville and Kuparuk rivers and one in the east between the Sagavanirktok and Canning rivers.[192] As development expanded out from Prudhoe Bay, caribou using the western calving grounds where new development occurred shifted south,[193] while those in the east outside of main development areas did not shift.[194] This shift away from new development likely had consequences for caribou as food availability was lower for development-exposed caribou that shifted calving areas[195] and these caribou showed lower calf body mass[196] and birth rate[197] though the herd still grew through this period.[198] A review by the United States Geological Survey (USGS) concluded there was no clear biological explanation for the shift in concentrated calving in the west, implicating petroleum development as its likely cause.[199] The observation that only the development-exposed portion of the herd showed this shift in calving location casts doubt upon alternative explanations, such as the timing of snowmelt.

The sensitivity to development of female caribou about to give birth and those with young calves has been well documented and must be addressed within the EIS. Studies of the Central Arctic Herd following expansion of the Kuparuk Development Area, west of Prudhoe Bay, found that use of areas near development declined after infrastructure was established[200] and was lower than expected within 4 km of roads.[201] While one study reported increasing density of caribou calves within 1 km of roads in the Kuparuk Development Area,[202] this study

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[192] Lenart 2015.
[193] Wolfe 2000, Noel et al. 2004, Cameron et al. 2005, Joly et al. 2006, Lenart 2015.
[194] Wolfe 2000, Russell and McNeil 2005.
[195] Wolfe 2000; Griffith et al. 2002.
[196] Arthur and Del Vecchio 2009.
[197] National Research Council 2003; Cameron et al. 2005.
[198] Lenart 2015.
[199] Griffith et al. 2002.
[200] Cameron et al. 1992, Dau and Cameron 1986.
[201] Cameron et al. 2005.
[202] Noel et al. 2004.

was criticized for not taking into account the overall decrease in caribou numbers within the development area when interpreting their findings.[203] This decrease in numbers occurred despite a rapid increase in herd size during this period and has been suggested to reflect a shift of caribou away from the area of concentrated development.[204] Caribou with calves also tend to occur farther from development than those without calves and tend to occur less in areas and at times of higher human activity.[205] Furthermore, females about to give birth or with very young calves tend to avoid, or are less likely to cross, roads and pipelines during the calving season.[206] The EIS must disclose the effects of leasing and development on caribou calving and calving habitat, including the effects of roads and other infrastructure. Population-level effects and trends must be assessed, as well as the functional loss of habitat resulting from caribou cows and calves avoiding development activities.

ii. Insect relief

Insect activity, primarily that of mosquitoes and oestrid flies, has a strong influence on caribou space use, leading caribou to seek areas of relief from insects, such as the coast, gravel bars, Aufies fields, and elevated areas.[207] Harassment due to insects can have a negative effect on caribou populations, leading to lower rates of calves being born in years following high insect activity.[208] Caribou may also use areas around infrastructure during periods of moderate to high insect activity.[209] Nevertheless, observations of lower reproduction rates following years of high insect activity for caribou occupying relatively developed areas compared to those occupying less developed areas led the National Research Council to conclude that by altering caribou movements development "probably exacerbates the adverse effects of insect harassment."[210] This is of grave concern as warming conditions in the Arctic are leading to earlier growth and increased survival of mosquitoes.[211] The EIS should discuss the disturbance, hindrance, and alteration effects of leasing and development on the movement of caribou associated with insect-

[203] Joly et al. 2006.
[204] Joly et al. 2006.
[205] Haskell et al. 2006.
[206] Wolfe et al. 2000, Griffith et al. 2002.
[207] Pollard et al. 1996.
[208] National Research Council 2003.
[209] Pollard et al. 1996.
[210] National Research Council 2003 at 115.
[211] Culler et al. 2015.

relief, as well as impacts to insect-relief habitat. Areas essential for movement and insect-relief should be defined and identified.

iii. Limited evidence of habituation

Some have argued that caribou habituate to human activity, learning not to fear it over time.[212] The evidence for this is equivocal at best. This is a topic that requires further scientific investigation to allow adequate determination of the possible effects of oil and gas development. The EIS should reflect the state of knowledge and acknowledge that the current scientific literature does not justify an assumption of habituation for caribou.

iv. Likelihood of increased development impacts for the Porcupine Caribou Herd

It is likely that the responses to development observed in the Central Arctic Herd will similarly apply to the Porcupine Caribou Herd. In fact, the USGS pointed out a number of reasons why responses may be greater in the Porcupine Caribou Herd compared to the Central Arctic Herd.[213] One major factor, and one that the effects analysis within the EIS must consider, is that the coastal plain is narrower within the Arctic Refuge compared to the main Central Arctic Herd range, leaving less room for shifts in space use.[214] Another is that the expansion of development and the shift in Central Arctic Herd calving occurred during a period of relatively favorable environmental conditions. The EIS should acknowledge that future environmental changes, due to natural fluctuations or climate change (see below), may reduce the ability of caribou to accommodate range shifts. As the National Research Council pointed out in their 2003 report, “although the accumulated effects of industrial development to date have not resulted in large or long-term declines in the overall size of the Central Arctic Herd, the spread of industrial activity into other areas that caribou use during calving and in summer, especially to the east where the coastal plain is narrower than elsewhere, would likely result in reductions in reproductive success, unless the degree to which it disturbs caribou could be reduced.”[215].

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[212] *See, e.g.*, Bureau of Land Management, Alpine Satellite Development Plan for the Proposed Greater Mooses Tooth 2 Development Project: Draft Supplemental Environmental Impact Statement (2018).

[213] Griffith et al. 2002.

[214] See Attached Map At Appendix 1.

[215] National Research Council 2003 at 6.

Success of mitigation measures to reduce disturbance to movement due to physical barriers has not been adequately verified.[216] However, the shift in Central Arctic Herd calving distribution to the south in the Milne Point and Kuparuk areas occurred in spite of use of structures intended to mitigate impacts like elevated pipelines and reduced road density,[217] suggesting that such mitigation was ineffective.

There is still much that we do not know about caribou and the things that influence their population dynamics, and the EIS must reflect this uncertainty and account for risk accordingly. It is important to note that while caribou populations naturally fluctuate, the USGS points out that "reduced calf survival may slow the rate of increase during positive phases of the growth curve of the herd and increase the rate of decline during the negative phases of the herd's growth curve."[218] Three expert groups evaluated potential consequences of energy development on the Arctic Refuge coastal plain for the Porcupine Caribou Herd.[219] These evaluations analyzed development scenarios, population simulation models, food availability, predator density, and more. All three indicated likely declines in calf survival, with effects on herd distribution and/or population growth, in response to coastal plain development.[220]

BLM must fully analyze these and other reasonably foreseeable direct, indirect, and cumulative impacts of all phases of oil and gas development on the Porcupine Caribou Herd, utilizing the best available scientific information and taking a precautionary approach to appropriately address uncertainty and the importance of the resource.

b. Data gaps

Understanding space use by species, caribou in particular, is fundamentally important. Protecting fish and wildlife species and their habitats in their natural diversity is among the primary purposes of the Arctic Refuge.[221] In other planning processes, BLM has undertaken a relevant analysis of resource selection by species using appropriate methodologies for the landscape and management scheme and the best available science. BLM must undertake a resource selection analysis in the EIS to understand the potential impacts to caribou.

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[216] Lenart 2015.
[217] Griffith et al. 2002.
[218] Griffith et al. 2002 at 32.
[219] Elison et al. 1986, Griffith et al. 2002, Russell and McNeil 2005.
[220] Elison et al. 1986, Griffith et al. 2002, Russell and McNeil 2005.
[221] ANILCA § 303(2)(B)(1).

Analysis of the historic information in combination with more recent use patterns is necessary to demonstrate the patterns of Coastal Plain use by caribou over time. For the Arctic Refuge, annual documentation of calving and post-calving use began during studies associated with the proposed Arctic Gas Pipeline in 1971 and continued by FWS and other agencies in the 1980's when extensive baseline studies involving field work and analyses were done for caribou, vegetation, and other wildlife as required under ANILCA section 1002(c) for the Arctic National Wildlife Refuge Coastal Plain Resource Assessment.[222] These studies, and others produced since, provide historical polygon-based depictions as well as fixed kernel distributions of habitat use and important areas and are necessary for evaluating long-term habitat use in the Coastal Plain, including for calving, post-calving, and movement routes.[223] This important baseline information needs to be included in documentation of the existing environment and for the impact analysis. However, updates are needed to this information, as most only depict habitat use prior to 2005.[224]

In addition to analysis of historic information, BLM must collect additional data and review recent studies to conduct a resource selection function analysis. In doing so, BLM must identify relative habitat value for Porcupine caribou in a spatially continuous manner based on environmental factors using the longest temporal range of data available. Such studies should be conducted so that they utilize, build upon, and complement historical studies, as well as other knowledge systems like that provided by traditional knowledge.

c. Climate change and caribou

The EIS must discuss the additive and synergistic effects of climate change and leasing activities on caribou habitat and population trends. Climate change is disproportionately affecting the arctic, with warming occurring more strongly than the global average.[225] Caribou population dynamics have been shown to be influenced by broad-scale climate patterns, [226]

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[222] Garner and Reynolds 1986.

[223] *E.g.*, Hemming 1971, Elison et al. 1986, Garner and Reynolds 1986, Clough et al. 1987, Griffith et al. 2002, Russell and McNeil 2005, McFarland et al. 2017.

[224] *But* see McFarland et al. 2017 (depicting calving polygons from 2012-2017 and winter polygons from 2008-2017).

[225] IPCC 2013.

[226] Joly et al. 2011, Mallory et al. 2018.

though in many cases local factors may exert population pressures as strong as, or stronger, than climate.[227] Climate change has the potential to both negatively and positively influence caribou populations. Warming winter conditions in the arctic have led to an increase in rain-on-snow events.[228] Such events lead to thick ice cover when temperatures subsequently decrease, blocking access to food for caribou and other species.[229] The potential of such icing events to decrease body condition of overwintering caribou is of great concern, as late winter body mass of female caribou is strongly linked to calf production and survival, influencing population growth rates.[230] These icing events are expected to continue to increase as the arctic keeps warming and sea ice retreats.[231]

Shifts in climate also are influencing the timing of snowmelt and plant green-up and growing season length across the globe. In northern Alaska, earlier plant greening and longer growing seasons have been observed.[232] While this could increase food availability, warming may also reduce forage quality for caribou, as has been seen in other systems.[233] Thus far, however, forage quality does not seem to have declined during the calving period.[234] Warming conditions also have been associated with expansion of shrubs in the arctic.[235] Some have suggested that decreased edibility of shrubs for caribou may explain why patterns of arctic greening are accompanied by population declines in caribou.[236] Potentially contradictory effects of longer, warmer growing seasons and increased rain on snow events make cumulative effects of climate change on caribou difficult to determine. The variability in potential responses of caribou to changing climate in the arctic calls for increased studies to understand how caribou are likely to respond to warming conditions and for monitoring to determine whether predicted patterns are met. Analyses have been done in Canada to evaluate net effects that consider both positive and negative influences under different climate scenarios.[237] Adapting such studies to

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[227] *See, e.g.*, Mahoney et al. 2016, Uboni et al. 2016.
[228] Hansen et al. 2011, Hansen et al. 2014, Forbes et al. 2016.
[229] Hansen et al. 2011, Hansen et al. 2013.
[230] Hansen et al. 2011, Albon et al. 2017, Veiberg et al. 2017.
[231] Hansen et al. 2014, Forbes et al. 2016.
[232] Gustine et al. 2017.
[233] Barboza et al. 2018.
[234] Gustine et al. 2017.
[235] Tape et al. 2016, Fauchald et al. 2017.
[236] Fauchald et al. 2017.
[237] *See, e.g*, Tews et al. 2007.

the Alaskan arctic may help provide increased understanding of climate effects and allow cumulative analyses of potential stresses from climate change and resource development. BLM must fully analyze existing and reasonably foreseeable impacts of climate change on caribou, including in the environmental baseline and affected environment, and across alternatives.

2. BLM Must Analyze and Fully Disclose the Impacts of an Oil and Gas Program on Polar Bears.

BLM must take a hard look at the impacts of lease sales and resulting oil and gas development activities on imperiled polar bears on the Coastal Plain and adjacent habitats and waters. Polar bear (*Ursus maritimus*) was listed as threatened under the ESA in 2008 and is also federally protected under the MMPA.[238] The EIS must analyze the direct, indirect and cumulative effects of the proposed action against a backdrop of continued climate change which is already causing habitat loss, conflicts with humans, and energetic costs, nutritional stress and strenuous long-distance swimming for polar bears. BLM must also consider how greenhouse gas (GHG) and black carbon pollution generated from an oil and gas program in the Arctic Refuge will affect polar bears and hinder recovery of the species. Absent significant reductions in GHG pollution, the small Southern Beaufort Sea (SBS) polar bear population faces a high probability of extirpation within this century, even without the added impacts of fossil fuel development in essential Coastal Plain habitat.

Polar bears are dependent upon Arctic sea ice for survival, as well as sufficient snow accumulation for dens for sows and cubs.[239] The species needs sea ice as a platform from which to hunt, to make seasonal migrations between the sea ice where they feed and their onshore denning areas, and to find mates.[240] Female polar bears give birth in snow dens excavated either on land or in the snow on top of the drifting sea ice.[241] The Coastal Plain of the Arctic Refuge provides the most important onshore denning habitat for polar bears in the United States, leading the FWS to designate the majority of the area as critical habitat for the species in 2010.[242] Polar

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[238] 73 Fed. Reg. 28212 (May 15, 2008); 75 Fed. Reg. 76086 (Dec. 7, 2010).
[239] 73 Fed. Reg. 28212.
[240] *Id.* at 28214.
[241] *Id.* at 28215.
[242] 75 Fed. Reg. 76086.

bears can be found on the Coastal Plain year-round.[243] Of the two polar bear populations (or stocks) found in the United States, the SBS population is the most likely to occur here.[244]

Polar bear populations have already been reduced to a precarious state due to impacts from climate change, which will only increase as warming in the Arctic region continues. Polar bears are particularly vulnerable to sea ice melt given their life history and specialized habitat needs. The USGS concluded that reduced sea ice could result in the loss of approximately two-thirds of the world's polar bears within 50 years, and Alaska's polar bears will likely be extirpated under current emission scenarios.[245] These predictions are already coming to pass. In fact, the SBS population has suffered dramatic losses in sea ice and is in decline.[246] The most recent estimate for the SBS population was 900 bears in 2010, representing a roughly 40 percent decline since the 1980s.[247] As sea ice is reduced, these bears are increasingly coming ashore to den on the Coastal Plain.[248]

Oil and gas lease sales and development on the Coastal Plain will not only impact polar bears and their critical habitat, but will also increase GHG pollution, further contributing to the reduction of essential snow cover and sea ice. It is vital that BLM analyze the impacts of lease sales and resulting activities on polar bears, and the SBS population in particular, in light of their precarious status due to climate change. The BLM is also obligated to consult with FWS to ensure an oil and gas program does not jeopardize the continued existence of polar bears in the United States or adversely modify or destroy their critical habitat in the Arctic Refuge.

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[243] J. W. Olson et al., *Collar temperature sensor data reveal long-term patterns in southern Beaufort Sea polar bear den distribution on pack ice and land*, 564 Marine Ecology Progress Series 211 (2017); T. C. Atwood *et al.*, *Rapid environmental change drives increased land use by an arctic marine predator*, 11 PLoS ONE e0155932 at 9 (2016).

[244] 75 Fed. Reg. at 76090.

[245] S.C. Amstrup, *et al.*, Forecasting the Range-wide Status of Polar Bears at Selected Times in the 21st Century, U.S. Geological Survey Administrative Report (2007).

[246] J. F. Bromaghin *et al.*, *Polar bear population dynamics in the southern Beaufort Sea during a period of sea ice decline*, 25 Ecological Applications 634 (2015).

[247] *Id.*; E. V. Regehr *et al.*, *Polar bear population status in the southern Beaufort Sea*, Open-File Report 2006-1337 at 1 (2006).

[248] J. W. Olson *et al.* 2017; 75 Fed. Reg. 76086.

a. BLM Must Consider the Impacts to Polar Bears from Habitat Loss, Degradation and Fragmentation Caused by Oil and Gas Development.

The BLM must analyze how leasing and subsequent oil and gas exploration, drilling and production in the Arctic Refuge will directly, indirectly and cumulatively affect polar bears due to habitat loss, degradation and fragmentation. The SBS population in particular is increasingly dependent on the Coastal Plain as refugia in an industrializing and warming Arctic. The Coastal Plain has more potential terrestrial denning habitat for pregnant sows than other areas of the Arctic, and 38 percent more denning habitat available than the region immediately west of the Refuge.[249] For decades, female SBS polar bears have used the Coastal Plain in late fall to seek dens and "other groups of polar bears seasonably frequent the coastal periphery of the area."[250] In one study, 50 percent of bears tracked along the northern mainland coast of Alaska were found to den within the Arctic Refuge, and 42 percent were within the Coastal Plain.[251] Based on known den locations from 2000-2010, 22 percent of dens for the entire SBS population were on the Coastal Plain.[252]

Declining sea ice conditions in the Beaufort Sea has led to an increase in the proportion of the SBS population coming onshore in summer and autumn (from 5.8 percent during 1986-1999 to 20 percent during 2000-2014) and a 30-day increase in time spent on land.[253] In addition, there is an increasing trend towards more bears denning on land in the winter.[254] The growing frequency of onshore denning is directly linked to diminished sea ice and the distance that pack

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[249] U.S. Fish & Wildlife Serv., Arctic National Wildlife Refuge Revised Comprehensive Conservation Plan, Final Environmental Impact Statement Volume 1 at 4-118 (2015); G. M Durner *et al*., *Polar bear maternal den habitat on the Arctic National Wildlife Refuge, Alaska.* 59 Arctic 31 (2006).

[250] U.S. Dep't of Interior, Arctic National Wildlife Refuge, Alaska, Coastal Plain Resource Assessment, 30 (1987).

[251] U.S. Fish & Wildlife Serv., *Polar Bear Denning*, available at: https://www.fws.gov/refuge/arctic/pbdenning.html (last updated May 1, 2014).

[252] G. M. Durner *et al*., *Catalogue of Polar Bear (Ursus maritimus) Maternal Den Locations in the Beaufort Sea and Neighboring Regions, Alaska, 1910-2010,* USGS Data Series 568 (2010).

[253] T. C. Atwood *et al*., *Rapid environmental change drives increased land use by an Arctic marine predator,* PLoS One 11:e0155932 (2016).

[254] A. S. Fischbach *et al.*, *Landward and eastward shift of Alaskan polar bear denning associated with recent sea ice changes*, 30 Polar Biology 1395 (2007); Olson et al. (2017).

ice has retreated from the coast.[255] Thus this climate-driven shift in denning habitat is predicted to continue.[256]

The lease sales are, by their nature, designed to lead to oil and gas development on vital Coastal Plain habitat, which will inevitably require associated pipelines, well pads, gravel mines, roads, airstrips and other infrastructure. The BLM must account for the resultant habitat loss, degradation and fragmentation of polar bear habitat in the EIS, with particular attention to potential for destruction or adverse modification of designated critical habitat. The EIS must fully analyze and disclose habitat loss, degradation and fragmentation in all management alternatives.

b. BLM Must Consider Impacts to Polar Bears from Disturbance and Displacement Caused by Oil and Gas Activities.

The BLM must evaluate the impacts to polar bears from disturbance and displacement resulting from lease sales and subsequent oil and gas exploration, drilling and production activities. Bears that are forced to den onshore are increasingly vulnerable to human encroachment, and denning females disturbed by human activities, including oil and gas development, may abandon their dens, causing a loss of cubs.[257] Bear denning selection and behavior is so sensitive to disturbance that Marine Mammal Protection Act incidental take regulations (ITR) for the Beaufort Sea and adjacent northern coast of Alaska (excluding the Arctic Refuge) stipulate that no activities may occur within 1.6 km (1 mile) of known or suspected polar bear dens.[258]

Polar bears are particularly vulnerable to anthropogenic disturbance during denning as compared to other times in their life cycle.[259] The best available science indicates that sows

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[255] *Id.*; 81 Fed. Reg. at 52287 (Aug. 5, 2016).

[256] *Id.*

[257] *See, e.g.*, S. C. Amstrup, *Human disturbances of denning polar bears in Alaska*, 46 Arctic 246 (1993).

[258] 81 Fed. Reg. at 52295 (Aug. 5, 2016). This ITR does not authorize oil and gas activities in the Arctic Refuge.

[259] S. C. Amstrup, *Polar bear, Ursus maritimus, in* WILD MAMMALS OF NORTH AMERICA: BIOLOGY, MANAGEMENT, AND CONSERVATION 587, 606 (G. A. Feldhamer, B. C. Thomson & J. A. Chapman (eds.), John Hopkins Press 2003).

entering dens or denning with cubs are more sensitive to noise disturbance than other demographic groups.[260] The mean dates of den entrance and emergence for polar bears that den onshore in the SBS population is November 11 and March 3, respectively.[261] Females observed with cubs emerged 15 days later than females observed without cubs.[262] Cubs, which are born in mid-winter, are generally unable to survive conditions outside the den until March or April.[263] If den site abandonment occurs before the cubs are able to survive outside the den, or if the female abandons the cubs, the cubs will die.[264]

The oil and gas program is intended to lead to oil and gas development on the Coastal Plain, which could disturb polar bears at maternal den sites. BLM must analyze the effects of noise, vibration, human presence and other disturbance to polar bears produced by industrial activities, including seismic activities, drilling, infrastructure construction and maintenance, production facilities operations, and air, vessel and vehicle traffic. Polar bears have been documented to abandon their dens in response to various industry activities depending on the level of exposure and distance from the den site.[265] Seismic exploration on Alaska's North Slope, including the use of heavy vehicles and equipment, may have particular impacts as it occurs during the winter months[266] (January–May) and can extend into the spring (March–April), overlapping with denning season and the period when bears emerge to hunt prey on sea ice.[267] Subsequent development activities will result in additional surface disturbance and noise, causing further potential bear displacement. The EIS must evaluate both the direct, indirect and incremental cumulative effects that could occur as a result of potential exclusion or temporary avoidance of polar bears from feeding, resting, or denning areas and disruption of associated

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[260] 81 Fed. Reg. at 52291 (Aug. 5, 2016).

[261] K. D. Rode *et al.*, *Den Phenology and reproductive success of polar bears in a changing climate.* 99 J. Mammalogy 16 (2018).

[262] *Id.*

[263] 81 Fed. Reg. at 52292.

[264] 75 Fed. Reg. at 76090.

[265] 81 Fed Reg. at 52292 (Aug. 5, 2016).

[266] U.S. Fish and Wildlife Service, *Potential Impacts of Proposed Oil and Gas Development on the Arctic Refuge's Coastal Plain: Historical Overview and Issues of Concern*, at 10 (2001), *available at*: https://www.fws.gov/uploadedFiles/Region_7/NWRS/Zone_1/Arctic/PDF/arctic_oilandgas_impact.pdf.

[267] F. Messier *et al.*, *Denning ecology of polar bears in the Canadian Arctic Archipelago*, 75 Journal of Mammalogy 2 (1994).

biological behaviors and processes as a result of disturbance and displacement caused by an oil and gas program.

c. BLM Must Consider Impacts to Polar Bears from Increased Human-Polar Bear Interactions.

Human-polar bear interactions are a management challenge in Alaska, and would escalate significantly on the Coastal Plain with the introduction of oil and gas development. Exacerbating the problem, the Coastal Plain is likely to become even more important to polar bears over the period of an oil and gas program. As sea ice continues to melt, polar bears will increasingly use terrestrial habitat, making them more vulnerable to interactions with humans and encounters with oil and gas development. Already the percentage of bears coming ashore on the Coastal Plain and staying for at least 21 days has at least tripled[268] as those bears are arriving earlier, staying later, and staying longer than ever before.[269]

Ample, local research is available on this topic. For example, one recent study found that during the annual sea ice minimum between 1989 and 2014, adult female polar bears in the SBS population spent less time in their preferred, prey-rich, shallow-water sea ice habitat in more recent years, corresponding with declines in availability of this preferred habitat type, and spent more time in lower-quality habitat—land and sea ice off the continental shelf—where they have reduced access to prey.[270] The study concluded that "[t]he substantially higher use of marginal habitats by SBS bears is an additional mechanism potentially explaining why this subpopulation has experienced negative effects of sea ice loss . . . ."[271] Another study found SBS bears exhibiting an alternative foraging strategy as sea ice disappears, represented by 'coastal' bears, which remain near shore for much of the year and use bowhead whale bone piles, in contrast to typical 'pelagic' bears, which hunt seals on sea ice.[272] Mammalian carnivores are known to

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[268] An average of 5.8% was recorded from 1986-1999 with an average of 20% from 2000-2014 and a high of 37% in 2013. T. C. Atwood *et al.*, *Rapid environmental change drives increased land use by an arctic marine predator*, 11 PLoS ONE e0155932 at 9 (2016).

[269] *Id.* at 12.

[270] Ware *et al.* (2017).

[271] *Id.* at 87.

[272] M.C. Rogers *et al.*, *Diet of female polar bears in the southern Beaufort Sea of Alaska: evidence for an emerging alternative foraging strategy in response to environmental change*, 38 Polar Biology 1035 (2015).

increasingly frequent human development and engage in risky behavior during extended periods of hunger,[273] and similar risk-prone behavior can be expected for polar bears as retreating sea ice prompts bears to increasingly seek food from human sources, thereby increasing threats to both humans and bears and provoking additional incidents of human-bear conflict.[274]

Increased use of terrestrial habitat has led, and will continue to lead, to a drastic increase in the harassment of polar bears by humans. According to one oil company, hazing at its facilities in and around the Beaufort Sea has more than tripled in the last three years compared to the three years prior, with 14 bears harassed in 2016 alone.[275] Though hazing in theory decreases the number of polar bears killed in defense of life or property, it is well known that polar bears have extremely high energy demands, and conserving energy is vital to their survival.[276] As such, harassment that results in movement, as hazing is intended to do, could lead to significant metabolic costs, especially if the metabolic response is sustained over an extended period of time.[277]

Harassment resulting in bears' running away will always have a high metabolic cost.[278] Moving at even relatively slow speeds results in bears' expending 13 times more energy than they otherwise would.[279] Female polar bears that are energetically stressed may forgo reproduction, rather than risk incurring the energetic costs of an unsuccessful reproductive process, and the persistent deferral of reproduction could contribute to a declining population trend, further threatening a species with an intrinsically low rate of growth.[280]

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[273] *Cf.* K. Blecha *et al., Hunger mediates apex predator's risk avoidance response in a wildland-urban interface*, 87 Journal of Animal Ecology 3 (2018).

[274] T. C. Atwood *et al.*, R*apid environmental change drives increased land use by an arctic marine predator*, 11 PLoS ONE e0155932 at 14 (2016).

[275] T. C. Atwood *et al., Rapid environmental change drives increased land use by an arctic marine predator*, 11 PLoS ONE e0155932 at 12 (2016).

[276] *See, e.g.*, S. Schliebe *et al*., Range-wide Status Review of the Polar Bear (Ursus maritimus) at 15, 76, 85 (Dec. 21, 2006).

[277] P. D. Watts et al., *Energetic output of subadult polar bears (Ursus maritimus): resting, disturbance, and locomotion*, 98 Comparative Biochemistry and Physiology Part A: Physiology 191 (1991).

[278] *Id.* at 192.

[279] Schliebe (2006) at 75.

[280] *Id.* at 20.

Oil and gas development on the Coastal Plain will inevitably increase human-polar bear interactions and conflicts due to increased human presence and food attractants including toxic substances, and due to habitat loss and fragmentation leading to loss of access to preferred Coastal Plain den locations. Polar bears are not only driven by hunger to enter human settlements, but are also naturally curious and may investigate oil and gas exploration sites and drilling pads, which could increase human bear conflicts and deaths.[281] BLM must address methods for reducing human food, hazardous substances, and other attractants associated with Southern Beaufort Sea and Arctic Refuge Coastal Plain oil and gas development.

Current bear-human interactions are managed by a partnership between the North Slope Borough's Wildlife Department with staff in Kaktovik and FWS's Arctic Refuge and Marine Mammals Management staff via continued education and outreach to both Kaktovik residents and tourists visiting seasonally (August–October) to view polar bears. BLM must require the comprehensive use of the 2017 FWS Polar Bear Deterrence Training and Manual (to apply to oil and gas development), which provides information and training for minimizing polar bear-human interactions and maximizing the safety for both people and polar bears.[282] BLM must also engage with Kaktovik and Nuiqsut communities to minimize polar bear conflicts and work with FWS to produce and distribute written information such as the Kaktovik Barter Island FWS 2009 fact sheet.[283]

A comprehensive analysis would quantify projected levels of intentional or incidental harassment of polar bears from the activities resulting from the lease sales, from other Arctic oil and gas operations, and from other interactions with humans. This is a significant issue considering available information indicating that increasing harassment is likely having, and will continue to have, negative impacts on polar bears at the same time sea ice loss is having multiple, negative effects on polar bears.

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[281] M. Elfström, *Ultimate and proximate mechanisms underlying the occurrence of bears close to human settlements: review and management implications*, 44 Mammal Review (2014).

[282] U.S. Fish & Wildlife Serv., *Polar Bear Deterrent Training Manual* (2017); *available at*: https://www.fws.gov/alaska/fisheries/mmm/polarbear/det_training_manual.htm.

[283] U.S. Fish & Wildlife Serv., *Minimizing Polar Bear and Human Interactions at Barter Island, Alaska* (2009); *available at:* https://www.fws.gov/alaska/fisheries/mmm/polarbear/pdf/factsheets/pb_barter_09_final.pdf.

d. BLM Must Consider Threats to Polar Bears from Potential Oil Spills.

BLM must study the impacts on SBS polar bears from potential oil spills, which are an inevitable result of oil and gas development. As discussed above, polar bears are spending more time onshore due to climate change, so terrestrial spills, lagoon, and nearshore spills are increasingly likely to affect their habitat and prey. Polar bears could come into contact with oil either directly at feeding areas or through ingesting contaminated prey.[284] Polar bears must regularly groom themselves for thermoregulation, meaning they could also ingest oil on their fur; in experiments done on oil-exposed bears, all the subjects were dead within a month.[285] The long-term effects of an oil spill could be much greater, as polar bears are biological sinks for pollutants.[286] For example, toxins could bioaccumulate in polar bears after eating contaminated prey for years after the original spill.[287] BLM must fully assess and disclose these potential threats from oil spills, and must explore alternatives to reduce spills and protect areas of particular importance to bears, like feeding and resting areas, summer refugia and winter denning areas.

BLM must also create a reliable, evidence-based plan and funding source for cleaning up oil contamination, including preparedness drills and response capacity (both equipment and trained staff). Currently no reliable method exists for removing oil from sea ice in the arctic marine environment. *In situ* burning is not acceptable because it kills marine mammals when they surface for air and quickens the rate of ice melt. The chemical dispersants used in mitigating the Deepwater Horizon spill were found to be lethal to marine wildlife and are currently being investigated. BLM's clean-up plan must adhere to the U.S. Fish and Wildlife Service's Oil Spill

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[284] J. M. Neff, *Composition and fate of petroleum and spill-treating agents in the marine environment*, *in* SEA MAMMALS AND OIL: CONFRONTING THE RISKS 1 (J.R. Geraci & D.J. St. Aubin eds., 1990).

[285] D.J. St. Aubin, *Physiological and toxic effects on polar bears*, *in* SEA MAMMALS AND OIL: CONFRONTING THE RISKS 235 (J.R. Geraci & D.J. St. Aubin eds., 1990) (St. Aubin, *Physiological and toxic effects on polar bears*).

[286] R. J. Norstrom *et al.*, *Organochlorine contaminants in Arctic marine food chains: identification, geographical distribution and temporal trends in polar bears*, 22 Environmental Science and Technology 1063 (1988).

[287] *Id.*; Schliebe (2006) at 156, 166.

Response Plan for Polar Bears, and the plan must be integrated into industry preparedness and response planning.[288]

e. BLM Must Consider Impacts to Polar Bears from Increased Greenhouse Gas Emissions.

In addition to the direct impacts of development, the BLM must assess the contributions of a Coastal Plain oil and gas program to global GHG emissions both from onsite development activities and the future combustion of petroleum extracted from the refuge. Increased GHG emissions and continued climate change will exacerbate already-increasing energetic costs and nutritional stress on polar bears. The development and use of fossil fuels from the Arctic Refuge could measurably contribute to this threat, even on polar bears that never use the area. BLM must fully consider these effects.

The startling and depressing evidence of adverse impacts from climate change on polar bears is mounting. For example, a recent study found that radio-tracked adult female polar bears in the SBS population increased their activity time and/or their travel speed to compensate for rapid westward ice drift in recent years, as ice drift rates increased due to reduced ice thickness and extent.[289] This additional activity increased their estimated annual energy expenditure, and "likely exacerbate[s] the physiological stress experienced by polar bears in a warming Arctic."[290]

Another recent study found that SBS polar bears cannot use a hibernation-like metabolism to prolong their summer fasting period meaningfully and that bears are susceptible to deleterious declines in body condition, and ultimately survival, during the lengthening period of

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[288] U.S. Fish & Wildlife Serv., *Oil Spill Response Plan for Polar Bears in Alaska* (2015); *available at*: https://www.fws.gov/alaska/fisheries/contaminants/pdf/Polar%20Bear%20WRP%20final%20v8_Public%20website.pdf.

[289] G.M. Durner *et al.*, *Increased Arctic sea ice drift alters adult female polar bear movements and energetics*, 23 Global Change Biology 3460 (2017).

[290] *Id.*; *see also* J.V. Ware *et al.*, *Habitat degradation affects the summer activity of polar bears*, 184 Oecologia 87 (2017) (finding that SBS bears were substantially more active than Chukchi Sea bears in lower quality habitat types and that onshore, SBS bears exhibited relatively high activity associated with the use of subsistence-harvested bowhead whale carcasses).

ice melt and food deprivation.[291] Scientists at DOI interpret these observations as a prelude to mass polar bear mortality events in the future: "[a]s changes in habitat become more severe and seasonal rates of change more rapid, catastrophic mortality events that have yet to be realized on a large scale are expected to occur."[292]

Polar bears are also increasing long-distance swimming due to the decline in sea ice, which results in drowning, cub mortality, and physiological stress. For example, one study documented an adult female making a 687-km continuous swim over nine days to reach the distant sea-ice edge, followed by an 1800-km walk and swim, during which time she lost 22 percent of her body mass and her yearling cub.[293] The study "indicates that long distance swimming in Arctic waters, and travel over deep water pack ice, may result in high energetic costs and compromise reproductive fitness" and that "[a]ssociated declines in body mass and losses of dependent young may ultimately become an important mechanism for influencing population trends."[294] Satellite telemetry records from 76 bears in the Beaufort Sea during 2007–2012, coupled with earlier results, indicated that the frequency of long-distance swims increased with (a) increases in the distance of the pack ice edge from land, (b) the rate at which the pack ice edge retreated, and (c) the mean daily rate of open water gain between June and August.[295] These results indicate that "long-distance swimming by polar bears is likely to occur more frequently as sea ice conditions change due to climate warming."[296]

Oil and gas exploration, drilling and combustion undermines a key Conservation and Recovery Action in FWS's Polar Bear Conservation Management Plan: "[l]imit global atmospheric levels of greenhouse gases to levels appropriate for supporting polar bear recovery

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[291] J.P. Whiteman *et al.*, *Summer declines in activity and body temperature offer polar bears limited energy savings*, 349 Science 295 (2015).

[292] Convention on Int'l Trade in Endangered Species, CONSIDERATION OF PROPOSALS FOR AMENDMENT OF APPENDICES I AND II, Sixteenth meeting of the Conference of the Parties, Bangkok (Thailand), 3-14 March 2013, Prop. 3 at 5.1.

[293] G. M. Durner *et al.*, *Consequences of long-distance swimming and travel over deep-water pack ice for a female polar bear during a year of extreme sea ice retreat*, 34 Polar Biology 975 (2011).

[294] *Id.*

[295] N. W. Pilfold, *et al.*, *Migratory response of polar bears to sea ice loss: to swim or not to swim*, 40 Ecography 189 (2017).

[296] *Id.* at 189.

and conservation, primarily by reducing greenhouse gas emissions."[297] The BLM must analyze and fully disclose how developing and combusting fossil fuels extracted from the Coastal Plain could possibly contribute to conservation and recovery of this imperiled, iconic species.

f. BLM Must Consider Impacts to Polar Bears from a Decline in Primary Prey Species.

Exploration and development and vessel traffic could impede polar bear access to prey, which could affect their body condition and survival. Polar bears nearly exclusively consume seals. Their primary prey, ringed seals and bearded seals, live on ice edges that are already affected by loss of seasonal sea ice. Polar bears hunt for ringed and bearded seals in the spring and summer months when sea ice extent is greatest, and they can only access seals from the surface of sea ice.

BLM must assess how oil and gas exploration and drilling will directly and indirectly affect seal species populations, behavior and availability for polar bear predation. Cumulative impacts and synergistic effects from potential Arctic Refuge Coastal Plain, Beaufort Sea OCS, and state offshore lease sales, exploration and oil drilling programs could impact seal feeding, pup survival and vulnerability to a suite of predators. For example, ice breakers used to move drilling vessels and related equipment to leased areas may fragment sea ice that ice-dependent seals require to build lairs and raise and feed their pups. Seismic noise and related vessel activities may also disturb seals, thereby reducing seal availability to polar bears during critical feeding periods. Increased human activity associated with exploration and drilling may also increase the occurrence of other Arctic predators like Arctic fox and non-native red foxes (*Vulpes Vulpes)* and their predation on seal pups,[298] thereby increasing predator competition and loss of meat to scavenging, and further reducing polar bear access to prey.[299]

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[297] U.S. Fish & Wildlife Serv., *Polar Bear Conservation Management Plan* (2016) (U.S. Fish and Wildlife, Region 7, Anchorage, Alaska); available at https://www.fws.gov/alaska/fisheries/mmm/polarbear/pbmain.htm.

[298] L. E. Eberhardt, *et al.*, *Arctic fox home range characteristics in an oil-development area*, 46 Journal of Wildlife Management 1 (1982).

[299] I. Stirling and W. R. Archibald, *Aspects of predation of seals by polar bears*, 34 Journal of the Fisheries Research Board of Canada 8 (1977).

g. BLM Must Consider Cumulative, Additive and Synergistic Effects of Other Threats in Combination with Climate Change on Polar Bears

BLM must properly analyze the many cumulative, additive and synergistic impacts of the many threats and stressors to polar bears described above, which together could magnify impacts on the species and accelerate habitat loss on the Coastal Plain and across the region. It is critical that BLM analyze direct and indirect impacts in context with continued climate change in order to fully understand the effects of potential oil and gas development in the Arctic Refuge on polar bears.

Research exists on how oil and gas activities pose a multi-faceted threat to polar bears. For example, Amstrup et al. (2010) evaluated the future range-wide population status of polar bears under five GHG emissions scenarios.[300] Under the A1B, B1, and "mitigation" emissions scenarios (where the "mitigation scenario" was characterized by 450 ppm CO_2, radiative forcing of ~3.5 watts/m^2, and mean global temperature rise limited to ~1.75ºC above preindustrial temperatures by 2100), extinction was the dominant outcome in the Divergent ecoregion (where sea ice recedes from the coast in summer, and polar bears must remain on land or move with the ice as it recedes north) encompassing the SBS population.[301] When the mitigation scenario was combined with the best-possible on-the-ground management to reduce threats from harvest, bear-human interactions, and oil and gas activities, reduced population was still the dominant outcome for the Divergent ecoregion, although the probability of extinction was still substantial at 24 percent by 2100.[302]

BLM must undertake its own analysis of potential cumulative impacts as they relate specifically to the Arctic Refuge and oil and gas development therein. As explained above, oil and gas development will increase GHG pollution while causing direct impacts to polar bears, elevating threats to the species and frustrating recovery. The BLM's cumulative effects analysis must include predicted impacts on polar bears under the "no action" management alternative to provide a baseline for understanding both current and potential future threats to the species. The agency's assessment must also consider how polar bears will become increasingly vulnerable to cumulative, additive and synergistic effects as development proceeds and climate change worsens over time.

[300] S. C. Amstrup *et al.*, *Greenhouse gas mitigation can reduce sea-ice loss and increase polar bear persistence*, 468 Nature 955 (2010).
[301] *Id.* at 3.
[302] *Id.*

3. BLM Must Analyze and Fully Disclose the Impacts of an Oil and Gas Program on Muskoxen.

BLM must take a hard look at the myriad impacts of the proposed lease sales and resulting oil and gas development activities on muskoxen (*Ovibos moschatus*) and their habitats. A purpose of the Arctic Refuge identified by ANILCA is to conserve muskoxen,[303] and BLM must evaluate the impacts of the oil and gas program in light of this management purpose. Muskoxen are threatened by disturbance and displacement and habitat degradation from seismic activities and increased air and ground traffic; direct loss of habitat from gravel mining; barriers to movement from facilities, roads, and other infrastructure; increased hunting and poaching associated with increased human presence; increased predation due to increased numbers of predators attracted to human trash and food; and the additive and synergistic effects of climate change. According to the FWS,[304] oil and gas exploration and extraction can cause:

- displacement from preferred winter habitat
- increased energy needs related to disturbance and displacement
- decreased body condition of females
- increased incidents of predation
- decreased calf production and animal survival

The muskox population on the Coastal plan is small, isolated, and declining. After being extirpated from the region by the mid-1800s due to hunting,[305] muskoxen returned to the Arctic National Wildlife Refuge via reintroductions in 1969 and 1970.[306] The population grew to a high

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[303] ANILCA § 303(2)(B)(i).

[304] U.S. Fish and Wildlife Service, Arctic National Wildlife Refuge, Potential Impacts of Proposed Oil and Gas Development on the Arctic Refuge's Coastal Plain: Historical Overview and Issues of Concern (Jan 17, 2001), *available at*: https://www.fws.gov/uploadedFiles/Region_7/NWRS/Zone_1/Arctic/PDF/arctic_oilandgas_impact.pdf.

[305] Lent, P. C. 1999. Muskoxen and their hunters: a history. University of Oklahoma Press, Norman, Oklahoma.

[306] Jingfors, K.T. and D.R. Klein. 1982. Productivity in recently established muskox populations in Alaska. J. Wildl. Manage. 46:1092-1096.

of over 400 animals in the mid-1990s.[307] The larger population in northeast Alaska and northwest Canada dropped precipitously between 1998 and 2006,[308] largely due to losses from the Refuge, but may be stabilized. The dramatic decline is associated primarily with increased predation by grizzly bears,[309] but also disease,[310] winter weather,[311] distributional changes in the populations of other ungulates such as moose and caribou, and other factors.[312] Muskoxen continue to occur on the Arctic Refuge, though the Refuge may not currently have a permanent resident herd.

Predation, nutritional conditions, dispersal (which can all be affected by oil and gas development), and also weather are the primary influencers on the species' population dynamics.[313] Unlike other ungulates that inhabit the region, muskoxen do not migrate and persist in the Arctic year-round.[314] They build fat stores in summer, and conserve energy in winter by

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[307] Reynolds PE. 1998a. Dynamics and range expansion of a reestablished muskox population. J Wildl Manage 62: 734–744; Reynolds PE, Reynolds HV, Shideler RT. 2002. Predation and multiple kills of muskoxen by grizzly bears. Ursus 13: 79–84.

[308] Reynolds PE, Reynolds HV, Shideler RT. 2002. Predation and multiple kills of muskoxen by grizzly bears. Ursus 13: 79–84; Lenart EA. 2011. Units 26B and 26C muskoxen management report. In: Harper P, editor. Muskox management report of survey-inventory activities 1 July 2008–30 June 2010. Alaska Department of Fish and Game, Juneau, Alaska, pp. 63–84.

[309] Reynolds PE, Reynolds HV, Shideler RT. 2002. Predation and multiple kills of muskoxen by grizzly bears. Ursus 13:79–84.

[310] Afema, Josephine A., Kimberlee B. Beckmen, Stephen M. Arthur, Kathy Burek Huntington, and Jonna AK Mazet. 2017. Disease complexity in a declining Alaskan muskox (*Ovibos moschatus*) population. Journal of Wildlife Diseases 53(2): 311-329.

[311] Berger, J., C., Hartway, A. Gruzdev, and M. Johnson. 2018. Climate Degradation and Extreme Icing Events Constrain Life in Cold-Adapted Mammals. Scientific Reports 8(1): 1156.

[312] Barboza PS, Reynolds PE. 2004. Monitoring nutrition of a large grazer: Muskoxen on the Arctic Refuge. Int Congr Ser 1275: 327–333.

[313] Reynolds PE. 1998b. Ecology of a reestablished population of muskoxen in northeastern Alaska. PhD Thesis, University of Alaska, Fairbanks, Alaska, 106 pp. Reynolds PE, Reynolds HV, Shideler RT. 2002. Predation and multiple kills of muskoxen by grizzly bears. Ursus 13: 79–84.

[314] Jingfors, K.T. 1982. Seasonal Activity Budgets and Movements of a Reintroduced Alaskan Muskox Herd. Journal Wildlife Management 46(2): 344-350.

trying to avoid movement.[315] Winter forage availability is typically of limited quantity and of low nutritional quality. Muskoxen winter habitat is restricted to shallow snows, often along windswept ridges because they do not move well in deep snow.[316] Additionally, the species reproduces slowly — not breeding until age four or five, only breeding every other year and sometimes less frequently, and only birthing one calf per cycle. These characteristics make the muskoxen vulnerable to oil and gas development activities, particularly in winter.

a. BLM Must Consider Impacts to Muskoxen from Seismic and Other Activities in Winter.

Seismic exploration, which tends to occur in winter, and other oil and gas development activities, such as air and ground traffic, can disturb muskoxen and have detrimental impacts to the animals' energy balance.[317] Reactions to seismic activities can be variable, but some have responded with alert behavior, assorting in defensive formations, and running from the disturbance from distances up to 2.5 miles away from operations.[318] According to the BLM, "Where 3-D seismic exploration survey lines were located only 500 to 2,000 feet apart, localized displacement of terrestrial mammals could last for several days or *lead to complete abandonment of localized habitat*"[319] (emphasis added). Calving season — just before snowmelt from mid-

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[315] J. Dau, Muskox Survey-Inventory Management Report, Unit 23. In Muskox. Federal Aid in Wildlife Restoration - Inventory Management Report, Grants W-24-5 and W27-1, Study 16.0, M.V. Hicks (ed.). Alaska Department of Fish and Game, Juneau, Alaska. (2001).

[316] U.S. Department of the Interior, Fish & Wildlife Service. 1999. Guide to Management of Alaska's Land Mammals. U.S. Department of Interior, U.S. Fish and Wildlife Service, Office of Subsistence Management. Anchorage, Alaska.

[317] Department of Interior, Bureau of Land Management. National Petroleum Reserve – Alaska, Final Integrated Activity Plan/EIS. Vol. 2, Ch. 4 (November 2012) at 189 and 191.

[318] P.E. Reynolds and D.J. LaPlant. 1985. Effects of Winter Seismic Exploration Activities on Muskoxen in the Arctic National Wildlife Refuge. In Arctic National Wildlife Refuge Coastal Plain Resource Assessment. 1984 Update Report Baseline Study of the Fish, Wildlife, and Their Habitats, G.W. Garner and P.E. Reynolds (eds.). ANWR Progress Report No, FY85-2, Volume I. U.S. Department of Interior, U.S. Fish and Wildlife Service, Anchorage, Alaska; J.F. Winters and R.T. Shidler 1990. An Annotated Bibliography of Selected References of Muskoxen Relevant to the National Petroleum Reserve. Alaska Department of Fish and Game. Fairbanks, Alaska.

[319] Department of Interior, Bureau of Land Management. Northeast National Petroleum Reserve – Alaska, Final Supplemental Integrated Activity Plan/EIS. Vol. 2, Ch. 4 (May 2008) at 4-158.

April to mid-May — is a sensitive time, and anthropogenic disturbance can be particularly taxing.[320] If the same animals experience repeated disturbance, energetic deficits could lead to increased mortality rates.[321]

b. BLM Must Consider Impacts to Muskoxen from Oil Spills and Resulting Release of Contaminants and Other Effects.

Oil spills can harm muskoxen by contaminating habitat and forage, causing air pollution, and causing disturbance with clean-up activities. Damage to tundra vegetation, including killing off macroflora, could persist for years, even decades.[322] Spills affecting waterways could have very detrimental effects to muskoxen because they congregate in riparian areas during summer months

Muskoxen are difficult to study, given the harsh conditions of where they live. But studies of oil spill impacts to cattle may be comparative. The 2012 DEIS for the NPRA IAP stated:

> Toxicity studies of crude-oil ingestion in cattle indicate that substantial weight loss and aspiration pneumonia leading to death are possible effects (Rowe et al. 1973). Exposure of livestock (horses and cattle) utilizing grazing lands with oil development has resulted in mortality and morbidity (Edwards 1985). Exposure could involve heavy metals, salt water, caustic chemicals, crude oil, and condensates. In cattle, this exposure has been shown to result in a wide variety of symptoms including effects on the central nervous system, cardio-pulmonary abnormalities, gastrointestinal disorders, inhalation pneumonia, and sudden death. Caribou, moose, and muskox that become oiled by contact with a spill in contaminated lakes, ponds, rivers, or coastal waters could die from toxic

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[320] Department of Interior, U.S. Fish and Wildlife Service. Proposed Oil and Gas Exploration within the Coastal Plain of the Arctic National Wildlife Refuge, DEIS and Draft Regulations. (September 1982) at IV-34.

[321] *Id.*

[322] McKendrick, J.E. and W. Mitchell. 1978. Fertilizing and Seeding Oil-Damaged Arctic Tundra to Effect Vegetation Recovery, Prudhoe Bay, Alaska. Arctic 31(3): 296-304; McKendrick, J.E. 2000. Vegetative Responses to Disturbance. In The Natural History of an Arctic Oil Field: Development and the Biota, J.C. Truett and S.R. Johnson (eds.). Academic Press, New York, New York.

hydrocarbon inhalation and absorption through the skin. In addition to acute toxicity, mortality from chronic effects could occur well after a spill.[[323]]

c. BLM Must Consider Impacts to Muskoxen from Facilities Construction, Roads and Other Related Infrastructure Associated with Oil and Gas Development.

Roads, pipelines, and other infrastructure can cause movement barriers and habitat fragmentation as well as habitat loss.[324] Gravel mining associated with oil and gas facility and road construction can cause harm from habitat loss, water loss, and disturbance and displacement.[325] Mining often occurs in river floodplains, where muskoxen congregate in the summer. Vegetation disturbance could lead to encroachment of non-native vegetation, affecting forage availability. The impacts of each of these activities on muskoxen must be considered in the EIS.

d. BLM Must Consider Impacts to Muskoxen from Increased Human Presence and Activity.

Grizzly bears are the primary predator on muskoxen, and they have caused significant declines in the northeastern Alaska population, as discussed above. Increased human presence around oil and gas facilities is likely to attract predators to oil and gas facilities due to trash and food accumulation. Predation not only causes mortality but also increases animal vigilance, stress, and energy use. Muskoxen typically respond to predation threats by circling into defensive groups. They may also respond by running and abandoning a resting site, and leaving

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[323] U.S. Department of Interior, Bureau of Land Management, Draft Environmental Impact Statement for the National Petroleum Reserve – Alaska, Integrated Activity Plan, Vol. 2, Chapter 4 (sections 4.1 to 4.6) (March 2012) at 195; Edwards, W.C. 1985. Toxicology Problems Related to Energy Production. Veterinary and Human Toxicology 21: 328-337; Rowe, L., J. Dollahite, and B. Camp. 1973. Toxicity of Two Crude Oils and of Kerosene to Cattle. Journal of American Veterinary Medicine Association 16: 60-66.

[324] Garner, G.W. and P.E. Reynolds (eds.). 1986. Impacts of Further Exploration, Development and Production of Oil and Gas Resources. In Arctic National Wildlife Refuge Coastal Plain Resource Assessment, Final Report. Baseline study of Fish, Wildlife, and Their Habitats, Volume II. U.S. Department of the Interior, Fish and Wildlife Service, Anchorage, Alaska. Clough, J.G., A.C. Christensen, and P.C. Patton (eds.). 1987. Arctic National Wildlife Refuge, Alaska, Coastal Plain Resource Assessment. U.S. Department of the Interior, Washington D.C.

[325] *Id.*

calves vulnerable to predation. Recently, declines in caribou and moose populations in the region — the historic prey base for grizzlies — has led to increased predation of muskoxen.[326]

Increased human presence and access to the region due to an increase of roads will likely lead to increased hunting and poaching of muskoxen. Hunting pressure has increased in other areas inhabited by muskoxen and have had potentially significant impacts on abundance. Not only does hunting cause direct mortality, but the targeting of males for trophies can decrease the resiliency of whole herds.[327] Males play a significant role in defensive behavior versus predators. The loss of males can lead to increased calf losses. The presence of humans cause general disturbance, and energy-depleting responses as described above. Oil and gas development will increase helicopter and plane traffic, road traffic, and off-highway vehicle use.[328] All of these activities and impacts on muskoxen must be considered in the EIS.

e. BLM Must Consider the Cumulative, Additive, and Synergistic Impacts of Other Threats in Combination with Climate Change Effects on Muskoxen.

Climate change is already affecting muskoxen habitat and is likely affecting the health of individuals. Warm, wet years can be detrimental to muskoxen populations, as shown by past research conducted in Greenland and Canada.[329] More erratic weather conditions in the Arctic is likely also contributing to mortality and morbidity. For example, rain-on-snow (ROS) events can cause direct mortality by freezing animals in the path of an extreme occurrence. Such an occurrence caused the sudden death of over 50 muskoxen in northwestern Alaska.[330] These events can also create icing conditions that prevents access to forage, and this may have an

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[326] Arthur, Stephen M., and Patricia A. Del Vecchio. 2017. Effects of grizzly bear predation on muskoxen in northeastern Alaska. Ursus 28(1): 81-91.

[327] Schmidt, J. H., and T. S. Gorn. 2013. Possible secondary population- level effects of selective harvest of adult male muskoxen. PLoS ONE 8(6):e67493; Berger, J. 2017. The Science and Challenges of Conserving Large Wild Mammals in 21st-Century American Protected Areas." Science, Conservation, and National Parks: 189.

[328] Murphy, S.M. and B.E. Lawhead. 2000. Caribou. In The Natural History of an Arctic Oil Field: Development and the Biota, J.C. Truett and S.R. Johnson (eds.). Academic Press, San Diego, California.

[329] Berger, J. 2017. The Science and Challenges of Conserving Large Wild Mammals in 21st-Century American Protected Areas. Science, Conservation, and National Parks: 189.

[330] Dau, J. 2005. Two caribou mortality events in northwest Alaska: Possible causes and management implications. Rangifer 25: 37–50.

adverse impact on the long-term health of individuals, especially if they experience food deprivations as juveniles.[331] ROS events are likely to increase as climate warming increases. New diseases appearing in the northeastern population of muskoxen may be correlated with warming temperatures.[332] Illness causes mortality and can make animals more vulnerable to predation. The impacts of climate change on muskoxen must be considered in the EIS.

4. BLM Must Analyze and Fully Disclose the Impacts of an Oil and Gas Program on Birds.

According to the Arctic Refuge CCP,[333] 201 bird species have been recorded in the Refuge. Of those, the following 92 breeding birds and nonbreeding migrants have been observed on the Refuge coastal plain (including inland coastal plain and nearshore islands). According to the U.S. Geological Survey, at least 57 of these species "regularly occur as breeding, nonbreeding, or both in the 1002 Area."[334] All but the two ptarmigan species and three grouse species are protected under the MBTA,[335] and several are protected under ESA or BGEPA, or are agency-designated sensitive species (see keys below tables). Some species that are uncommon breeders are present in larger numbers as nonbreeding migrants, such as the Greater White-fronted Goose and Brandt.[336]

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[331] Berger, J., C. Hartway, A. Gruzdev, and M. Johnson. 2018. Climate Degradation and Extreme Icing Events Constrain Life in Cold-Adapted Mammals. Scientific Reports 8(1): 1156.

[332] Kutz SJ, Jenkins EJ, Veitch AM, Ducrocq J, Polley L, Elkin B, Lair S. 2009. The Arctic as a model for anticipating, preventing, and mitigating climate change impacts on host-parasite interactions. Vet Parasitol 163: 217–228; Kutz SJ, Bollinger T, Branigan M, Checkley S, Davison T, Dumond M, Elkin B, Forde T, Hutchins W, Niptanatiak A, et al. 2015. Erysipelothrix rhusiopathiae associated with recent widespread muskox mortalities in the Canadian Arctic. Can. Vet. J. 56: 560–563; Afema, Josephine A., Kimberlee B. Beckmen, Stephen M. Arthur, Kathy Burek Huntington, and Jonna AK Mazet. 2017. Disease complexity in a declining Alaskan muskox (Ovibos moschatus) population." Journal of Wildlife Diseases 53(2): 311-329.

[333] CCP Final EIS, Appendix F.

[334] Pearce, J.M. et al. 2018. Summary of Wildlife-Related Research on the Coastal Plain of the Arctic National Wildlife Refuge, Alaska, 2002–17. Open-File Report 2018-1003. US Geological Survey, Reston, VA.

[335] U.S. Fish and Wildlife Serv., Migratory Bird Act Protected Species, *available at*: https://www.fws.gov/birds/management/managed-species/migratory-bird-treaty-act-protected-species.php.

[336] Pearce, J.M. et al. 2018. Summary of Wildlife-Related Research on the Coastal Plain of the Arctic National Wildlife Refuge, Alaska, 2002–17. Open-File Report 2018-1003. US Geological Survey, Reston, VA.

Abundant, Common & Fairly Common Breeders	**Uncommon Breeders**	**Possible Breeders**	**Nonbreeding Species**	**Rare to Casual Breeders**
Cackling Goose Tundra Swan Northern Pintail King Eider* Common Eider (islands) Long-tailed Duck Red-breasted Merganser Willow Ptarmigan‡ Rock Ptarmigan‡ *Red-throated Loon* Pacific Loon American Golden-Plover†* Semipalmated Plover **Upland Sandpiper** Ruddy Turnstone Semipalmated Sandpiper† Pectoral Sandpiper†* Red-necked Phalarope Red Phalarope Glaucous Gull Pomarine Jaeger Long-tailed Jaeger Snowy Owl‡* *Eastern Yellow Wagtail Lapland Longspur Snow Bunting	Greater White-fronted Goose Brant* Rough-legged Hawk Golden Eagle Gyrfalcon‡ Spotted Sandpiper Wandering Tattler* Baird's Sandpiper ***Dunlin**** Stilt Sandpiper ***Buff-breasted Sandpiper**** Long-billed Dowitcher Sabine's Gull *Arctic Tern* Parasitic Jaeger **Short-eared Owl** American Dipper‡ American Robin White-crowned Sparrow	Northern Shoveler Surf Scoter White-winged Scoter Horned Grebe Northern Harrier Merlin ***Bar-tailed Godwit**** Western Sandpiper Wilson's Snipe Northern Shrike Cliff Swallow	Abundant to Common: Snow Goose Uncommon: American Wigeon Black Scoter* ***Yellow-billed Loon**** Rare to Casual: Ross's Goose ***Red Knot**** Sharp-tailed Sandpiper* Ivory Gull* Ross's Gull* Herring Gull Thick-billed Murre	Trumpeter Swan Mallard Green-winged Teal Greater Scaup* Lesser Scaup SPECTACLED EIDER* Harlequin Duck ***Peregrine Falcon*** Sandhill Crane Black-bellied Plover ***Whimbrel**** Sanderling White-rumped Sandpiper Mew Gull Black Guillemot Common Raven‡ Horned Lark Bluethroat American Pipit Yellow Warbler Fox Sparrow

American Tree Sparrow Savannah Sparrow Common Redpoll Hoary Redpoll				

Key to species designations:
ALLCAPS= Federally threatened under the ESA
SMALLCAPS = Protected under BGEPA
Bold = FWS Birds of Conservation Concern, National (2008)[337]
Italic = FWS Birds of Conservation Concern, Bird Conservation Region 3 (Arctic Plains & Mountains)[338]
Underlined= BLM Sensitive Species
†2016 Shorebirds of Conservation Concern[339] prepared for next revision of BCC list
*Audubon Alaska 2017 WatchList Species[340]
‡ Year-round resident

Additionally, the following species are known as rare to casual visitors to the coastal plain of the Refuge, but may in the future have increased presence in the area due to local and global change:

Rare to Casual Visitors		
Gadwall	Least Sandpiper	Violet-green Swallow*
Eurasian Wigeon	Ruff	Bank Swallow*
Canvasback	Black-legged Kittiwake*	Barn Swallow
STELLER'S EIDER	Bonaparte's Gull	Northern Wheatear
Common Goldeneye	Thayer's Gull	Gray-cheeked Thrush
Common Merganser	Slaty-backed Gull	Varied Thrush

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[337] U.S. Fish and Wildlife Service, 2008. Birds of Conservation Concern. https://www.fws.gov/migratorybirds/pdf/management/BCC2008.pdf, Table 48
[338] *Id.*, Table 4
[339] U.S. Shorebird Conservation Plan Partnership. 2016. U.S. Shorebirds of Conservation Concern — 2016, *available at:* https://www.shorebirdplan.org/wp-content/uploads/2016/08/Shorebirds-Conservation-Concern-2016.pdf.
[340] Warnock, N. 2017. The Alaska WatchList 2017. Audubon Alaska, Anchorage, AK 99501.

Common Loon	Glaucous-winged Gull	***Smith's Longspur***
Red-necked Grebe*	Least Auklet	Orange-crowned Warbler*
Northern Fulmar	Horned Puffin	Yellow-rumped Warbler
Short-tailed Shearwater	Tufted Puffin*	Northern Waterthrush
BALD EAGLE	Common Nighthawk	Wilson's Warbler
Sharp-shinned Hawk	Belted Kingfisher	Chipping Sparrow
Northern Goshawk	Say's Phoebe	White-throated Sparrow
American Kestrel	Gray Jay	Dark-eyed Junco
Killdeer	Tree Swallow	Red-winged Blackbird
Eurasian Dotterel		**Rusty blackbird**
Lesser Yellowlegs*		Brown-headed Cowbird
Hudsonian Godwit		Pine Siskin
Red-necked Stint		

Key to species designations:
ALLCAPS= Federally threatened under the ESA
SMALLCAPS = Protected under BGEPA
Bold = FWS Birds of Conservation Concern, National (2008)
Italic = FWS Birds of Conservation Concern, Bird Conservation Region 3 (Arctic Plains & Mountains
Underlined= BLM Sensitive Species
*Audubon Alaska 2017 WatchList Species

BLM must include a catalogue of the species of terrestrial, aquatic, and marine birds that use the Coastal Plain of the Arctic Refuge at various life stages, and include details on each species' status, distribution, abundance, and available conservation resources and discuss the impacts to each. The EIS should provide a monitoring plan to track effects of development, activity, noise, and climate on birds that breed, feed, molt, and stage in the planning area. The agency must also review existing literature and identify gaps in knowledge. The Coastal Plain of the Arctic Refuge is also an important migratory staging area for some bird species.[341] The agency should describe the migratory staging phenomenon, and analyze the ways that an oil and gas program in the program area may impact migratory staging.

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[341] *See, e.g.*, Jerry W. Hupp and Donna G. Robertson, *Forage site selection by lesser snow geese during autumn staging on the Arctic National Wildlife Refuge, Alaska*, 138 Wildlife Monograph 3 (1998).

Conservation of the birds of the Arctic Refuge is of interest nationally and internationally, not just locally. Many Refuge species undertake lengthy migrations: the various species that occur in the Arctic Refuge migrate to all 50 states and six continents (see Appendix), so any impacts that reduce the likelihood of successful survival, breeding, and migration are of concern to people in other states and around the globe. This is particularly true for the species that are indicated above as being Birds of Conservation Concern at both the Bird Conservation Region and National level. The following statement from the 2012 National Petroleum Reserve-Alaska Final Integrated Activity Plan/Environmental Impact Statement (NPR-A FEIS) holds true for the birds of the Arctic National Wildlife Refuge as well:

> Because most of the species found in the NPR-A migrate along the Pacific and mid-continent flyways and other major corridors to areas where they spend most of the year, numerous stakeholder groups in Alaska south of the Arctic Coastal Plain, the lower 48 states, and elsewhere, are interested in their conservation and management. These groups include consumptive and nonconsumptive users and wildlife managers. One or more national conservation plans or international agreements signed by the U.S. address most stakeholder interests. These include the Migratory Bird Treaty Act conventions with Mexico, Canada, and Russia, the North American Waterfowl Management Plan, Partners in Flight Bird Conservation Plans, the Arctic Goose, Pacific Coast, and Sea Duck Joint Ventures, U.S. National Shorebird Plan, the North American Colonial Waterbird Plan, North American Bird Conservation Initiative, and the Conservation of Arctic Flora and Fauna.[342]

a. *BLM must thoroughly assess the potential impacts of oil and gas spills and leaks on birds in the Refuge.*

[342] Bureau of Land Management, National Petroleum Reserve-Alaska Final Environmental Impact Statement (NPR-A FEIS) (2012), Volume 1, Section 3.3.5 at 242, *available at*: https://eplanning.blm.gov/epl-front-office/projects/nepa/5251/41003/43153/Vol1_NPR-A_Final_IAP_FEIS.pdf.

An oil and gas program in the Arctic terrestrial environment will cause spills of oil and associated noxious fluids and materials.[343] Oil spills on land can have devastating effects on birds,[344] and can be particularly impactful when the spill reaches a water source such as a lagoon, estuary, or marine environment. As on the NPR-A, oil and gas drilling in the Arctic presents the threat of crude oil spills from "pipelines, storage tanks, production and exploration facilities, drilling rigs (well-control incidents), and vessels"[345] and spills of refined products, including "avian fuel, diesel fuel, engine lube, fuel oil, gasoline, grease, hydraulic oil, transformer oil, and transmission oil,"[346] from "barges, helicopters, airplanes, gravel pad facilities"[347] and along gravel or ice roads. Spills of any of these types of products that enter terrestrial, aquatic or marine habitats can lead to "direct oiling of plumage, oiling of eggs, ingestion of oil, contamination of food resources, disturbance due to cleanup efforts, and long- and short-term loss or alteration of habitat due to spilled oil and cleanup activities."[348]

The magnitude of these impacts depends upon the season, type, amount and location of the spill, and by the timeliness and effectiveness of the response, potentially an enormous challenge in the Arctic environment. A review of oil spills off the coast of Norway[349] found that: 2000-3000 seabirds were killed by release of 570 tonnes of oil released from the 2004 grounding of the *MS Rocknes*; 3,200-8,000 birds died from the 388 tonnes of oil released in by the MS *Server* in 2007; 1,500 to 2,000 common eider and 500 other birds died when 293 tonnes of heavy oil leaked from the 2009 grounding of the MS *Full City*; and 2,500-3,00 seabirds were killed when 112 tonnes leaked from the grounding of the "Godafoss" in 2009. In one of the worst

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[343] *See e.g.* Alaska Department of Environmental Conservation, *Annual Summary of Oil and Hazardous Substance Spills Fiscal Year 2014* (2015), *available at*: https://dec.alaska.gov/spar/ppr/spill-information/spill-data.

[344] *See* Frederick A. Leighton, *The toxicity of petroleum oils to birds*, 1 Environmental Reviews 92 (1993), *available at*: http://www.nrcresearchpress.com/doi/abs/10.1139/a93-008#.WxGaQkgvzIU.

[345] NPR-A Final EIS. Volume 2, Chapter 4, Section 4.3.8.2 at 179.

[346] *Id.*

[347] *Id.*

[348] *Id.* at 179–180.

[349] Boitsov, S. et al. 2013. Experiences from oil spills at the Norwegian coast. A summary of environmental effects. Norwegian Institute of Marine Research, 36 pp. https://www.hi.no/filarkiv/2012/07/hi-rapp_23-2012_oljeutslipp.pdf/en.

incidents known, 700,000 birds died as a result of contamination from the Deepwater Horizon disaster.[350]

Gas releases could result from "(1) loss of well control at production areas, (2) ruptured gas pipelines, and (3) leaks at gas processing facilities," which raises the possibility of explosion and further is associated with "increased air pollution and associated health impacts and exacerbated climate impacts."[351]

The agency should provide oil spill scenarios that include the likelihood, potential frequency, times of year, and potential volume of oil spills from development and vessel activity and the impacts to birds. The agency should then compare these oil spill scenarios with where they may occur in the planning area using hypothetical development scenarios. The agency should compare oil spill scenarios and hypothetical occurrences on the landscape with range maps, movement timing, and life histories of the bird species that occur in the Arctic Refuge. Areas of particular concern are along rivers, river deltas, and barrier island lagoons in the fall and spring, where birds concentrate for migration and post-nesting staging.

b. BLM must assess the impact of habitat loss on Refuge birds.

The oil and gas program will result in the direct and indirect loss of bird habitat from roads, infrastructure, and human activity. The program will also result in impacts to wetlands and aquatic habitat through water use and contamination. The agency should quantify and describe the acreage that will be disturbed, destroyed, or covered in the process of seismic work, gravel excavation, gravel staging areas, building roads, pipelines, drill pads, crew housing and support, water withdrawals, and other activity stemming from the oil and gas program.[352] Analysis of the habitat impacts must include the full range of developments and construction activities that have the potential to destroy, degrade and fragment habitats. For birds, particular attention must be

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[350] Haney, J.C., H.J. Geiger and J.W. Short. 2014. Bird mortality from the Deepwater Horizon oil spill. II. Carcass sampling and exposure probability in the coastal Gulf of Mexico. Marine Ecology Progress Series Vol. 513: 239–252. http://www.int-res.com/articles/meps_oa/m513p239.pdf.

[351] *State of California v. BLM*, *Sierra Club v. Zinke*, Case Nos. 17-cv-07186-WHO; 17-cv-07187-WHO (N.D. Cal. 2018) (Order denying motion to transfer venue and granting preliminary injunction), *available at:* https://earthjustice.org/sites/default/files/files/Order%20Granting%20PI%20and%20Denying%20Tranfer%20BLM%20Suspension.pdf.

[352] *See supra* Part V.D.1.c.

paid to areas that are important for seasonal congregation, including breeding colonies, molting areas, and migration staging zones. Site utilization, particularly by special status species (threatened species and birds of conservation concern), should be thoroughly assessed prior to undertaking any activities that destroy habitats, and every effort should be made to avoid and minimize these impacts. Effects to aquatic habitats must also be considered, including stream crossings, wetlands, and proximity to lakes. The EIS must explain the impacts to birds that will result from these activities and what remedies and mitigation measures the agency will apply to address these problems.

Winter exploration activities entail potential proximate impacts to fewer species than do disturbances in the breeding or migration seasons, as only a few bird species (ptarmigan, snowy owl, gyrfalcon, raven, and dipper) occupy the Refuge year-round. However, the residual effects of ice roads and ice pads constructed for winter exploration activities, and the grid patterns left by seismic exploration, can linger long outside the winter season in the fragile tundra and cause changes in spring flow and hydrology. Following seismic exploration of the Arctic Refuge in 1984-5, 5% of seismic trails had not recovered even after 25 years.[353] These medium- and long-term vegetation changes potentially impact available nesting habitat, cover, and food resources for various avian species.

Ice roads and other winter infrastructure also utilize large quantities of fresh water. Whether water withdrawals for ice production have long-term effects on aquatic habitats depends on the specific hydrologic conditions of the area; the depth, number and connectedness of aquatic resources affects the rate of recharge. This, in turn could affect habitat and food availability for waterfowl and shorebirds.[354]

c. *BLM must assess and address other sources of additive mortality and behavioral disruption to birds, including collisions, nest destruction and predation, and noise disturbance.*

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[353] U.S. Fish & Wildlife Service. Arctic National Wildlife Refuge, Seismic Trails. https://www.fws.gov/refuge/arctic/seismic.html.

[354] BLM, 2012. NPR-A FEIS, Volume 2, section 4.3.8.2 (page 168) https://eplanning.blm.gov/epl-front-office/projects/nepa/5251/41004/43154/Vol2_NPR-A_Final_IAP_FEIS.pdf

Collisions with static infrastructure is a prominent cause of bird mortality around the globe.[355] Across the U.S. and Canada, collisions with buildings annually kill 365–988 million birds in the U.S. and 16–42 million in Canada; with automobiles 200–340 million in the U.S. and 9–19 million in Canada, and power lines 8–57 million in the U.S. and 10– 41 million in Canada.[356] BLM must assess the potential for collision mortality from the structures and vehicles associated with oil and gas exploration and development and undertake management practices to reduce these sources. We find that many of the recommendations associated with reducing mortality from wind energy development[357] are potentially applicable here: "(1) Avoiding areas of high bird use (e.g., regularly used flight paths, migration corridors, and aggregation areas); (2) Avoiding areas inhabited by sensitive species or those of conservation concern; (3) Avoiding topographical features that promote foraging or that are used by migrating birds for uplift (e.g., the tops of slopes; Kitano and Shiraki 2013); (4) Avoiding areas of high biodiversity, endemism, and ecological sensitivity; (5) Developing conservation buffers for vulnerable species based on thresholds determined through empirical research; (6) Carefully selecting or modifying infrastructure to minimize collision risk or indirect effects," such as by modifying lighting or operations as conditions warrant. The agency should include discussion of lighted structures at night or in foggy conditions that may attract or disorient birds as they migrate or commute to foraging areas.

Tundra travel and development activities during the nesting season risks trampling or forcing the abandonment of bird nests. In Canada, it has been estimated that terrestrial oil and gas development (well sites, pipelines, oil sands, and seismic exploration) causes annual

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[355] Graham R. Martin, *Understanding bird collisions with man-made objects: a sensory ecology approach*, 153 Ibis 239 (2011), *available at*: https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1474-919X.2011.01117.x; Andrew R. Jenkins, Jon J. Smallie, and Megan Diamond, *Avian collisions with power lines: a global review of causes and mitigation with a South African perspective*, 20 Bird Conservation International 263 (2010), *available at*: https://www.cambridge.org/core/journals/bird-conservation-international/article/avian-collisions-with-power-lines-a-global-review-of-causes-and-mitigation-with-a-south-african-perspective/8C0875430F0C4376693820CA3A90369C.

[356] Loss, S.R. 2016. Avian interactions with energy infrastructure in the context of other anthropogenic threats. The Condor 118: 424–432. http://www.americanornithologypubs.org/doi/pdf/10.1650/CONDOR-16-12.1

[357] Smith, J.A. and J.F. Dwyer. 2016. Avian interactions with renewable energy infrastructure: An update. The Condor 118: 411–423. http://www.americanornithologypubs.org/doi/pdf/10.1650/CONDOR-15-61.1

mortality of between 9,900–72,000 birds due to nest destruction.[358] The agency must assess the direct impacts from industrial activity on bird nest survivorship.

Buildings, human activity, and waste products attract mammalian predators. In an extremely horizontal landscape, infrastructure, vehicles, buildings, and other vertical structures can offer nesting and perching habitat for avian predators as well.[359] Infrastructure therefore may have an impact on tundra nesting birds via increased predation. The National Research Council, in its 2003 report on "Cumulative Environmental Effects of Oil and Gas Activities on Alaska's North Slope,"[360] notes that: Birds and their nests in the oil fields have a suite of predators, the most important of which are arctic foxes, glaucous gulls, grizzly bears, and ravens. The populations of all those predators have increased in the oil fields. . . most likely because of the increase in garbage." The NPR-A FEIS[361] also cites evidence that buildings and other structures on the North Slope have provided ravens with artificial nest locations, which may also contribute to increased predation pressure. Predation on passerine nests has been found to be higher within five kilometers of oilfield infrastructure on the Arctic coastal plain.[362]The EIS should describe, quantify, and analyze the increased predation on nesting birds that will occur from development infrastructure and compare the increased predation potential with the distribution and abundance of vulnerable bird species.

Noise from all stages of industrial activity can impact birds including causing stress, fright or flight, avoidance, changes in behavioral habits like nesting and foraging, changes in nesting success, modified vocalizations, or interference with the ability to hear conspecifics or predators.[363] For instance:

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[358] Loss, S.R. 2016.

[359] Liebezeit, J. R., J. Kendall, S. Brown, C. B. Johnson, P. Martin, T. L. McDonald, D. C. Payer, C. L. Rea, B. Streever, A. M. Wildman, and S. Zack, *Influence of human development and predators on nest survival of tundra birds, Arctic Coastal Plain, Alaska*, 19 Ecological Applications 1628 (2009), *available at*: https://www.ncbi.nlm.nih.gov/pubmed/19769108 .

[360] National Research Council, 2003. Cumulative Environmental Effects of Oil and Gas Activities on Alaska's North Slope. The National Academies Press, Washington, D.C., *available at:* http://www.nap.edu/openbook/0309087376/html/1.html.

[361] BLM, 2012. NPR-A FEIS, Volume 1 Section 3.5.8.8 (pp. 277-278).

[362] *See supra* Note 369.

[363] Clinton D. Francis and Jessica L. Blickley, *The influence of Anthropogenic Noise on Birds and Bird Studies*, 74 Ornithological Monographs 6 (2012), *available at*:

Aircraft: The noise of helicopter and plane overflights can elicit avoidance behaviors, including flushing from nests and disruption of feeding. This is particularly of concern with birds that are naïve to such disturbances, as is likely the case on the coastal plain of the Refuge. In Colorado, breeding Red-tailed hawks (*Buteo jamaicensis*) in an area newly exposed to low-level helicopter traffic flushed from nests at a much higher rate than those in an area that had experienced decades of such traffic (52% vs 8%).[364] Low-flying aircraft are also potentially problematic outside the breeding season. Low overflights of large helicopters were associated with significant weight loss in Pacific black brant (*Branta bernicla nigricans*) during their first week of molt near Teshekpuk Lake, Alaska.[365] Fall-staging brant also took flight in response to low-flying aircraft (particularly helicopters), as did Canada geese (*B. canadensis*) to a lesser extent.[366] During staging and feeding in preparation for autumn migration, low flying aircraft repeatedly prompted snow geese (*Chen caerulescens atlantica*) in a sanctuary in Quebec were to take flight, with disturbance to the entire flock in 20% of the cases and disruption to feeding behavior lasting a mean of 12 minutes. Furthermore, disturbance levels of greater than 2.0 per hour resulted in a 50% drop in the mean number of geese using the sanctuary the following day.[367] The combination of energy expenditure due to taking flight plus the loss of feeding time represented a significant energy loss for snow geese in the pre-migration staging.[368]

Vehicles, Equipment and Pedestrians: According to the NPR-A FEIS, "Activities related to oil and gas development and production, such as vehicle, aircraft, pedestrian, and boat traffic, routine maintenance activities, heavy equipment use, and oil and gas spill cleanup activities could create disturbances that affect birds. These disturbances could result in temporary or

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http://americanornithologypubs.org/doi/pdf/10.1525/om.2012.74.1.6?code=coop-site, *see also supra* Part VI.B.5.

[364] Anderson, D.E., O.J. Rongstad, and W.R. Mytton. 1989. Response of nesting Red-tailed Hawks to helicopter overflights. Condor 91(2):296-299.

[365] Miller, M.W. 1994. Route selection to minimize helicopter disturbance of molting Pacific Black Brant: a simulation. Arctic 47(4):341-349.

[366] Ward, D.H., R.A. Stehn, W.P. Erickson, and D.V. Derksen. 1999. Response of fall-staging Brant and Canada Geese to aircraft overflights in southwestern Alaska. Journal of Wildlife Management 63(1):373-381.

[367] Belanger, L. and J. Bedard. 1989. Responses of staging Snow Geese to human disturbance. Journal of Wildlife Management 53:713-719.

[368] Belanger, L. and J. Bedard. 1990. Energetic cost of man-induced disturbance to staging Snow Geese (*Chen caerulescens atlantica*). Journal of Wildlife Management 54:36-41.

permanent displacement from preferred habitats, potentially resulting in decreased nest attendance, nest abandonment, nest predation, and increased energy expenditures that could affect an individual bird's survival or reproduction."[369] While noise and dust are issues from motorized equipment, there is evidence that human foot traffic is also major cause of birds taking flight, particularly geese, swans and raptors.[370] Birds in molt that are unable to take flight may experience elevated stress and energetic loss when exposed to vehicular and pedestrian traffic. All these types of disturbances and impacts could also affect birds in the Arctic Refuge as well, and each should be thoroughly assessed. The EIS should catalogue the existing noise in the planning area, explain the changes in noise that will occur with the development of an oil and gas program, describe impacts that will occur for birds, and provide a method for addressing and monitoring this issue.

Finally, the agency should consider impacts to birds within the project area at the project-, state-, national-, and global-population levels. The EIS should evaluate the cumulative impacts like collisions, acoustic effects, disturbance from vehicle and vessel traffic on water and land, habitat fragmentation and loss, road effects, increased predation from predator attraction to infrastructure, oil spills, water withdrawals and water contamination, and climate effects such as warmer soil temperatures, vegetation changes, and any shift in phenology that may affect foraging and nesting opportunities. The cumulative impact analysis is particularly critical for migratory birds because their life histories take them around the globe along migratory routes, where they require suitable stopover habitat and wintering habitat in addition to their Arctic nesting habitat. The effects on birds from one part of their life history can impact them in surprising ways in other times of their life cycle.[371] Threats and influences beyond the North Slope should be considered for migratory bird populations in the project area.

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[369]BLM, 2012. NPR-A FEIS, Volume 2, Section 4.3.8.2 (page 173).

[370] Johnson et al. 2003. Alpine avian monitoring program, 2001. Fourth annual and synthesis report for ConocoPhillips Alaska, Inc., and Anadarko Petroleum Corporation, Anchorage, by ABR, Inc., Fairbanks, AK. 194 pp.

[371] *See e.g.* Jan A. Van Gils, Simeon Lisovski, Tamar Lok, Wlodzimierz Meissner, Agnieszka Ozarowska, Jimmy De Fouw, Eldar Rakhimberdiev, Mikhail Y. Soloviev, Theunis Piersma, and Marcel Klaassen, *Body shrinkage due to Arctic warming reduces red knot fitness in tropical wintering range,* 13 Science 819 (2016).

5. **BLM Must Analyze and Fully Disclose the Impacts of an Oil and Gas Program on Terrestrial Mammals, including brown bears, wolves, and foxes.**

   a. *BLM must assess and fully disclose the impacts of the oil and gas program on both predator and prey species, and predator-prey relationships.*

BLM must take a hard look at how the proposed lease sales and subsequent oil and gas development will affect terrestrial mammals in the Arctic Refuge. The agency must study direct impacts, such as increased human interaction, increased reliance on human-created food sources, and increased habitat disruption. BLM must also analyze indirect impacts of these activities on wildlife, including potential effects on predator-prey relationships.

Existing oil and gas development on the North Slope has already altered wildlife behavior and distribution and created source-sink population dynamics for some species. Garbage and food associated with oil fields have produced higher than normal densities of predators (such as brown bears, arctic foxes, ravens, and glaucous gulls) that prey on bird eggs, nestlings, and fledglings. As a result, the reproduction rates of some bird species such as black brant, snow geese, eiders, and probably some shorebirds in industrial areas are, at least in some years, insufficient to balance mortality. These populations may persist in the oil fields only because of immigration of individuals from source areas where annual production exceeds mortality.[372]

In addition to drawing predators to prey habitats, oil and gas development may push prey toward predators. For example, it could displace caribou from preferred calving or feeding grounds on the Coastal Plain, forcing herds south or east, potentially increasing predation risk from brown bears and wolves that favor habitat to the south. Similarly, muskox populations that are already declining face increased predation risk if bear and wolf populations rise on the Coastal Plain or if development displaces muskoxen further south into traditionally denser bear and wolf habitats.

[372] National Research Council 2003. *Cumulative Environmental Effects of Oil and Gas Activities on Alaska's North Slope*. Washington, DC: The National Academies Press, *available at*: https://doi.org/10.17226/10639.

Additional impacts to bird, caribou, and muskox populations are discussed in other sections of these comments. In addition to affecting the prey populations in the area, oil and gas development in the Arctic Refuge would adversely affect the predators themselves.

b. BLM Must Assess the Impacts of Increased Human-Brown Bear Interactions and the Alteration or Destruction of Brown Bear Habitat.

A purpose of the Arctic Refuge is to conserve brown bears (*Ursus arctos)*,[373] and the BLM must evaluate the effects of the leasing program against this management standard. The brown bear inhabits the Arctic Refuge and the Coastal Plain and is a species known to be drawn to oil and gas development areas. BLM must analyze how development in the Refuge would affect brown bears. This is particularly important because brown bears in the Refuge have lower rates of reproduction than brown bears in other areas and there is a distinct lack of information about brown bears on the Coastal Plain.

In the Arctic Refuge, the average female brown bear does not successfully reproduce until age nine years.[374] The average litter size for brown bears in arctic areas is two, and cubs can have a high mortality rate during their first year. Weaning does not occur until age two or three years. The interval between successful litters exceeds three years. The delayed age for initial reproduction, long inter-birth intervals, small litters and high cub mortality result in low rates of reproduction for brown bears in northern latitudes.

Brown bears are more abundant in the foothills and mountains of the Brooks Range in the Arctic Refuge than on the Coastal Plain. A 2007 study estimated there were 390 brown bears in the foothills and mountains between the Canning River and the U.S.-Canada border (Game Management Unit 26C) and 269 brown bears in the northwestern Refuge and adjacent areas (Unit 26B). Population trends and distribution of brown bears south of the Brooks Range are not well known.[375]

Brown bear distribution was mapped based on annual locations of radio-collared bears during the first week of June from 1983 to 1994. There have been no additional distribution studies or updates of this information for the Refuge Coastal Plain since 2002.[376] BLM should

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[373] ANILCA § 303(2)(B)(i).
[374] CCP Final EIS at 4-123.
[375] *Id.* at 4-124.
[376] 2018 USGS Report at 7.

identify baseline brown bear distribution before developing any oil and gas program for the Coastal Plain to better understand subsequent significant changes in habitat use.

The existing infrastructure that supports industrial development in the Arctic substantially increases bear-human interactions. BLM must study how additional industrial development to support potential leases on the Refuge would exacerbate interactions. Development has led to at least temporarily increased brown bear population density and prey mortality near oil fields, and could have long-term impacts on brown bear populations on the North Slope.[377] There are a number of ways in which brown bears drawn to development areas are directly affected and BLM must analyze how the proposed lease sales and post-lease activity would perpetuate that.

For example, increased human presence could lead to increased hunting. An average of 36 brown bears were killed per year by general public hunters in and near the Refuge during 1993–2006.[378] The number of brown bears taken by subsistence hunters is unknown. New roads and increased presence of humans on the Coastal Plain could lead to increased hunting pressure on brown bears on the Coastal Plain, as development in the central Arctic increased potential hunter access by road and airstrip.[379] Defense of life and property (DLP) mortality of brown bears also arises with increased human presence and anthropogenic food availability. Twenty-one percent of oil-field brown bears were found to supplement natural forage with anthropogenic food sources; when access to garbage and human food was suddenly eliminated, food-conditioned bears suffered DLP mortalities at greater than sustainable rates.[380] Research on brown bear populations that use Prudhoe Bay oil fields showed that bears that consumed human food resources had higher than average cub survival (possibly also due to a scarcity of natural predators such as wolves, wolverines, and adult male bears). But this increased cub survival was offset by greater-than-average mortality among post-weaned subadults because their conditioning to human foods made them more vulnerable to hunters along the Dalton Highway, which included DLP take.[381]

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[377] National Research Council 2003 at 157–58.

[378] CCP Final EIS at 4-124.

[379] Shideler, R., and J. Hechtel. 2000. Grizzly bear. Pp. 105–132 in The Natural History of an Arctic Oil Field, J.C. Truett and S.R. Johnson, eds. San Diego: Academic Press.

[380] CCP Final EIS at 4-118.

[381] National Research Council 2003 at 118.

Construction of industrial facilities results in alteration or destruction of brown bear habitat, and as the amount of developed area expands so will the effects on bear habitat. Issues of potential concern include disturbance from roads and impacts of seismic exploration on denning habitat and denning bears, and habitat alterations that influence food availability.[382] The adverse effects of noise associated with road construction, pipeline installation, gravel mining and camp and drilling operations also must be considered within the EIS. Gravel mining in riparian corridors can also alter or destroy bear habitat and disturb bears. Those effects will be greater when development expands toward the foothills because brown bear densities are higher there than on the coastal plain.[383]

Overall, "oil and gas activities on Alaska's North Slope have changed the demographics of the [brown] bear population primarily because of the availability of anthropogenic food sources."[384] BLM must assess the likely impacts from development on the narrower Coastal Plain of the Arctic Refuge, which lies in closer proximity to the foothills where there are higher concentrations of brown bears.

c. BLM Must Assess the Impacts of Oil and Gas Activities on Arctic Foxes, Wolves and Associated Predator-Prey Relationships.

Other species are drawn to oil and gas development areas, including arctic foxes (*Alopex lagopus*) and gray wolves (*Canis lupus*). BLM must analyze how these species would be directly and indirectly affected by post-lease development activity and how that would, in turn, affect local prey populations such as birds and muskoxen. Arctic foxes gravitate toward developed areas, attracted by opportunities for shelter and food. In the Prudhoe Bay oilfield, foxes seek human food and garbage sources and den in culverts under roads and in underground utility corridors, and in sections of natural gas pipe. Particularly in winter, large concentrations of foxes occur at dumps and other developed areas, and garbage is commonly found at den sites in summer. The density and rate of occupancy of dens and the sizes of litters are greater in oil fields than in adjacent areas, resulting in a larger and more stable population.[385] To reduce the

[382] *Id.*
[383] *Id.*
[384] *Id.*
[385] *Id.* at 117.

possibility of disease transmission to humans, especially rabies, oil companies have developed employee education programs and have trapped and removed foxes.[386]

The current concerns about foxes apply to proposed new development in the Arctic Refuge. A higher density of foxes over the long-term could result in reduced nesting success and smaller local and regional populations of some bird species.[387] Predation can be locally devastating to colonial birds that nest in areas normally inaccessible to foxes.[388] Human modification to habitats, such as roads or causeways that connect barrier islands to the mainland, could cause serious problems in such circumstances. Impacts could accumulate as more area is developed and as more nesting habitat is affected by fox predation.[389] The EIS must assess the likely impacts to birds on the Coastal Plain from increased predation by arctic foxes.

BLM must also study how development would contribute to increased greenhouse gas emissions, which further contribute to climate change. Arctic foxes are extremely vulnerable to the impacts of climate change particularly because rising temperatures will decrease the availability of their tundra habitat and increase the range of red foxes, which may compete with the Arctic foxes for prey and even kill Arctic foxes.[390] Their position will become increasingly vulnerable as climate change continues to occur and BLM must undertake analysis of the present impacts of climate change on the foxes, as well as future impacts.

In addition to foxes, BLM must analyze the impact of oil and gas development on wolves and their associated predator-prey relationships. A purpose of the Arctic Refuge is to conserve wolves,[391] and the EIS must evaluate the effects of the leasing program against this management standard. The geographic distribution of wolves within and adjacent to the Coastal Plain was mapped in the 1980s and early 1990s as part of a study on caribou predation; due to funding constraints those distributions were based solely on aerial surveys and wolves received only

[386] *Id.*
[387] *Id.*
[388] *Id.*
[389] *Id.*
[390] Feng et al. 2011; Dalen et al. 2007.
[391] ANILCA § 303(2)(B)(i).

"cursory attention."[392] There has been no update of this information for the Coastal Plain since 2002.[393] Updated information is needed for BLM to evaluate the impacts in the EIS.

From what is known, it appears that wolves prefer the Brooks Range foothills area and are more likely to occur there than on the Coastal Plain. However, given potential effects, BLM must analyze wolf populations and the potential impacts of oil and gas development in the area on wolves and their prey, including muskoxen. Wolves will also experience permanent habitat loss and avoidance, and may be disturbed by air and surface traffic associated with post leasing activities. As noted above, oil and gas development in the Coastal Plain could also entice species such as arctic foxes, wolves, and brown bears, which would have negative impacts on those species, as well as their natural prey. The EIS must fully assess the cascading ecological effects of introducing oil and gas development to the Coastal Plain, including effects on both predators and prey.

6. BLM Must Analyze and Fully Disclose the Impacts of an Oil and Gas Program on Marine Mammals, Including Whales and Ice Seals.

Leasing and oil and gas development activities will have potentially significant, but also uncertain, impacts on whales and ice seals that live in and around the Arctic Refuge. The Refuge supports the Beringia Distinct Population Segment of the bearded seal (*Erignathus barbatus*)[394] and the Arctic subspecies of the ringed seal (*Phoca hispida hispida*)[395] (together, ice seals), both of which are listed as threatened under the Endangered Species Act due to loss of sea ice and snow cover. Bowhead whale (*Balaena mysticetus*), listed as endangered under the Endangered Species Act, also use coastal waters offshore of the Refuge. BLM, therefore, must consult with the National Marine Fisheries Service to determine whether leasing may affect these species, and ensure that permitted activities do not jeopardize these species.

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[392] Douglas, D.C., Reynolds, P.E., and Rhode, E.B., 2002, Arctic Refuge coastal plain terrestrial wildlife research summaries, USGS Biological Science Report 2002-0001 at 51; available at: https://alaska.usgs.gov/products/pubs/2002/2002-USGS-BRD-BSR-2002-0001.pdf.

[393] 2018 USGS Report at 7.

[394] 77 Fed. Reg. 76740.

[395] 77 Fed. Reg. 76706.

Ice seals utilize sea ice around the Refuge, and inhabit coastal areas.[396] Camden Bay, just offshore the Refuge, provides important habitat for bowhead whales.[397] New information indicates that bowhead whales have used nearshore, shallow regions in recent years.[398] Scientists surmise that this shift may have occurred due to changes in food availability for the whales associated with changes in wind patterns and oceanic upwelling,[399] which will likely increase in the future.[400] Given how close these whales and seals are to shore and the fact that onshore development will also encourage offshore oil and gas development and associated activities, BLM must study and disclose the direct, indirect and cumulative impacts that the lease sales and development activities on the surrounding land would have on these species, including noise pollution and oil spills, as well as cumulative impacts related to increased greenhouse gas emissions contributing to climate change and other development actions in the Southern Beaufort Sea.

a. BLM Must Properly Consider the Impacts of Noise Pollution on Whales and Ice Seals from an Oil and Gas Program in the Arctic Refuge and the Southern Beaufort Sea.

The lease sales may lead to oil and gas development on the Coastal Plain. Oil and gas development generates noise through a variety of industrial activities, including pile driving, vessel and aircraft traffic, and drilling and production. For example, the 1987 Legislative EIS outlines some potential development traffic that would be relevant to analyze for noise pollution impacts in the current planning process, such as use of C-130 aircraft, helicopters, barges, and low ground pressure vehicles.[401] Extensive infrastructure construction and deconstruction would also occur, including drilling pads, camps, airstrips, roads, oil pipelines, and marine facilities.[402]

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[396] Lori Quackenbush, *et al.*, Biology of the Bearded Seal (*Erignathus barbatus*) in Alaska, 1961-2009, 4 (2011); Lori Quackenbush, *et al.*, Biology of the Ringed Seal (*Phoca hispida*) in Alaska, 1961-2009, 5 (2011); Lori Quackenbush, *et al.*, Biology of the Spotted Seal (*Phoca largha*) in Alaska, 1961-2009, 2 (2009).

[397] *See, e.g.,* National Oceanic and Atmospheric Administration, Effects of Oil and Gas Activities in the Arctic Ocean, Final Environmental Impact Statement at 4-496 (October 2016).

[398] Bureau of Ocean Energy Mgmt., Liberty Development and Production Plan: Draft Environmental Impact Statement, at 3-64, 4-259 (2017) [hereinafter “Liberty DEIS”].

[399] *Id.*

[400] *Id.* at 3-19.

[401] LEIS, ch. IV, at 83-89.

[402] *Id.*

BLM must analyze the full suite of activities and the noise and disruption they may introduce into the coastal marine environment.

BLM must consider the impacts of these activities based on current and evolving scientific understanding of how noise affects marine mammals. Most recent scientific information demonstrates that marine mammals are more sensitive to industrial noise than previously understood. Scientists are finding that behavioral disruptions are occurring at much lower noise exposure levels than the National Marine Fisheries Service's currently accepted threshold for Level B disturbance under the MMPA:[403]

> Level B takes . . . often occur well outside of our ability to directly observe the disruption, and typically outside the 1,000 m observation zones around such disruptive activities. The best available science clearly shows that behavioral disruptions occur at vastly lower noise exposure levels than the current regulatory thresholds for Level B disturbances, and at much larger distances than on-board Marine Mammal Observers or passive acoustic monitoring can document.[404]

Recent research on disruption thresholds has demonstrated, for example, that bowhead whales increase call rates at initial detection of airguns at 94 dB, then decrease after 127 dB, and stop calling above 160 dB;[405] that beluga whales are displaced from foraging areas beyond the 130 dB isopleth;[406] and that harbor porpoise buzz rates, a proxy for foraging success, decrease 15 percent with exposure to seismic airguns at 130 dB and above.[407] A low-frequency, high-

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[403] 160dBRMS re: 1μPa for behavioral disruption for impulsive noise (e.g., impact pile driving), 120dBRMS re: 1μPa for behavioral disruption for non-pulse noise (e.g., vibratory pile driving, drilling); *see e.g., id.* at 4-108.

[404] D. Nowacek *et al.*, Comment Letter regarding Notice of Receipt of Applications for Incidental Harassment Authorization ("IHA") for Geophysical Surveys in the Atlantic Ocean at 3 (July 29, 2015).

[405] S.B. Blackwell *et al.*, Effects of airgun sounds on bowhead whale calling rates: Evidence for two behavioral thresholds, 10(6) PLoS ONE e0125720 (2015).

[406] G.W. Miller *et al.*, Monitoring seismic effects on marine mammals—southeastern Beaufort Sea, 2001-2002, *in* Armsworthy, S.L., *et al.* (eds.), *Offshore Oil and Gas Environmental Effects Monitoring/ Approaches and Technologies* 511-542 (2005).

[407] E. Pirotta *et al.*, Variation in harbour porpoise activity in response to seismic survey noise, 10 Biology Letters 20131090 (2014).

amplitude fish mapping device was recently found to silence humpback whales at a distance of 200 kilometers, where received levels ranged from 88 dB to 110 dB.[408]

Individual animals that encounter noise may move away or become habituated to the noise, but both of these adaptations can be harmful, especially if animals are moving away from feeding, breeding, or other biologically important areas. Moreover, there are often physical impacts to marine mammals that do not move away from the sound source: according to Bedjer et al. (2009), "several studies have indicated that physiological evidence of a response could be detected in animals even when they exhibited little or no behavioural reaction or sign of disturbance (Moen et al. 1982, Culik et al. 1990, Wilson et al. 1991, Nimon et al. 1995, Regel & Putz 1997, Ratz & Thompson 1999, Müllner et al. 2004)."[409] Habituation is hard to determine because the only way to know if a population has truly habituated is if "studies adopt a long-term experimental design involving sequential sampling of the same individuals at different levels of exposure to a disturbance, [if not, then] they will be unable to meet the conditions required to detect behavioural habituation or sensitisation."[410] Therefore, the assumption that animals would habituate to noise is not an assumption that can readily be supported by available information, and in fact, is contrary to much of the available information, as discussed below.

Ice seals use sound for navigation, communication, foraging, and to avoid predation,[411] and are extremely sensitive to sound. For example, spotted seals were found to have some of the lowest hearing thresholds out of water of any marine mammal recorded, and have an extremely sensitive hearing range in water.[412] A study of spotted seal haulout patterns in Piltun Lagoon on Sakhalin Island noted that small motorboats operated by local fishers and hunters and helicopters related to offshore oil and gas development activities caused the majority of hauled-out seals to

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[408] D. Risch *et al.*, Changes in humpback whale song occurrence in response to an acoustic source 200 km away, 7(1) PLoS ONE e29741 (2012).

[409] L. Bejder *et al.*, Impact assessment research: Use and misuse of habituation, sensitisation and tolerance in describing wildlife responses to anthropogenic stimuli, 395 Marine Ecology Progress Series 177 (2009).

[410] *Id.* at 181.

[411] J.M. Sills *et al.*, Amphibious hearing in spotted seals (Phoca largha): underwater audiograms, aerial audiograms and critical ratio measurements, 217 The Journal of Experimental Biology 726 (2014).

[412] *Id.*

flee into the water quickly.[413] Ringed seals also are sensitive to aircraft noise and flee into the water in response.[414] Thus, low-flying aircraft and vessel noises cause hauled-out seals to move into the water, disrupting the animals' normal behavior and causing additional and unnecessary energy expenditures. Anthropogenic noise can also mask important communications with conspecifics, increase stress levels, and induce temporary or permanent hearing threshold shifts in pinnipeds.[415] Beluga and bowhead whales found in the area may also experience effects caused by increased noise, such as reduced reproduction, negatively affected health, and even death.[416]

BLM must fully assess the ways in which industrial noise will affect seals and whales using coastal waters offshore of the Refuge, assessing the full suite of noise-creating activities and using the newest scientific information about sound effects, which may well require undertaking new studies of the potential impacts of increased noise pollution on seals and whales. This would require identifying key locations and periods for marine mammal species' travel, feeding, rearing and mating areas to evaluate the effects of displacing animals from these areas.

b. BLM Must Analyze and Fully Disclose the Impacts of Oil Spills on Whales and Ice Seals from an Oil and Gas Program in the Arctic Refuge and the Southern Beaufort Sea.

i. Impacts of Oil Spills

The available information indicates that oil spills have significant negative impacts on whales, other cetaceans, and seals, and BLM must analyze this in the EIS. Particularly, BLM

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[413] A.L. Bradford *et al.*, Spotted seal haul-out patterns in a coastal lagoon on Sakhalin Island, Russia. 30 Mammal Study 145 (2005).

[414] E.W. Born *et al.*, Escape response of hauled out ringed seals (Phoca hispida) to aircraft disturbance, 21 Polar Biology 171 (1999).

[415] R.A. Kastelein *et al.*, Underwater audiogram of a Pacific walrus (Odobenus rosmarus divergens) measured with narrow-band frequency modulated signals, 112 Journal of Acoustical Society of America 2173 (2002).

[416] *See, e.g.*, T.A. Romano *et al.*, Anthropogenic sound and marine mammal health: measures of the nervous and immune systems before and after intense sound exposure, 61 Canadian Journal of Aquatic Science, 1124 (2004) (finding increased levels of stress hormones following noise exposure study using a captive beluga and noting increased stress can weaken the immune system and potentially affect fertility, growth rates, and mortality).

must assess potential impacts of onshore oil spills, and spills from ships and loading facilities on marine wildlife habitat, including species migrating through the coastal area. Understanding these impacts is vital as oil spills "are an inevitable consequence of oil-field development."[417]

Oil spills have documented lethal and sublethal impacts on marine species,[418] and oil spilled onshore could cause the same impacts if it reached the water. Direct impacts to wildlife from exposure to oil include behavioral alteration, suppressed growth, induced or inhibited enzyme systems, reduced immunity to disease and parasites, lesions, tainted flesh, and chronic mortality.[419] Marine mammals can be exposed to oil internally by inhaling volatile compounds at the surface, swallowing oil, or consuming oil-contaminated prey, and externally by swimming in oil.[420] Exposure to toxic fumes from hydrocarbons during oil spills has been recently linked to mortality in cetaceans, even years after such accidents.[421]

Oil spills can kill individual ice seals and have population-level impacts by decreasing survival and reproductive success, inhibiting normal behaviors, and exerting deleterious health effects. For example, seals depend on scent to establish a mother-pup bond, and mothers often do not recognize their oil-coated pups.[422] Oiled pups may be prematurely abandoned, reducing the pups' chances of survival. During the nursing period, ringed, bearded, and spotted seals return to the water several times a day between nursing bouts, increasing the chances of repeated contact with oil.[423]

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[417] LEIS at 115.

[418] C.H. Peterson *et al.*, Long-term ecosystem response to the Exxon Valdez oil spill, 302 Science 2082-2086 (2003); S. Venn-Watson *et al.*, Adrenal Gland and Lung Lesions in Gulf of Mexico Common Bottlenose Dolphins (Tursiops truncatus) Found Dead following the Deepwater Horizon Oil Spill. 10 *PLoS ONE* e0126538 (2015) (Venn-Watson *et al.* (2015)).

[419] D.A. Holdway, The acute and chronic effects of wastes associated with offshore oil and gas production on temperate and tropical marine ecological processes, 44 Marine Pollution Bulletin 185 (2002).

[420] National Marine Fisheries Service, Impacts of Oil on Marine Mammals and Sea Turtles.

[421] Venn-Watson *et al.* (2015).

[422] D. J. St. Aubin, *Physiological and toxic effects on pinnipeds, in* SEA MAMMALS AND OIL: CONFRONTING THE RISKS 121 at 131 (J. R. Geraci & D. J. St. Aubin eds., 1990).

[423] *Id.* at 100.

Oil spills also impede seals' foraging activities. Seals are reluctant to enter into the water when oil is present in the sea,[424] reducing their chances of getting food. Exposure to oil may also interfere with locomotion, especially in young seals. Studies have documented two gray seal pups' drowning because their flippers were stuck to the sides of their bodies, preventing them from swimming.[425] And direct ingestion of oil, ingestion of contaminated prey, or inhalation of hydrocarbon vapors can cause serious health effects, or even death.[426]

Oil spills could also harm whales and ice seals by reducing their prey. Oil contamination of mollusks has been found to impair growth, fertilization, and development of embryos, kill gill tissue, and encourage cancerous growths.[427] Additionally, exposure to crude oil also adversely affects fish at all stages.[428] Early life stages of fish are particularly sensitive to the effects of toxic oil components such as polycyclic aromatic hydrocarbons, which can cause larval deformation and death.[429] Adult fish exposed to oil can suffer from reduced growth, enlarged liver, changes in heart and respiration rates, fin erosion, and reproductive impairment.[430] Exposure to crude oil has also been linked to long-term population effects in fish. A recent study based on 25 years of research demonstrated that embryonic salmon and herring exposed to very low levels of crude oil can develop heart defects that reduce their later survival, indicating that spills may have much more widespread impacts than previously thought.[431]

Scientific research indicates that small spills can have substantial negative impacts on the Arctic ecosystem. For example, one study found that only small amounts of oil spilled into the ocean reduced hatching rates of *C. hyperboreus* copepods significantly —the fattest of the Arctic

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[424] *Id.* at 132.

[425] *Id.* at 134

[426] 77 Fed. Reg. at 76746.

[427] J. M. Neff *et al.,* Histopathologic and biochemical responses in Arctic marine bivalve molluscs exposed to experimentally spilled oil, 40 Arctic 220 (1987).

[428] M.G. Carls *et al.*, Sensitivity of fish embryos to weathered crude oil: part I. Low-level exposure during incubation causes malformations, genetic damage, and mortality in larval pacific herring (Clupea pallasi), 18 Environmental Toxicology and Chemistry 481 (1999) (Carls *et al*. (1999)); J. Bernanke and H.-R. Kohler, The impact of environmental chemicals on wildlife vertebrates, 198 Reviews of Environmental Contamination and Toxicology 1 (2008).

[429] *See, e.g.*, Carls, et al. (1999) at 488-490.

[430] Bernanke and Kohler 2009.

[431] J. P. Incardona *et al.*, Very low embryonic crude oil exposures cause lasting cardiac defects in salmon and herring. 5 Scientific Reports 13499 (2015).

copepods.[432] Moreover, the species' eggs are covered by only a thin membrane that is permeable to organic substances such as oil, which can penetrate the egg and lead to mortality.[433] As such, an oil spill could wipe out an entire generation of these copepods.[434] This could have substantial negative impacts on whales that feed on copepods, such as bowhead whales whose primary prey is copepods,[435] and could also have other ripple effects up the food chain.[436]

ii. Challenges of Cleaning and Containing an Oil Spill in the Arctic Marine Environment

BLM also must consider that oil spilled in the Arctic Ocean is almost impossible to contain and clean adequately, especially where there is inadequate infrastructure and technology to deal with an oil spill. The region is the most daunting and remote environment in the country. A spill would occur more than a thousand miles from the nearest Coast Guard station, with the constant threat of sea ice, subzero temperatures, and darkness up to 20 hours a day. The remote location, lack of infrastructure, extreme cold, changing ice conditions, high winds, and low visibility would combine to make spill response operations difficult or ineffective. In light of these concerns, BLM must address the difficulties of responding to an oil spill in the ocean from lease sale activities.

First, BLM must address the unique nature of the Arctic Ocean's oil spill response gap,[437] which is more significant than anywhere else in the country. According to the Canadian National Energy Board, in the Arctic, oil spill cleanup would be impossible on average three to five days of each week due to weather and sea conditions.[438] A recent analysis confirmed that conditions

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[432] R.D. Nørregaard *et al.*, Evaluating pyrene toxicity on Arctic key copepod species Calanus hyperboreus, 23 Ecotoxicology 163 (2014); *see also* Kristian Sjøgren, Even tiny oil spills may break Arctic food chain, Science Nordic, Jan. 30, 2014 (Sjøgren 2015) (one of the Calanus hyperboreus study's authors discussing finding).

[433] *Id.*

[434] *Id.*

[435] *See, e.g.*, Liberty DEIS at 3-71.

[436] Sjøgren 2014.

[437] A response gap analysis evaluates the amount of time oil spill responders are unable to work based on, among other things, adverse weather conditions, and delays in deployment of equipment and personnel. *See generally* Pew Environment Group, Oceans North U.S., Response Gap Fact Sheet (Sept. 1, 2013) (noting the value of a response-gap analysis).

[438] See J. George, Most Arctic Oil Spills Impossible to Clean Up: WWF, NUNATSIAQ NEWS (Sept. 8, 2011) (George 2011); *see also* S. L. Ross Environmental Research Ltd., *Spill*

in the Beaufort Sea would not be suitable for mechanical recovery of oil 98 percent of the time during winter (from November to June).[439] As the USGS has explained, "[u]nderstanding what combination of countermeasures will likely be available under the temporal and spatial variability of the Arctic is *essential* to assess environmental risks from any potential spilled oil."[440]

Second, the EIS must acknowledge that there is no proven way to recover significant oil quantities in conditions prevalent in the Arctic.[441] Mechanical containment and recovery strategies can be significantly hindered by ice coverage in the Arctic Ocean. According to the Minerals Management Service, in broken ice conditions, oil spill recovery rates drop dramatically to between "1 [percent] to 20 [percent] depending on the degree of ice coverage and if responding during freeze-up or spring break-up."[442] Following the most recent offshore spill exercises in the Beaufort Sea in 2000,[443] the Nuka Research and Planning Group explained, "the limit to mechanical recovery with containment booms and skimmers in ice-infested waters is generally considered to be 20-30% ice coverage . . . However, the 2000 offshore response exercises in the Alaska Beaufort Sea demonstrated that the actual operating limits were closer to

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Response Gap Study for the Canadian Beaufort Sea and the Canadian Davis Strait at 28 (July 12, 2011) (noting that, from July through October, conditions in the nearshore Beaufort Sea would be favorable for cleanup only 32 to 77 percent of the time; at other times of year, "active response would be deferred until the following melt season").

[439] Nuka Research and Planning Group, LLC, Estimating an Oil Spill Response Gap for the U.S. Arctic Ocean (Revised) at 30, 53, Tbl. 18 (June 2016).

440 USGS Report at 130 (emphasis added).

[441] Even under warmer conditions, and with a vast response capacity entirely unavailable in the Arctic, oil recovery in marine waters is limited; only three percent was skimmed from the water in the case of the *Deepwater Horizon* spill. NOAA, *Federal Science Report Details Fate of Oil from BP Spill* (Nov. 2010); *see also* WWF Canada, *WWF Report Shows Limited Response Possible to Arctic Oil Spill* (Sept. 8, 2011) (finding that oil spill clean-up is impossible 54 to 81 percent of time during the warmest five months in the near offshore Beaufort Sea and 100 percent of the time during the other seven to eight months of the year).

442 Minerals Mangement [sic] Service, Arctic Oil Spill Response Research and Development Program, A Decade of Achievement at 14 (2009) ("5 to 30% for open ocean response without broken ice").

[443] *See* T. L. Robertson & E. DeCola, Joint Agency Evaluation of the Spring and Fall 2000 North Slope Broken Ice Exercises (Dec. 18, 2000).

10%. . . ."[444] Roughly ten years after the Beaufort Sea oil spill exercises, Pew Environmental Group commissioned a report that reached the same troubling conclusions regarding mechanical cleanup in the Arctic Ocean:

> If a major blowout were to occur in the Arctic OCS, the same mechanical cleanup techniques [as those used in the *Deepwater Horizon* spill response] (boats with skimmers and booms) would be applied at a much less efficient recovery rate. Although some refinements have been made to adapt certain types of equipment for use in cold or ice-infested waters, there have been no breakthroughs in oil spill response technologies to significantly enhance the capacity to recover oil when sea ice is present. The National Academy of Sciences (NAS) determined that 'no current cleanup methods remove more than a small fraction of oil spilled in marine waters, especially in the presence of broken ice' (National Research Council-NAS 2003).[445]

A 2014 review by the National Research Council confirms these findings:

> Conventional booms and skimmers become increasingly ineffective as ice concentrations increase. Limited effectiveness is possible in very open drift ice (1/10 to 3/10) and in isolated polynyas within closer pack ice. The presence of ice interferes with boom operation and reduces flow to the skimmer head, greatly reducing overall effectiveness.[446]

The EIS must address these problems in a realistic way and apply its conclusions to the unique circumstances presented here, including the possibility of an oil spill during fall freezing and spring breakup.

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[444] Nuka Research & Planning Group, LLC, Oil Spill Response Mechanical Response Recovery Systems for Ice-Infested Waters: Examinations of Technologies for the Alaskan Beaufort Sea at 58 (June 2007).

[445] Pew Report at 8.

[446] Committee on Responding to Oil Spills in the U.S. Arctic Marine Environment, Responding to Oil Spills in the U.S. Arctic Marine Environment at 92 (2014).

c. BLM Must Adequately Consider How Climate Change Will Exacerbate Existing Threats to Whales and Ice Seals from an Oil and Gas Program in the Arctic Refuge and the Southern Beaufort Sea

As climate change continues, the absorption of carbon dioxide by the ocean could create noisier oceans (particularly as noise from potential development increases).[447] When carbon dioxide reacts in the ocean, it lowers pH, creating more acidic waters. The more acidic the water, the less sound waves are absorbed. Researchers predict that ocean acidification will reduce the intrinsic ability of surface seawater to absorb sound at frequencies important to marine mammals by 40 percent by 2050 because of increased carbon dioxide acidifying our oceans.[448] Such changes will only exacerbate the harms from noise pollution from oil and gas drilling operations in the Arctic and other anthropogenic noise sources.

Melting sea ice from climate change also affects ice seals. Bearded seals rely on sea ice for breeding, feeding, giving birth, molting, and other essential life functions.[449] And ringed seals excavate subnivian lairs in snowdrifts over breathing holes, which they use for resting, giving birth, and nursing pups.[450] Without sufficient sea ice and snow cover, ringed seals freeze to death or are taken by predators.[451] Research has documented a nearly 100 percent mortality rate when snow cover was insufficient to build snow caves.[452]

Recent studies also show that loss of sea ice is leading to poor body condition in ringed seals. For example, Harwood et al. (2015) found that ringed seals in the Beaufort Sea experienced a significant decline in body condition over the last two decades, as well as low pup production in recent years (2012, 2013, 2014), which could have far-reaching negative

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[447] K.C. Hester *et al.*, Unanticipated consequences of ocean acidification: A noisier ocean at lower pH, 35 Geophysical Research Letters L19601 (2008).

[448] *Id.*

[449] 77 Fed. Reg. 76740, 76742 (Dec. 28, 2012) (final rule listing bearded seals as threatened under the ESA).

[450] 77 Fed. Reg. 76706, 76709 (Dec. 28, 2012) (final rule listing Arctic ringed seals as threatened under the ESA).

[451] *Id.*

[452] *Id.*

consequences in the Beaufort Sea ecosystem.[453] And MacIntyre et al. (2015) found that "losses in ice cover may negatively affect bearded seals, not just by loss of habitat but also by altering the behavioral ecology" of the population in the Beaufort Sea region.[454] In other words, climate change stress is increasing for ice seals, and already having negative effects on populations. BLM must address how the lease sales and oil and gas activities will exacerbate these effects. and oil and gas activities will exacerbate these effects.

d. The BLM Must Adequately Consider the Cumulative Impacts and Synergistic Effects from an Oil and Gas Program in the Arctic Refuge and the Southern Beaufort Sea on Marine Species.

The EIS must address all known and anticipated cumulative impacts and synergistic effects from Arctic Refuge and Southern Beaufort Sea lease sales, exploration and oil and gas drilling. These impacts will likely be significant to the long-term viability of bowhead and beluga whales and other Arctic marine species.

Numerous vessels, drill rigs and other support sea and air craft will need to travel through the Bering Sea and Bering Strait to reach the Southern Beaufort Sea and Arctic Refuge Coastal Plain. The U.S. Coast Guard concluded that changing sea ice, unpredictable weather and increased marine vessel traffic combine to "make the Bering Strait region increasingly vulnerable to maritime casualties."[455] The Bering Strait is also "a bottleneck that connects two unique, but globally significant large marine ecosystems: the Bering Sea, part of the North Pacific Ocean, and the Chukchi Sea, part of the Arctic Ocean."[456] Due to decreasing sea ice, Bering Strait ship transits increased 118 percent from 220 in 2008 to 480 in 2012; this trend is expected to continue.[457] Increasing vessel traffic could result in a higher risk and impact from shipping accidents and oil spills. Current Bering Strait maritime vessel transit routes overlap one of the largest migratory marine wildlife corridors on the planet.[458]

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[453] L. A. Harwood, *et al*., Change in the Beaufort Sea ecosystem: Diverging trends in body condition and/or production in five marine vertebrate species, 136 Progress in Oceanography 263 (2015).

[454] K. MacIntyre, The relationship between sea ice concentration and the spatio-temporal distribution of vocalizing bearded seals (Erignathus barbatus) in the Bering, Chukchi, and Beaufort Seas from 2008 to 2011, 136 Progress in Oceanography 241 (2015).

[455] U.S. COAST GUARD, ARCTIC STRATEGY 13 (2013).

[456] L. BRIGHAM, *ET AL.*, ARCTIC MARINE SHIPPING ASSESSMENT BERING SEA REGION CASE STUDY 2 (2009).

[457] U.S. COAST GUARD, ARCTIC STRATEGY (2013).

[458] L. BRIGHAM, *ET AL.* (2009).

Increased vessel transits due to sea ice loss, coupled with increasing oil exploration and development in the Chukchi and Beaufort seas, makes a spill affecting Arctic marine wildlife all but inevitable, especially since marine mammals are changing their spring travel patterns due to extremely low sea ice in the Bering and Chukchi Seas. For example, FWS (pers. comm.) shared that bowhead whales are traveling north through the Bering Sea to the Chukchi and Beaufort Seas one month earlier this year and Arctic ice dependent seals are now resting on Aleutian Islands, far south of where they should be in April and May due to severe lack of sea ice this year in the Bering Sea off western Alaska.

Potential conflicts between increased ship traffic and large marine pinnipeds and cetaceans in this maritime region include increased ambient and underwater ship noise, ship strikes, entanglement in marine debris and pollution (including oil spills).[459] Arctic species that may be affected from increased ship traffic include threatened polar bears (*Ursus maritimus*), Pacific walrus (*Odobenus rosmarus* ssp. *divergens*), the Alaska stock of bearded seal, Western Arctic stock of bowhead whale, Bering Sea stock of harbor porpoise (*Phocoena phocoena*), the Western North Pacific stock of humpback whale (*Megaptera novaeangliae*), the Alaska stock of ringed seal, and North Pacific stock of sperm whale (*Physeter macrocephalus*) and the critically endangered North Pacific right whale (*Eubalaena japonica*).

7. BLM Must Analyze and Fully Disclose the Impacts of an Oil and Gas Program on Fish.

Freshwater and near-shore waters of the Coastal Plain contain numerous Arctic fish species that are sensitive to stressors from oil and gas development. The two most abundant anadromous fish species, Dolly Varden (*Salvelinus malma*) and Arctic Cisco (*Coregonus autumnalis*),[460] are also the most harvested subsistence fish resources, with thousands of pounds harvested annually in the Kaktovik subsistence fishery.[461] Arctic Cisco have not been documented using freshwater habitat within the Coastal Plain, but extensively use nearshore habitat within the Beaufort Seas as essential foraging habitat between their spawning migration

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[459] ARCTIC DATABASE, 2020 FUTURE SCENARIO FOR THE BERING STRAIT REGION (undated); *available at*: http://www.arctis-search.com/2020+Future+Scenario+for+the+Bering+Strait+Region.

[460] Craig 1984.

[461] Bacon et al. 2009.

to the Mackenzie River and overwintering location in the Colville River Delta.[462] Dolly Varden have two life forms and both resident and anadromous forms are present in freshwater and nearshore habitats.[463] Other fishes within the Coastal Plain freshwater habitat include Lake Trout (*Salvelinus namaycush*), Arctic Grayling (*Thymallus arcticus*), Burbot (*Lota lota*), Ninespine Stickleback (*Pungitius pungitus*), and Slimy Sculpin (*Cottus cognatus*).[464] The delta and lower sections of many of the rivers within the Coastal Plain contain extensive essential fish habitat such as rearing areas for juvenile Dolly Varden[465] as well as distinct overwintering areas located at perennial springs and deep sections of rivers.[466] Another type of essential fish habitat, spawning areas, are located upstream of the Coastal Plain and many post spawned Dolly Varden either migrate downstream and overwinter at perennial springs within the Coastal Plain or nearby watersheds.[467]

Due to the limited amount of available winter liquid water, if ice roads are built using water extracted from rivers there will likely be both short and long-term impacts on fish populations. Impacts could include direct loss of overwintering habitat, reduced dissolved oxygen concentrations, and increased stress and mortality of Dolly Varden or other Arctic fishes.[468] Seismic exploration through noise or instantaneous pressure change has the potential to cause short term, but severe impacts to overwintering fishes and could include negative behavioral changes (e.g., fleeing, herding), hearing loss and direct mortality of fish and embryos.[469]

BLM must consider impacts from the full suite of exploration, development and production on fish habitat, and complete an Essential Fish Habitat Consultation that includes these activities. Construction of gravel and ice roads, pipelines, and other infrastructure with river crossings would mobilize sediment, with associated impacts to rearing, spawning, and

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[462] Reist and Bond 1988, Brown 2008.
[463] Ward and Craig 1974.
[464] U.S. Fish and Wildlife Service 2015.
[465] Ward and Craig 1974.
[466] Craig and McCart 1974, Viavant 2005, Brown et al. 2014.
[467] Brown et al 2014.
[468] *See, e.g.*, Gaboury and Patalas 1984, Evans 2007, Cott et al. 2008.
[469] McCauley et al. 2003, Popper et al. 2005.

overwinter habitat,[470] as well as the health and behavior of fishes.[471] Within floodplain channels, infilling and various types of stream and river crossing structures (e.g., ice-bridges, culverts, concrete bridges) have the potential to cause long-term changes to the natural flow regime, and restrict channel movement and fish passage, causing negative impacts to fish populations.[472] Additionally, with the construction and maintenance of a gravel road network, numerous other minor to severe impacts may occur such as hydrocarbon and sump contamination,[473] introduction of non-native species and increased fishing pressure all of which would have both short and long-term impacts to fish populations.[474]

The leasing EIS must fully analyze these and all other reasonably foreseeable direct, indirect, and cumulative impacts to fish and subsistence biological resources of the Coastal Plain associated with all phases of development. The BLM must also fully address the following considerations and information gaps:

- Identify all water withdrawal sites (lakes and rivers) and fully analyze how winter fish presence will be accurately detected and adverse impacts avoided, minimized, and mitigated.
- Fully analyze and articulate how essential fish habitat (spawning, overwintering, and rearing) will be managed or avoided so that development does not have negative impacts on fish populations.
- Fully analyze and articulate how stream crossing structures within floodplain channels (50 yr-200 yr.) will be managed to minimize impacts to essential fish habitat, the natural flow regime, and aquatic ecological processes.
- Fully analyze and identify the physiological and behavioral impacts associated with sediment mobilization and deposition on Arctic fishes.
- Fully analyze and identify how temporary and permanent fish passage restrictions will be avoided or minimized to allow seasonal movement patterns by fish species such as Dolly Varden and Arctic Grayling.
- Fully articulate how important Dolly Varden and Arctic Cisco populations will be monitored to detect short and long term negative impacts to the subsistence fishery.

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470 *See, e.g.*, Robertson et al. 2006.
471 *See, e.g.*, Newcombe and Macdonald 1991, Reid et al. 2003, Robertson et al. 2006.
472 Semple et al. 1995.
473 Schein et al. 2009, Kanigan and Kokelj 2010
474 Schindler 2001.

8. BLM Must Analyze and Fully Disclose the Impacts of an Oil and Gas Program on Connectivity and Habitat Fragmentation.

Conserving wildlife corridors is one of the best strategies to mitigate the negative impacts of habitat fragmentation and support wildlife species to adapt to climate change[475] and other stressors. Management that seeks to maintain or restore connectivity between protected or otherwise intact natural areas are now considered critical to biodiversity conservation.[476] Scientists agree that "the preponderance of evidence is that corridors almost certainly facilitate travel by many species."[477] The FWS Strategic Plan for Responding to Accelerating Climate Change states that ''processes such as pollination, seed dispersal, nutrient cycling, natural disturbance cycles, predator-prey relations, and others must be part of the natural landscapes we seek to maintain or restore. These processes are likely to function more optimally in landscapes composed of large habitat blocks connected by well-placed corridors.''[478] Many analytical frameworks for identifying and prioritizing specific habitat corridors to preserve landscape connectivity have been formulated.[479] New research has confirmed the importance of proactive management to conserve habitat connectivity for native plants and animals in central and northeastern Alaska.[480]

States and federal agencies are increasingly providing for wildlife corridors and habitat connectivity in planning and management. The Western Governors' Association approved a

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[475] Nicole E. Heller & Erika S. Zavaleta, *Biodiversity Management in the Face of Climate Change: A Review of 22 Years of Recommendations*, 142(1) Biological Conservation 14 (2009).

[476] Jodi A. Hilty et al., *Corridor Ecology: The Science and Practice of Linking Landscapes for Biodiversity Conservation* (Island Press 2006); Philip D. Taylor et al., *Connectivity Conservation* 29-43 (Kevin R. Crooks & M. Sanjayan, Cambridge U. Press, 2006).

[477] Paul Beier & Reed F. Noss, *Do Habitat Corridors Provide Connectivity?*, 12(6) Conservation Biology 1241-52 (1998).

[478] U.S. Fish & Wildlife Serv., Rising to the Urgent Challenge Strategic Plan for Responding to Accelerating Climate Change 23 (2010).

[479] Carlos Carroll et al., *Use of Linkage Mapping and Centrality Analysis Across Habitat Gradients to Conserve Connectivity of Gray Wolf Populations in Western North America*, 26(1) Conservation Biology 78–87 (2012); Brad H. McRae et al., *Using Circuit Theory to Model Connectivity in Ecology and Conservation*, 89(10) Ecology 2712–24 (2008); Andrew G. Bunn et al., *Landscape Connectivity: A Conservation Application of Graph Theory*, 59(4) J. of Envtl. Mgmt. 265–278 (2000).

[480] Dawn R. Magness et al., *Using Topographic Geodiversity to Connect Conservation Lands in the Central Yukon, Alaska*, 33(4) Landscape Ecology 547 (2018).

policy resolution in 2007 calling for the protection of wildlife corridors and crucial wildlife in the West, including Alaska.[481] The BLM, in accordance with federal planning mandates, is committed to addressing ecological effects in planning, including "effects on natural resources and on the components, structures, and functioning of affected ecosystems,"[482] which should include habitat connectivity. The agency operationalized this direction in its Land Use Planning Handbook, stating that plan "analysis should describe the status, or present characteristics and condition of the public land; the status of physical and biological processes that affect ecosystem function; the condition of individual components such as soil, water, vegetation, and wildlife habitat; and the relative value and scarcity of the resources."[483] These data and characteristics are relevant to habitat connectivity; BLM planning should account for connectivity, including identifying wildlife corridors in the current planning process. The North Slope Rapid Ecological Assessment commission by the BLM provides useful information on habitat types and wildlife movement in the planning area.[484] BLM must consider impacts from the full suite of exploration, development and production on habitat connectivity and habitat fragmentation.

9. BLM Must Analyze and Fully Disclose the Impacts of an Oil and Gas Program on BLM Sensitive Species.

The Federal Land Policy and Management Act (FLPMA) mandates BLM to "protect" ecological and environmental values and "provide food and habitat for fish and wildlife" in the agency's administration of federal lands, waters and resources.[485] In accordance with the act and a host of other authorities, BLM promulgated a policy for the "conservation of BLM special status species and the ecosystems upon which they depend on BLM-administered lands."[486] Special status species include plants, animals and insects listed or proposed for listing under the Endangered Species Act and "sensitive species," designated by BLM State Directors, that require special management consideration to promote their conservation and reduce the likelihood and

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[481] Western Governors' Association, Policy Resolution 07-01 (Feb. 27, 2007).

[482] 40 C.F.R. § 1508.8.

[483] BUREAU OF LAND MANAGEMENT, BLM LAND USE PLANNING HANDBOOK (H-1601-1) (2005) at 20.

[484] E.J. Trammell, M.L. Carlson, N. Fresco, T. Gotthardt, M.L. McTeague, and D. Vadapalli, eds., North Slope Rapid Ecoregional Assessment. Prepared for the Bureau of Land Management, U.S. Department of the Interior. Anchorage, Alaska.

[485] 43 U.S.C. § 1701(a)(8).

[486] SPECIAL STATUS SPECIES MANAGEMENT MANUAL at 6840.01.

need for future listing under the ESA.[487] "BLM-administered lands" includes split-estate lands, where the agency manages only the subsurface estate.[488]

The special status species policy details the BLM's responsibilities for conserving and contributing to the recovery of ESA-listed species, which are described throughout these comments. A review of relevant authorities, including the Arctic Refuge CCP and NatureServe data (focusing on three HUC-8 watersheds on the North Slope of the Refuge, 190605-01, 02 and 03), found approximately 19 sensitive species designated by the BLM Alaska State Office to occur on the Arctic Refuge Coastal Plain, though with varying levels of certainty. These include seven bird species, one mammal, one fish, eight plant species and two insects respectively listed below:

1. Rusty blackbird (*Euphagus* carolinus) [casual visitor]
2. Golden eagle (*Aquila chrysaetos*) [uncommon breeder]
3. Arctic peregrine falcon (*Falco peregrinus* tundrius) [rare breeder, uncommon visitor]
4. Red knot (*Calidris* canutus) (nonbreeding migrant]
5. Yellow-billed loon (*Gavia adamsii*) [nonbreeding migrant]
6. Short-eared owl (*Asio* flammeus) [uncommon breeder]
7. Trumpeter swan (*Cygnus buccinator*) [rare breeder]

8. Pacific walrus (*Odobenus rosmarus* ssp. *divergens*)

9. Arctic char (*Salvelinus alpinus*)

10. Pygmy aster (*Aster pygmaeus*)
11. False-oats, Siberian false-oats (*Trisetum sibiricum* ssp. *litorale*)
12. Muir's fleabane (*Erigeron muirii*)
13. Plant sp. (*Papaver gorodkovii*)
14. Plant sp. (*Puccinellia* wrightii) [possible]
15. Walpole poppy (*Papaver walpolei*)
16. Sabine-grass (*Pleuropogon* sabinei) [possible]
17. Wallflower sp. (*Erysimum asperum* spp. *angustatum*) [possible]

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[487] *Id.*
[488] *Id.* at Glossary 1.

18. Mayfly (*Acentrella feropagus*) [unknown]
19. Alaska sallfly (*Alaskaperla ovibovis*) [unknown]

BLM's policy states that "planning process[es]…shall address sensitive species and their habitats in land use plans and associated NEPA documents" and that "land use plans shall be sufficiently detailed to identify and resolve significant land use conflicts with Bureau sensitive species without deferring conflict resolution to implementation-level planning."[489] In implementing the policy, the agency is committed "to determining, to the extent practicable, the distribution, abundance, population condition, current threats, and habitat needs for sensitive species, and evaluating the significance of BLM-administered lands and actions undertaken by the BLM in conserving those species."[490] Moreover, the agency is to ensure "that BLM activities affecting Bureau sensitive species are carried out in a way that is consistent with its objectives for managing those species and their habitats at the appropriate spatial scale."[491] Consistent with other Department of the Interior and agency policy, BLM is obligated to coordinate with Indian tribes, including Alaska Natives, in planning and management of special status species.[492]

10. BLM Must Analyze and Fully Disclose the Impacts of an Oil and Gas Program on State Wildlife Action Plan Species.

The EIS must consider and analyze the direct, indirect, and cumulative effects of an oil and gas program on species recognized under the State of Alaska's State Wildlife Action Plan (SWAP). SWAPs are state blueprints for conserving the full diversity of our nation's fish and wildlife. Each state plan identifies "species of greatest conservation need," their habitats, threats, and needed conservation actions, including priorities and goals for recovering imperiled species. SWAPs are developed in partnership with federal, state, and local agencies, Indian tribes, non-governmental organizations, academic institutions, private landowners, and the public. Each SWAP must include eight statutory elements and must be approved by the U.S. Fish and Wildlife Service before a state can receive federal funding to support conservation activities contained in its plan.

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[489] *Id.* at 6840.06.2B.
[490] *Id.* at 6840.06.2B.
[491] *Id.*
[492] *Id.* at 6840.06.3A.

Alaska's SWAP was revised in 2015[493] and identifies more than 375 species of greatest conservation need in the state,[494] including plants and animals that depend on the Arctic National Wildlife Refuge, such as polar bear, arctic fox, arctic char, bald and golden eagle, Peregrine falcon, and beluga whale.[495] Species added to the list are at risk (including candidate and listed species under the ESA); culturally, ecologically, or economically important; serve as sentinel species (indicators of environmental change); and/or are stewardship species (species with a high percentage of their North American or global populations in Alaska).[496] The Alaska SWAP notes the importance of the Arctic Refuge and the Coastal Plain to wildlife in the state.[497]

Congress directed that states develop and implement SWAPs in coordination with federal agencies,[498] and the Alaska SWAP anticipates federal cooperation in implementing plan components (noting the extensive federal lands and waters and numerous federal management authorities that apply in the state). Many Alaska species of greatest conservation need are also BLM-designated sensitive species, which the BLM is already committed to conserving (see elsewhere in these comments). FLPMA[499] and BLM's administrative procedures otherwise direct the agency to use a collaborative approach to planning that is "consistent with [other governmental entities'] plans and policies…to the maximum extent consistent with Federal law"[500] and "address(es) common needs and goals within the planning area."[501] This includes "working in close coordination with state wildlife agencies, and drawing on state comprehensive wildlife conservation strategies [a.k.a. SWAPs]."[502] The BLM's Land Use Planning Handbook even identifies in what section of a NEPA planning document the agency should describe

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[493] ALASKA DEPARTMENT OF FISH AND GAME. 2015 ALASKA WILDLIFE ACTION PLAN (2015).

[494] USGS, Alaska 2015 State Wildlife Action Plan, *available at*: https://www.sciencebase.gov/catalog/item/595a98e3e4b0d1f9f0528535.

[495] ALASKA DEPARTMENT OF FISH AND GAME. 2015 ALASKA WILDLIFE ACTION PLAN, APPEND. A (2015).

[496] *Id. at* 28-32.

[497] *Id.* at 34-36, 85.

[498] 66 Fed. Reg. 7657–60

[499] 43 U.S.C. § 1712(b)(9).

[500] BUREAU OF LAND MANAGEMENT, BLM LAND USE PLANNING MANUAL (1601) (2000) at 1601.02C.

[501] *Id.* at 1601.06C2.

[502] BUREAU OF LAND MANAGEMENT, BLM LAND USE PLANNING HANDBOOK, APPEND. C (H-1601-1) (2005) at 6.

coordination with SWAPs.[503] BLM must consider the impacts of an oil and gas program on both the species identified in the SWAP as well as how it may impact the coordination and management of the SWAP itself.

B. BLM MUST ANALYZE AND FULLY DISCLOSE THE IMPACTS OF AN OIL AND GAS PROGRAM ON SURFACE RESOURCES.

1. BLM Must Analyze and Fully Disclose the Impacts of an Oil and Gas Program on Water and Hydrology.

There are a number of issues that BLM must consider in the leasing EIS related to water and hydrology impacts. Water, including rivers, lakes, and ponds, cover very little of the Coastal Plain, much less in comparison to the Western North Slope. As the USGS explained, "[u]nderstanding water resources in the [Coastal Plain] informs questions related to multiple ecosystems as well as possible infrastructure development."[504] While some water resource data has been collected, very little is known about how development infrastructure or water withdrawal would affect aquatic ecosystems within the Refuge. Ensuring accurate and updated information on water resources (including baseline water quality) and appropriate modeling is important not only to understand the impacts of oil and gas activities to water resources but also to understanding the synergistic impacts between local hydrology and aquatic and terrestrial ecosystems and potential impacts.

The Coastal Plain of the Arctic National Wildlife Refuge contains a variety of permafrost dominated lentic and lotic ecosystems including large rivers, springs, aufeis, taliks, small beaded streams and both shallow and deep thermokarst lakes that are sensitive to oil and gas development. Compared to the rest of the North Slope Coastal Plain, the area within the Arctic Refuge lacks widespread deep lakes to provide water sources for ice roads,[505] and areas that do contain deep lakes will need to be carefully managed for impacts to surface water connectivity, seasonal flow regime patterns, and processes within aquatic ecosystems.

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[503] *Id.*, Append. F at 12.
[504] 2018 USGS Report at 20.
[505] Trawicki et al. 1991, Lyons and Trawicki 1994.

Impacts from improper water withdrawals could include loss of overwintering habitat, degraded water quality, loss of littoral habitat and freezing of fish eggs or benthos.[506] While historically considered as a potential water source for ice roads, lotic environments should be avoided due to the high potential for detrimental aquatic impacts.[507] Due to the lack of available winter water for ice roads, development will likely require construction, maintenance, and use of numerous permanent gravel roads, which in turn have a number of significant impacts.[508]

Both short and long-term impacts from roads, stream crossings and development within the riverine floodplain may occur and could include increased sediment transport and deposition, increased frequency of mass wasting and slump events, and degraded water quality and habitat.[509] Associated negative impacts to Arctic fish populations from degraded water quality and habitats are likely to include minor to severe impacts to essential fish habitat (i.e., spawning, rearing, and overwintering) quality and quantity and to Arctic fish fitness.[510]

The EIS must fully analyze these and all other reasonably foreseeable direct, indirect, and cumulative impacts to water resources and hydrology of the Coastal Plain associated with all phases of development. Specifically, BLM must fully address the following considerations and information gaps:

- Identify water withdrawal amounts and locations under each alternative and fully analyze associated impacts to Arctic fishes. BLM must also identify and analyze a full suite of protective measures to avoid, minimize, and mitigate adverse impacts to fish and hydrology associated with water withdrawals.
- Ensure adequate information on the spatial and temporal variability of winter liquid water and dissolved oxygen concentrations in lakes within the study area.
- Identify and analyze a full suite of protective measures for designation, construction, and maintenance of stream crossings to minimize impacts to water quality, natural flow regimes and ecological processes.
- Ensure that river and stream setbacks minimize impacts to riparian and floodplain processes.
- Fully analyze physiological and behavioral impacts on Arctic fishes, migratory birds, and other aquatic life from impacts to water resources associated with all phases of oil and gas development.

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[506] Gaboury and Patalas 1984, Turner et al. 2005, Cott et al. 2008.
[507] Bendock 1976.
[508] *See, e.g.*, DFO 2000; *see also infra* Part VI.E.1.c.
[509] *See, e.g.*, Newcombe and Macdonald 1991, Robertson et al 2006.
[510] *See, e.g.*, Goldes et al. 1988, Berg and Northcote 1985, Reynolds et al. 1989.

a. BLM must study the impacts of the lease sales and resulting future activity on water quantity.

BLM must take a hard look at the impacts of the lease sales and post-lease oil and gas development activity on water quantity in the Coastal Plain. Typical oil and gas development projects involve constructing large drill pads, drill camps, and roads using ice produced from water in surrounding areas.[511] These developments require massive amounts of water. For example, in the NPRA, oil exploration activities consume millions of gallons of water each season.[512] Water from surrounding areas is used for drilling ("a 10,000 foot well could require approximately 420,000 to 1.9 million gallons of water") and waterflooding, which requires about 760 million gallons per year for a 50,000 barrel per day operation.[513] Water is also used for the camp water supply ("approximately 100 gallons per day for each person"), as well as road and pad maintenance ("approximately 20 percent of the initial volume of water required to construct the road or pad") throughout the season.[514] Moreover, hydraulic fracturing is increasingly being used onshore and offshore Alaska,[515] and fracking increases water use. Between 2000 and 2014, the average water used for fracking a horizontal well increased from 177,000 gallons to 4 million gallons.[516]

Free flowing water in the Coastal Plain is limited, despite the area being classified as wetlands — most of the lakes are shallow and cover less than one square mile.[517] And the last comprehensive assessment of the area (done by DOI in 1987) noted that very little is known about the rivers that run through it.[518] That study concluded that obtaining water for these

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[511] LEIS at 84 (1987); U.S. Dep't of Interior, National Petroleum Reserve-Alaska Final Integrated Activity Plan/Environmental Impact Statement, Vol. 1 at 196 (2012) [hereinafter "NPR-A IAP/EIS"].

[512] NPR-A IAP/EIS Vol. 1 at 196.

[513] *Id.* Vol. 2 at 19, 36, 37.

[514] *Id*. Vol. 1 at 196, Vol. 2 at 19, 21, 36.

[515] Fracfocus.org, Hydraulically Fractured Wells in Alaska, https://fracfocusdata.org/DisclosureSearch/Search.aspx (last visited May 16, 2018).

[516]T. J Gallegos *et al.*, *Hydraulic fracturing water use variability in the United States and potential environmental implications*, 51 WATER RESOUR. RES. 5839 (2015).. RES. 5839 (2015).

[517] LEIS at 13.

[518] *Id.* at 13–14.

activities in the Coastal Plain "has the potential for major adverse effects."[519] The hydrology of the area is also changing rapidly, as the climate changes. Climate change will have varied and complex effects throughout the region and is predicted to particularly affect the coastal areas.[520] BLM must undertake studies of how climate change will act cumulatively and synergistically with water withdrawals in the Refuge throughout the period of potential leased activities.

"Water is the lifeblood of the Arctic National Wildlife Refuge,"[521] and BLM must study how oil and gas development in the Refuge would affect the various species relying on its water sources. While there are similarities in hydrology across the Arctic Coastal Plain,[522] BLM must study the differences and how post-lease activities would affect areas that could be leased. For example, the Sadlerochit Spring region within the Coastal Plain is of particular importance to the region as it has a large discharge and constant temperature, which allows it to support a dense population of microorganisms, fish (such as Arctic char and grayling), birds, and plants that may not be found elsewhere in the region.[523] Muskoxen rely heavily on the availability of water in this area and other riparian areas of the Refuge.[524] Furthermore, there is very little open water available in the winter in the Refuge, and species such as American dippers rely on what little water is available and are restricted to where they can access it.[525] Modifications to surface water flow could also affect caribou habitat.[526] Climate change is modifying water resources and ecology of rivers, lagoons, nearshore estuaries of the Arctic Refuge and its adjacent waters due to melting of Brooks Range glaciers.[527]

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[519] *Id.* at 111, 113 ("The dedicated industrial use of the limited natural fresh-water sources of the 1002 area would be a major effect.").

[520] CCP Final EIS at 4-27, 60, 73-78; NPR-A IAP/EIS, Vol. 1 at 142-44.

[521] U.S. Fish & Wildlife Serv., *Water and Water Rights*, https://www.fws.gov/refuge/arctic/water.html (last updated Jan. 14, 2014).

[522] Svetlana L. Stuefer, Recent Extreme Runoff Observations From Coastal Arctic Watersheds in Alaska, AGU Publications (2017)

[523] LEIS at 19.

[524] *Id.* at 26.

[525] *Id.* at 33.

[526] *Id.* at 119.

[527] Nolan, M., R. Churchwell, J. Adams, J. McClelland, K.D. Tape, S. Kendall, A. Powell, K. Dunton, D. Payer, P. Martin. 2011. Pp. 49-in: Observing, Studying, and Managing for Change: Proceedings of the Fourth Interagency Conference on Research in the Watersheds, 26-30 September, 2011: Fairbanks, AK. Ed. By C.N. Medley, G. Patterson, and M.J. Parker. Scientific Investigations Report 2011-5169, USGS. https://pubs.usgs.gov/sir/2011/5169/

Anadromous and fresh-water fish in the Refuge are dependent upon maintenance of water supplies in the region, particularly for their below-ice winter habitat needs.[528] Fish may be killed or trapped if they are swept into reservoirs built to serve these water needs,[529] but there are also risks to fish beyond the direct impacts of the water supply reservoirs. "Overwintering habitat is probably the greatest factor limiting Arctic anadromous and fresh-water fish populations," and the suitability of this habitat depends partly on the volume of the pools in which the fish reside.[530] BLM must also study how oil and gas development could affect beaded streams (which consist of regularly spaced pools connected by narrow channels) in leased areas.[531]

Lastly, BLM must also consider how deconstruction (i.e., thawing) of the ice construction will affect water quantity. Allowing water to melt into different water sources could have impacts on both the originating and receiving sources. Permafrost prevents water from percolating through soil, as it does in many areas,[532] so BLM must study whether and how recharge of depleted water sources would occur.[533]

b. BLM Must Consider Existing Protections and Recommendations for Water Quantity and Water Resources on the Coastal Plain.

There are pending instream flow reservation applications for 152 waters on the Coastal Plain, including 140 lakes and 12 rivers.[534] Maintaining water quantity is one of the ANILCA purposes for the entire Arctic Refuge.[535] The instream flow applications were submitted in the

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[528] CCP Final EIS at 4-73.

[529] *Id.* at 136

[530] *Id.* at 34.

[531] William Morris, Seasonal Movements and Habitat Use of Arctic Grayling (Thymallus arcticus), Burbot (Lota Lota), and Broad Whitefish (Coregonus Nasus) within the fish creek drainage of the National Petroleum Reserve-Alaska, 2001-2002, 50, 52, 57, 60 (2003).

[532] U.S. Fish & Wildlife Serv., *Water and Water Rights*, https://www.fws.gov/refuge/arctic/water.html; CCP Final EIS at 4-38.

[533] *See* CCP Final EIS at 4-38 (noting that water resource data is limited in the Refuge).

[534] U.S. Fish and Wildlife Service, Realty & Natural Resources, Water Resources, Arctic National Wildlife Refuge, *available at*: https://www.fws.gov/alaska/water/arctic_water_rights.htm (last visited April 20, 2018).

[535] ANILCA § 305.

mid-1990s to “protect the habitat, migration, and propagation of fish and wildlife.”[536] While the Alaska Department of Natural Resources (DNR) has yet to adjudicate the applications, all applications have priority dates from the 1990s corresponding to the date of their submission.[537] The EIS must acknowledge these applications and address how water quantity resources will be managed consistent with the pending applications and the water quantity purpose of the Refuge.

Finally, the Hulahula River, which runs across the Coastal Plain, was recommended for designation under the Wild and Scenic Rivers Act and inclusion in the National Wild and Scenic River System as a Wild river.[538] “Wild” rivers “denote[] minimal access and development.”[539] In assessing the suitability of the Hulahula for designation, FWS stated that “[m]ulti-cultural exchange and contemporary cultural values and uses combine to give the Hulahula River outstandingly remarkable cultural values,” that “[t]he Hulahula River has outstandingly remarkable recreational values [] is unique from other rivers in Alaska and those in the NWSRS,” that it “offers an unparalleled northern arctic recreational experience,” and that it is “one of the most important subsistence rivers on the north side of the Refuge, particularly for fishing and Dall’s sheep hunting.”[540] The Hulahula was recommended for wild river designation because of its “remarkable recreational values.”[541] As the CCP acknowledged, “[u]ntil Congress makes a decision [on the recommendation], under Alternative E the Refuge will maintain the free-flowing condition, water quality, recommended classification (i.e., wild), and the outstandingly remarkable and other values of the [Hulahula] river[].”[542] The BLM must address the recommendation of the Hulahula as a wild river and consider the impacts of any oil and gas development and related activities on the outstandingly remarkable values for which the river was recommended and ensure its proper management.

2. BLM Must Analyze and Fully Disclose the Impacts of an Oil and Gas Program on Air Quality.

The leasing EIS must rigorously assess the significant air quality impacts associated with all phases of an oil and gas development program for the Coastal Plain. An adequate NEPA

[536] *Id.*
[537] *See* Alaska Constitution, Art. VIII, sec. 13, AS 46.15.040, .050.
[538] CCP ROD at 1, 3, 12; 16 U.S.C. §§ 1271, 1273.
[539] CCP Final EIS, Appendix I at I-2; 16 U.S.C. § 1273(b)(1).
[540] CCP Final EIS Appendix I at 74, 77.
[541] CCP Final EIS, Chapter 3 at 3-56
[542] CCP Final EIS, Chapter 3 at 3-56; *see also* CCP Final EIS, Chapter 3 at 3-3 (“Recommending rivers for inclusion in the NWSRS requires the implementation of management prescriptions intended to protect the rivers’ values.”).

analysis and compliance with the Clean Air Act requires BLM to quantitatively analyze the air pollution impacts associated with each alternative considered in the EIS, ensure prevention of significant deterioration of air quality, fully analyze a suite of enforceable mitigation measures, and address greenhouse gas emissions and climate change impacts associated with all phases of oil and gas development. In order to adequately do so, BLM must perform a quantitative analysis of criteria pollutants — a qualitative analysis is insufficient.

To comply with NEPA, BLM must analyze enforceable mitigation measures to protect air quality. BLM must fully analyze and condition any leasing on a comprehensive set of required, measurable, and enforceable mitigations to ensure there will be no significant impacts to air quality associated with leasing and development of the coastal plain. Reasonable alternatives to eliminate or mitigate exceedances of the NAAQS for NO_x, particulate matter, and ozone, unacceptable health risks from near-field HAPs concentrations, and climate change impacts must include a combination of management of the pace, location, and intensity of development and various control techniques. BLM should also work with stakeholders and commit to regularly updating regional cumulative air quality modeling and analysis.

BLM must also take a hard look at greenhouse gas emissions and climate change impacts associated with all phases of development.[543] Methane is a prime contributor to short-term climate change over the next few decades and a prime target for near-term greenhouse gas reductions.[544] There are many proven technologies and practices available to significantly reduce methane emissions from oil and gas operations. These technologies offer opportunities for significant cost-savings from recovered methane gas and prevent waste of oil and gas resources and associated economic value. Many proven methane emission controls for the oil and gas sector also have the co-benefit of reducing emissions of volatile organic compounds and HAPs.

a. BLM Must Perform a Full-Scale Dispersion Modeling Analysis to Inform Its Evaluation of the Direct, Indirect, and Cumulative Impacts from All Reasonably Foreseeable, Full-Scale Development Scenarios.

Air quality modeling is a necessary tool for assessing future air pollutant impacts under NEPA. Air quality models simulate the physical and chemical processes that affect air pollutants as they disperse and react in the atmosphere. They are used to estimate pollutant concentrations at locations of interest based on inputs that include meteorological data and source-specific parameters, such as emission rates and source characteristics (*e.g.*, location, height, etc.). Air quality modeling is the only way to evaluate how emissions sources will impact air quality aside

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[543] *See infra* Part VI.D.
[544] *Id.*

from direct monitoring, which is only able to measure real-time pollution levels at the location of the monitoring device.

BLM must prepare a modeling analysis of the direct, indirect, and cumulative impacts on air quality that could occur under the various alternatives in the leasing EIS considering all phases of oil and gas activities. For each alternative, a comprehensive emissions inventory should be developed and used as input to an air quality dispersion modeling analysis in order to fully assess the impacts on air quality throughout the region from the development of the leased parcels.

In conjunction with the FWS, U.S. Environmental Protection Agency, U.S. Bureau of Ocean Energy Management, National Park Service, U.S. Forest Service, and the State of Alaska, BLM has conducted air quality modeling to address the potential near-field and far field air quality impacts of several other BLM-authorized oil and gas leasing activities on the North Slope, including the NPR-A IAP, Greater Mooses Tooth (GMT1), and Greater Mooses Tooth 2 (GMT2). We encourage BLM to utilize the experience and expertise of these agencies to ensure air quality modeling conducted as part of this NEPA analysis thoroughly and accurately discloses the effects of the proposed lease sales and subsequent development on Arctic Refuge air quality.

BLM should also convene a technical workgroup under the terms of the Memorandum Of Understanding Among The U.S. Department Of Agriculture, U.S. Department Of The Interior, And U.S. Environmental Protection Agency, Regarding Air Quality Analyses And Mitigation For Federal Oil And Gas Decisions Through The National Environmental Policy Act Process Understanding (Air Quality MOU), signed June 23, 2011. Modeling must be conducted pursuant to the Air Quality MOU between these agencies regarding air quality analyses and mitigation in connection with oil and gas development on Federal lands.

To ensure the professional and scientific integrity of the air quality analysis,[545] BLM should use EPA-preferred models and modeling practices specified in EPA's recently-updated Guideline on Air Quality Models[546] and include the following components:

<u>A Near-Field Modeling Analysis to Assess Localized Criteria Air Pollutant Impacts</u>: BLM must

[545] 40 C.F.R. § 1502.24.
[546] 40 C.F.R. Part 51, Appendix W.

perform a near-field modeling analysis of localized maximum ambient air impacts from the direct and indirect emissions from the development of leased parcels to assess whether the activities allowed under each alternative would exceed the National Ambient Air Quality Standards (NAAQS) and the Prevention of Significant Deterioration (PSD) increments in Class II areas.[547] BLM should assess the development impacts on the exposed population, including the Native Village of Kaktovik. The agency should model the maximum emission rates from sources over the averaging times of the standard for which impacts are being assessed. The modeling analysis should be based on meteorological input data according to EPA's Guideline on Air Quality Models.[548] For the NAAQS analysis, appropriate background concentrations reflective of current air quality in the area should be added to the modeling results.[549]

<u>A Near-Field Modeling Analysis to Assess Localized Hazardous Air Pollutant Impacts</u>: BLM must perform a near-field modeling analysis of localized maximum ambient hazardous air pollutant (HAP) impacts from the direct and indirect emissions from the development of leased parcels to assess whether the activities allowed under each alternative will cause adverse health impacts.[550] The acute reference exposure limits should be used as a comparison for short-term development impacts, and non-cancer reference concentrations for chronic inhalation should be used as a comparison for annual impacts. BLM should also assess long-term cancer risk. BLM should assess these health risks along with the cumulative HAP impacts to the exposed

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[547] Under the Clean Air Act, Class I areas receive the highest degree of protection, with only a small amount of certain kinds of additional air pollution allowed. Mandatory Class I areas were designated by Congress and include international parks, areas in the National Wilderness Preservation System, or national parks larger than 6,000 acres, that were in existence (or authorized) on August 7, 1977. Large national parks and wilderness areas established since 1977, such as most park areas in Alaska, have not been designated subsequently as Class I. The Mollie Beattie Wilderness in the Arctic National Wildlife Refuge was designated in 1980 by ANILCA, so it is not a Mandatory Class I area. CCP Final EIS, Volume 3 (Response to Public Comments) at 3-17. Congress initially designated all other attainment areas as Class II and allowed only a moderate increase in certain air pollutants. The Arctic Refuge overall is designated as a Class II Area. Congress prohibited re-designation of some Class II areas that exceed 10,000 acres to the less protective Class III status. These areas are called Class II floor areas, and the Arctic Refuge's Mollie Beattie Wilderness is a Class II floor area. *Id.*

[548] *See, e.g.*, Section 8.4 of EPA's Guideline on Air Quality Models at 40 C.F.R. Part 51, Appendix W.

[549] *See infra* Part VI.B.2.g; Section 8.3 of EPA's Guideline on Air Quality Models at 40 C.F.R. Part 51, Appendix W.

[550] *See infra* Part VI.C.4.

population, including the Native Village of Kaktovik. BLM's HAP assessment should be a cumulative one, not just an analysis of the incremental risk associated with the proposed action, which would be imposed on top of existing health risks in the area. The HAP assessment should include the full suite of Mobile Source Air Toxics (MSAT), methanol, chlorinated solvents used on-site, carbonyl compounds used in flaring and diesel particulate matter and should include construction activities as well as oil and gas production activities. BLM should also include ultrafine particles (UFPs) in this assessment, which are particulate matter of nanoscale size. Though not regulated by EPA as ambient air pollution particles, UFPs are far smaller than the regulated PM10 and PM2.5 particle classes and are believed to have several more aggressive health implications than those classes of larger particulates.[551]

A Far-Field Modeling Analysis to Assess Air Quality Impacts on Sensitive Class II Areas: BLM must perform a far-field modeling analysis of the impacts from the direct and indirect emissions from the development of the leased parcels to assess whether the specific activities under each alternative would adversely impact air quality in sensitive Class II areas, including the Mollie Beattie Wilderness and the remainder of the Arctic Refuge. The analysis should include all sensitive Class II areas that could be affected by emissions from the proposed lease development. BLM should model the maximum emission rates from sources over the averaging times of the standard for which compliance is being assessed. For visibility impacts, this requires modeling of the maximum 24-hour average emission rates. The modeling analysis should be based on meteorological input data according to EPA's Guideline on Air Quality Models.[552] The far-field analysis should assess the impacts of the alternatives on PSD increments and on air quality related values, including visibility and deposition.

A Cumulative Air Quality Impacts Analysis: BLM must perform a cumulative analysis of air quality impacts that could occur under each alternative. Specifically, the cumulative analysis must include impacts from all existing sources and reasonably foreseeable sources of air emissions that could impact the same area. BLM should model the maximum emission rates from all sources over the averaging times of the standard for which compliance is being assessed. The cumulative modeling analysis should adhere to EPA's Guideline on Air Quality Models,

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[551] Kumar, P., et al, Environment International, Vol. 66, May 2014, 1-10, *available at*: https://www.sciencedirect.com/science/article/pii/S016041201400018X.

[552] *See, e.g.*, Section 8.4 of EPA's Guideline on Air Quality Models at 40 C.F.R. Part 51, Appendix W.

including guidance for modeling ozone and secondarily-formed particulate matter (including $PM_{2.5}$ and PM_{10}).[553]

b. Model Scenarios

Regarding its scenarios, BLM must account for concurrent oil and gas development activities (*e.g.*, construction, drilling, well intervention, and ongoing maintenance activities) in its modeled scenarios. BLM should ensure that the modeling fully accounts for all emissions sources in the year with maximum emissions, making sure to include all oil and gas development and operation activities that will be occurring concurrently. BLM should ensure that the emissions from reasonably foreseeable development sources also reflect the maximum emissions scenarios for each pollutant.

c. Meteorological Data

BLM must also reconcile data gaps in the available meteorological record for the North Slope. In a 2011 report, the Alaska Department of Environmental Conservation concluded:

> The stringent requirements of the meteorological data used in dispersion modeling for regulatory applications result in data gaps in the meteorological record on the North Slope. These gaps are realized in both spatial and temporal contexts. The spatial aspect of these gaps refers to the limited geographic coverage which makes finding representative data in many areas of the North Slope a challenge, while the temporal gaps are primarily associated with the period of record of usable data.[554]

In addressing these gaps, BLM must follow EPA's Guidance on Air Quality Models regarding meteorological input data for the air quality analyses conducted for the leasing EIS.[555] EPA's recommendations for meteorological input data for photochemical grid modeling are contained in the latest version of EPA's Modeling Guidance for Demonstrating Attainment of Air Quality Goals for Ozone, $PM_{2.5}$, and Regional Haze.[556] BLM should consult with EPA and the

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[553] *See* Section 5 of EPA's Guideline on Air Quality Models at 40 C.F.R. Part 51, Appendix W.

[554] Alaska Department of Environmental Conservation, *Emissions, Meteorological Data, and Air Pollutant Monitoring for Alaska's North Slope*, pp. 5-7 (2011), *available at* http://dec.alaska.gov/air/ap/NS_Report.html.

[555] *See* Section 8.4 of EPA's Guideline on Air Quality Models at 40 C.F.R. Part 51, Appendix W.

[556] https://www3.epa.gov/scram001/guidance/guide/Draft_O3-PM-RH_Modeling_Guidance-2014.pdf.

State regarding the appropriate meteorological data to be used for the leasing EIS and ensure that meteorological data are collected in the communities closest to development. Any data used in the analysis should be reviewed and approved by EPA or the State to ensure the data satisfy EPA guidelines.

d. Emissions Inventory

BLM must ensure that all assumptions regarding operations and control effectiveness which are the basis for the modeling analysis are established as enforceable mitigation measures and implemented through lease and permit stipulations. Otherwise, BLM should model emission sources under maximum possible operating conditions and assuming no controls. The inventory of emissions must be representative of maximum operating scenarios. BLM must provide sufficient detail in the leasing EIS for stakeholders to review and assess the underlying assumptions used in developing the emission inventories.

e. Background Monitoring Data

BLM must fully account for all sources of background air quality to ensure that additional impacts from the anticipated oil and gas development will not cause or contribute to exceedances of the NAAQS and to provide an accurate baseline for purposes of NEPA compliance. BLM should consult with EPA, the State, and the North Slope Borough regarding the appropriate representative background concentrations to be used for the leasing EIS. EPA or the State should review and approve any data used in the analysis to ensure proper collection and quality assurance. BLM should not remove data from the monitoring dataset for exceptional events without making a determination based on relevant EPA criteria and procedures.[557] The background air monitoring data utilized should be made publicly available. BLM should also include in the leasing EIS alternatives enforceable commitments to improve air quality monitoring and data prior to authorization of any leasing or development of the coastal plain.

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[557] *See* https://www.epa.gov/air-quality-analysis/treatment-air-quality-data-influenced-exceptional-events.

f. Modeling of Existing Sources

BLM cannot assume that existing sources are accounted for in its background monitoring data. Background monitoring data is limited to providing a historical account of concentrations observed at a fixed location and therefore does not reflect what could potentially occur at another location under maximum operating scenarios from all existing sources in the area and/or under different meteorological conditions. As discussed in EPA's Guideline on Air Quality Models, modeling of existing sources is necessary for sources that are not adequately represented by ambient monitoring data.[558] BLM may not rely on its background monitoring data to reflect existing sources in the region absent a showing that that monitoring data accurately reflects the impacts of existing sources under operating and meteorological conditions that result in maximum concentrations and that the data have been properly collected and quality assured. Instead, BLM must inventory and model existing sources affecting the region for its cumulative effects analysis.

g. Combining Modeled and Monitored Concentrations in a NAAQS Analysis

In combining modeled and monitored concentrations in a NAAQS analysis, BLM must utilize methods that ensure exceedances will not occur in the future. For example, pairing of monitored and modeled data, in time — as opposed to adding a single representative background concentration to the modeled design value concentration — should only be used in very limited situations, with adequate justification, and according to EPA guidance.[559]

h. BLM Must Assure the Prevention of Significant Deterioration of Air Quality.

Further, as required by the Clean Air Act, BLM must complete a proper PSD increment analysis to determine how much of the available increments have already been consumed in the affected area and how much additional increment is available for consumption from all phases of an oil and gas development program for the coastal plain. This should include an analysis of all increment consuming and increment expanding sources that impact the area, including an inventory of increment-affecting emissions. An approach that compares modeled project impacts to Class II PSD increments would be insufficient because it would only show how much of the

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[558] *See* Section 8.3 of 40 C.F.R. Part 51, Appendix W.

[559] *See, e.g.*, March 1, 2011 EPA Memo Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO_2 National Ambient Air Quality Standard, p. 17.

available PSD increments are consumed by the predicted modeled concentrations from oil and gas development sources and therefore not ensure that air quality will not deteriorate more than is allowed under the Clean Air Act.

3. BLM Must Analyze and Fully Disclose the Impacts of an Oil and Gas Program on Wilderness Values and Designated Wilderness.

Both existing and potential future designated Wilderness are resources and values of the Arctic National Wildlife Refuge which must be addressed in the EIS. Specifically, the EIS must fully analyze all reasonably foreseeable direct, indirect, and cumulative impacts to the Refuge's existing and recommended Wilderness resource associated with all phases of an oil and gas program, including leasing, exploration and development.

The Arctic Refuge is distinctive among refuges— it was established specifically to preserve wilderness values. As outlined above, the Arctic Refuge and Coastal Plain have exceptional wilderness values.[560] The Coastal Plain in particular is a key part of the broader ecosystem and is adjacent and connected to existing Wilderness by means of watersheds, rivers, and migration corridors. The Coastal Plain also provides key habitat for migratory birds and the Porcupine Caribou Herd, and is the most important land denning habitat in the U.S. Arctic for the threatened polar bear — all species which benefit from the undeveloped and undisturbed wilderness character of the area.

The Coastal Plain contains outstanding wilderness and wildlife values and fits the definition of Wilderness as defined in the Wilderness Act: "an area of undeveloped federal land retaining its primeval character and influence. . . , which generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable."[561] The definition does not require a pristine area with no evidence of human activities. Rather, an area must appear substantially natural to the average visitor, and human imprints cannot dominate.

When Congress passed ANILCA, section 1002 set out to:

> . . . provide for a comprehensive and continuing inventory and assessment of the fish and wildlife resources of the coastal plain of the Arctic National Wildlife Refuge; an analysis of the impacts of oil and gas exploration, development, and production, and to authorize

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[560] *See supra* Part II, VI.B.3.
[561] 16 U.C.S. § 1131(c).

> exploratory activity within the coastal plain in a manner that avoids significant adverse effects on the fish and wildlife and other resources.

The resulting studies done under section 1002 of ANILCA documented the outstanding wilderness and wildlife values of the Refuge's Coastal Plain, demonstrating that the Coastal Plain is an extraordinary wilderness enclave and vital wildlife sanctuary. [562]

The wilderness values of the refuge were further documented and underscored in the 2015 CCP. The CCP identified the Refuge's wilderness characteristics as among it's "most prominent" special values and described them in-depth:

> Arctic Refuge exemplifies the idea of wilderness—to leave some remnants of this nation's natural heritage intact, wild, and free of the human intent to control, alter, or manipulate the natural order. Embodying tangible and intangible values, the Refuge's wilderness characteristics include natural conditions, natural quiet, wild character, and exceptional opportunities for solitude, adventure, and emersion in the natural world.[[563]]

In the final decision adopting Alternative E for the Arctic Refuge, FWS stated that the Arctic Refuge is "one of the finest representations of the wilderness that helped shape our national character and identity."[564] According to FWS, the Coastal Plain has exceptional wilderness characteristics and values.[565] The majority of the Refuge lands added by ANILCA (south of the then-Arctic National Wildlife Range) are also recommended for Wilderness designation because of their exceptional wilderness values.[566] The EIS must consider the impact of oil and gas on the wilderness characteristics and values of the Coastal Plain and ensure protection of those values. The EIS should also consider whether there will be any impacts to the

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[562] In April 1987, Secretary of the Interior, Donald Hodel, disregarded what the studies showed and forwarded the Final LEIS and Arctic National Wildlife Refuge Coastal Plain Resource Assessment to Congress, with a recommendation that Congress authorize full-scale oil and gas leasing for the entire 1.5 million acres of the Coastal Plain. This recommendation ignored the fact that the assessment itself confirmed the internationally significant wilderness and wildlife values of the coastal plain.

[563] CCP Final EIS, Chapter 1 at 1-23.

[564] CCP ROD at 12.

[565] CCP Final EIS, Appendix H at H-12.

[566] CCP Final EIS, Appendix H at H-9, H-11.

wilderness values of the ANILCA-added southern areas and consider how best to protect the values in that area as well.

Additionally, the area of the Arctic Refuge to the immediate east and south of the Coastal Plain is designated Wilderness: the Mollie Beattie Wilderness Area.[567] This area is "the largest, wildest, and most diverse Wilderness in the National Wildlife Refuge System."[568] Wilderness enjoys our nation's strongest protections. Under the Wilderness Act, Wilderness areas must be:

> administered for the use and enjoyment of the American people in such manner as will leave them unimpaired for future use and enjoyment as wilderness, and so as to provide for the protection of these areas, the preservation of their wilderness character, and for the gathering and dissemination of information regarding their use and enjoyment as wilderness. . . [[569]]

Additionally, the Wilderness Act mandates that:

> each agency administering any area designated as wilderness shall be responsible for preserving the wilderness character of the area and shall so administer such area for such other purposes for which it may have been established as also to preserve its wilderness character. Except as otherwise provided in this chapter, wilderness areas shall be devoted to the public purposes of recreational, scenic, scientific, educational, conservation, and historical use.[[570]]

To comply with the mandates under the Wilderness Act and ANILCA, the EIS must consider the impacts of any oil and gas activities in the Coastal Plain on the designated Wilderness within the Arctic Refuge. With respect to the Mollie Beattie Wilderness Area, BLM must ensure that no activities will harm its wilderness characteristics or otherwise run afoul of its management as Wilderness.

Adverse impacts to wilderness characteristics from oil and gas exploration, leasing, and development include but are not limited to:

- Roads and infrastructure affecting the areas' roadlessness;

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[567] ANILCA § 702(3).
[568] CCP Final EIS, Chapter 4 at 4-15.
[569] 16 U.S.C. § 1131(a).
[570] 16 U.S.C. 1133(b).

- The sights and sounds associated with exploration and development activities and associated infrastructure degrading opportunities for solitude and primitive recreation and the apparent naturalness of the area; and
- Exploration and development activities degrading air and water quality, wildlife habitat, and other ecological, scientific, scenic, and historical values.

a. *Wilderness Stewardship*

The 2015 Record of Decision for the CCP was finalized prior to passage of the 2017 Tax Act, and BLM must address in the EIS how the agency intends to resolve the discrepancies between the two. The Tax Act does not render the original purposes of the Refuge irrelevant; nor does it render the management direction and implications resulting from the final CCP irrelevant. Wilderness stewardship is a critical part of national wildlife refuge and ecosystem management and should be addressed as the BLM analyzes leasing, exploration and development impacts in the EIS. The EIS should address how the BLM and FWS intends to meet wilderness management and stewardship directives resulting from the CCP:[571]

Allow natural processes to operate freely within Wilderness. Wilderness stewardship and management requires uses to minimize impacts to wilderness values. In Wilderness, the natural forces of insects, disease, wildfire, wind, and wildlife are the overarching managers, though exceptions to this may be made in order to protect communities, life and property particularly in the event of fire.

Manage Wilderness as a distinct resource with inseparable parts. BLM will need to address the integrity of the whole Wilderness area, making management decisions that are mindful of what impact decisions could have on Wilderness. The ecoregion or ecosystem context of a Wilderness also needs to be addressed to determine what decisions are being made outside of the Wilderness that could affect or impact it.

Set carrying capacities to prevent unnatural change. Wilderness has a limited capacity to absorb the impacts of use and still retain its wilderness qualities. BLM should address how the

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[571] These wilderness stewardship points have been adapted from the publications: National Park Service, Keeping it Wild in the National Park Service: A User Guide to Integrating Wilderness Character into Park Planning, Management, and Monitoring (2014), *available at* https://www.fs.fed.us/rm/pubs_other/rmrs_2014_landres_p001.pdf and Chad P. Dawson and John C. Hendee, Wilderness Management: Stewardship and Protection of Resources and Values (4th ed. 2009).

agency will work within the Limits of Acceptable Change framework to protect the wilderness character of the Arctic Refuge.

Monitor the social and ecological conditions of the area as a key to long-term Wilderness stewardship. Only through sound research and monitoring can the BLM identify baseline conditions and determine whether management objectives have been met.

Control and reduce the adverse impacts of human use in wilderness through education or minimum regulation. Wilderness management is not passive; it is very active, but it should be designed to be as unobtrusive as possible. The BLM should address temporal or spatial permitting or zoning of Wilderness in very high use areas to protect the quality of the visitor experience. However, when use levels threaten the wilderness resource, then BLM must limit uses to protect the Wilderness.

4. BLM Must Analyze and Fully Disclose the Impacts of an Oil and Gas Program on Soils and Permafrost.

Numerous factors contribute to permafrost impact, including infrastructure, roads, a warming climate, and human activity including seismic work. Melting permafrost is creating an increasingly thermokarst landscape in the Arctic and the Arctic Refuge has particularly ice-rich soils. BLM should analyze coastal plain vegetation and soils and their disturbance and recovery patterns from past, present and future activities including seismic surveys and associated activities, vehicle activity, ice infrastructure, gravel structures, ports, oil and gas wells, air pollution, gravel mine and water reservoir sites, dust from gravel roads, spills and contaminants, abandonment and reclamation work, climate change and permafrost melt. In order to properly consider the exploration and development impacts and mitigation opportunities for these resources, the agency should conduct a fine-scale analysis of soils and permafrost, with analysis of different development scenarios.

5. BLM Must Analyze and Fully Disclose the Impacts of an Oil and Gas Program on Soundscapes.

Soundscapes are a public land resource affected by agency-authorized uses such as oil and gas development, with corresponding impacts on other resources including wildlife, wilderness, and recreation. The final EIS for the Arctic Refuge CCP recognizes this:

> Natural quiet and natural sounds are intrinsic elements of the Wilderness character of designated Wilderness and the wilderness characteristics of the entire Refuge. As such, their perpetuation is important for meeting the Refuge's purposes, goals, objectives, and

> special values. Human-caused sounds may mask or obscure natural sounds and disrupt wildlife behavior. They may interfere with locating prey or detecting predators, or with the complex communication systems many species have evolved to assist in mating or other behaviors. As well, human-caused sound interferes with the sense of solitude that is important to many visitors.[572]

As FWS recognizes, preservation of natural soundscapes is an important component of achieving the Refuge's purposes of conserving wildlife, habitat, wilderness, and recreation.

Noise can affect the physiology, behavior, and spatial distribution of wildlife. While impacts vary by species and habitat, studies have shown that anthropogenic noise, including from oil and gas development, can impact species in ways crucial to survival and reproductive success.[573] For instance, as described in detail above, marine mammals are particularly sensitive to noise impacts.[574]

Noise also affects caribou. Experiments testing the response of wild woodland caribou to simulated seismic exploration found that caribou responded to noise disturbance by increasing movement rates, displacement distances, and energy expenditure, though effects were relatively short-lived.[575] A study of response to simulated drilling noise by white tailed deer found that deer avoided areas near loud noise sources but did not increase their home range sizes or movement rates relative to control animals.[576] BLM must carefully evaluate the impacts of noise from fixed-wing aircraft and helicopters on caribou. A variety of studies have also shown that caribou respond to aircraft overflights, with cows with young calves reacting most strongly, especially during calving and post-calving seasons.[577] Alaska Native communities have long voiced concerns regarding the effects of aircraft noise and activity on caribou, given corresponding impacts to subsistence.[578]

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[572] CCP Final EIS at 4-43–4-44; *see also* CCP ROD at 11–12 ("The Refuge exemplifies the idea of wilderness embodying tangible and intangible values including natural conditions, *natural quiet*, wild character, and exceptional opportunities for solitude, adventure, and immersion in the natural world." (emphasis added)).

[573] *E.g.*, Keyel et al. 2017 (in press); Shannon et al. 2016; Barber et al. 2009.

[574] *See supra* Part VI.A.6.a.

[575] Bradshaw et al. 1997, 1998.

[576] Drolet et al. 2016.

[577] Calef et al. 1976; Maier et al. 1998; Wolfe et al. 2000.

[578] *E.g.*, Georgette and Loon 1988; Halas 2015.

Noise from all stages of industrial activity can also impact birds including causing stress, fright or flight, avoidance, changes in behavioral habits like nesting and foraging, changes in nesting success, modified vocalizations, or interference with the ability to hear conspecifics or predators.[579] The EIS should catalogue the existing noise in the planning area, explain the changes in noise that will occur with the development of an oil and gas program, describe impacts that will occur for birds, and provide a method for addressing and monitoring this issue.

Anthropogenic noise also has significant impacts on recreationists who visit natural areas like the Refuge to escape non-natural noises and attain a sense of solitude and tranquility. Studies have found that anthropogenic noise interferes with the quality of the visitor experience and even impacts the perceived visual and aesthetic qualities of the landscape.[580] Non-natural noise degrades wilderness characteristics, including apparent naturalness and opportunities for solitude.[581]

BLM must take a hard look at these and other reasonably foreseeable impacts of oil and gas leasing and development to the natural soundscape of the coastal plain. Indeed, BLM Manual 7300.06D requires the agency to consider noise and its potential impacts on public lands during planning and project authorizations:

> When BLM programs, projects, and/or use authorizations have the potential to affect existing resources that may be sensitive to noise such as public health and safety, wildlife, heritage resources, wilderness, wildland/urban interface areas, and other special value areas . . . , BLM will consider noise and its potential impacts on the public and the environment, as well as any appropriate mitigation measures, during the planning and authorization review process.

Courts have affirmed the responsibility of federal land management agencies to evaluate noise impacts on the natural soundscape, including in the context of authorizing oil and gas

[579] Clinton D. Francis and Jessica L. Blickley, *The influence of Anthropogenic Noise on Birds and Bird Studies*, 74 Ornithological Monographs 6 (2012), *available at*: http://americanornithologypubs.org/doi/pdf/10.1525/om.2012.74.1.6?code=coop-site.

[580] *E.g.*, Mace 1999.

[581] *See* 16 U.S.C. § 1131(c).

development or other noise-producing activities that could impact wildlife, wilderness, or recreation.[582]

BLM must utilize acoustic modeling to fully analyze the impacts of each alternative on the natural soundscape of the Coastal Plain and the resources that would be affected by anthropogenic noise associated with oil and gas development. This will require accurate data on background ambient noise levels to establish the necessary baseline. Methods for obtaining this data could be adapted from other acoustic studies in northern Alaska.[583] The 2010 study conducted in conjunction with the proposed Point Thomson Development Project that measured ambient noise levels at six locations adjacent to the northwestern border of the Refuge is inadequate to provide an accurate baseline for modeling and analysis of reasonably foreseeable noise impacts associated with developing an oil and gas program for the coastal plain.[584] That study focused on areas adjacent to the Refuge that are affected by noise associated with nearby oil production and associated industrial sites; it did not measure ambient noise levels within and throughout the coastal plain.[585] Nevertheless, the study documented that natural ambient sound levels even along the northwestern boundary of the Refuge are low, with sounds from insects, animals, water features, and other natural sources dominating the soundscape.[586] Presumably baseline noise levels within and throughout the coastal plain will be even lower, though may be affected by existing aircraft activity throughout the region.

After gathering sufficient baseline soundscape data, BLM must conduct a proper noise impact study, including acoustic modeling of all development scenarios. Various models and methodologies that constitute the best available scientific information are available for purposes of conducting soundscape modeling. Based on the results of the modeling, BLM must then utilize acoustic ecologists and wildlife biologists to fully assess the reasonably foreseeable direct, indirect, and cumulative impacts of increased anthropogenic noise on various wildlife species. BLM also must fully analyze the reasonably foreseeable acoustic impacts on the Refuge's wilderness resources and on recreationists' experiences. The agency must consider and fully

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[582] *See, e.g.*, *S. Utah Wilderness Alliance v. U.S. Dep't of Interior*, No. 2:13-cv-01060-EJF, 2016 U.S. Dist. LEXIS 140624, *20–*24 (Oct. 3, 2016); *Izaak Walton League of Am. v. Kimbell*, 516 F. Supp. 2d 982, 995–97 (D. Minn. 2007).
[583] Betchkal 2015; Stinchcomb 2017.
[584] *See* CCP Final EIS at 4-44 (describing 2010 study).
[585] *Id.*
[586] *Id.*

analyze all options for avoiding, minimizing, and mitigating adverse impacts to natural soundscapes.

6. BLM Must Analyze and Fully Disclose the Impacts of an Oil and Gas Program on Coastal and Marine Areas, Including Marine Protected Areas.

An oil and gas program in the planning area could potentially connect to marine and coastal areas by way of infrastructure, water use and hydrology, and vessel traffic. In order to analyze these activities, the agency will need to present a thorough documentation and analysis of coastal and marine hydrology during different seasons, coastal and underwater geology, characteristics of sea ice coverage and movement, coastal and marine currents along the mainland and between nearby barrier islands, and the physical and chemical characteristics of marine and coastal zones. The agency must also address threats and rules applicable to the Marine Protected Area within the boundaries of the Arctic National Wildlife Refuge.[587]

7. BLM Must Analyze and Fully Disclose the Impacts of an Oil and Gas Program on Tundra and Vegetation.

Oil and gas operations have the potential to cause considerable impacts to tundra and vegetation; the EIS must fully consider the impacts to these resources. The Coastal Plain is comprised of gently rolling terrain, with tussocks, shrubs, and graminoids.[588] Riparian and flood plains support willows and related plant communities.[589] Because of the climate and soil conditions, the vegetation is generally slow-growing and "very sensitive to disturbance."[590] The occurrence and distribution of plants is already being affected by climate change, and continued effects are likely. The distribution and availability of various vegetation is very important for the wildlife that rely on it at critical stages of its life cycle, like calving, migration, and staging.

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[587] *See* CCP Final EIS at 4-13 ("In 2005, all marine waters located within Refuge boundaries were nominated as part of the National Marine Protected Area System. Currently, approximately 91,000 acres of marine waters and lagoons located off the northern coast of the Refuge are a designated marine protected area (MPA)."

[588] 2002 USGS Report at 2.

[589] 2002 USGS at 2.

[590] Janet C. Jorgenson, *et al*. Long-term recovery patterns of arctic tundra after winter seismic exploration, *Ecological Applications* 20(1) at 205 (2010).

Inventory and mapping of vegetation at a sufficient level to evaluate impacts and inform avoidance areas, stipulations, mitigation measures, and reclamation standards is lacking for the Coastal Plain.[591] A change in plant occurrence can have significant impacts on wildlife that is dependent on the vegetation for forage and habitat.[592] Climate change and disturbance also bring the threat of invasive species.[593] BLM must gather updated information about tundra and vegetation cover in order to evaluate the impacts from oil and gas.[594] The EIS must include information about the impacts from oil and gas activities to tundra and vegetation and also consider how to protect vegetation from direct, indirect and cumulative impacts. Oil and gas is known to have long-term and significant direct impacts to tundra and vegetation — the impacts to the tundra and vegetation from seismic that occurred in the mid-1980s is still visible today[595] — and activities have the ability to have indirect effects as well, like the introduction of invasive species. The EIS must account for these impacts and address how best to avoid and reduce them.

The EIS must also address reclamation of tundra and vegetation from the impacts of any oil and gas activities. Reclamation in the Arctic is very challenging, and its takes decades for areas to recover, if they ever do.[596] The EIS must consider reclamation and address the challenges and feasibility of reclaiming areas impacted by oil and gas activities.

C. BLM Must Analyze and Fully Disclose the Impacts of an Oil and Gas Program on Social Systems and Uses.

1. BLM Must Analyze and Fully Disclose the Impacts of an Oil and Gas Program on Subsistence Uses and Resources.[597]

Six communities (Arctic Village, Chalkyitsik, Fort Yukon, Kaktovik, Venetie, and Wiseman) are in or relatively close to Arctic Refuge and use the Refuge for subsistence purposes.[598] In addition, the following communities have geographic or cultural ties to Arctic Refuge and its subsistence resources: Beaver, Circle, Birch Creek, and Stevens Village in

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[591] CCP Final EIS at 4-45–4-53; 2002 USGS at 4; 2018 USGS Report at 3.
[592] CCP Final EIS at 4-59.
[593] CCP Final EIS at 4-58–4-59.
[594] *See also infra* Part V.F.
[595] *See* Jorgenson, *et al.*, *infra* Note 588.
[596] 2003 NRC Report at 158.
[597] *See also infra* Part VII.
[598] CCP Final EIS, Chapter 4 at 4-174.

Alaska, and Old Crow, Fort McPherson, Tsiigehtchic, Aklavik, and Inuvik in Canada.[599] These communities have a "mixed subsistence-market" economy, combining subsistence and commercial-wage activities. Subsistence is a way of life that involves the harvest, preparation, sharing, and consumption of wild resources for food and other culturally important purposes. In rural Alaska that includes hunting, fishing, and gathering activities, which are vital to the preservation of communities and their culture.[600] Subsistence resources have pronounced health, economic, cultural, and spiritual importance in the lives of rural Alaskans.[601]

Subsistence use areas vary among communities that utilize the resources of the Arctic Refuge, and seasonally within communities. In Arctic Village, for example, residents vary their activities between fishing, berry-picking, and harvesting waterfowl throughout the summer, to hunting migrating caribou in the fall into the winter, to ice fishing and fur trapping throughout the winter until spring.[602] By contrast, subsistence harvest studies for Kaktovik in 1995 indicated that 61% of the subsistence harvest (in edible pounds of food) were from marine mammals.[603]

BLM should not consider allowing any oil and gas activities on the Coastal Plain until sufficient baseline data is collected and meaningful studies completed on how such activities would impact subsistence resources and practices, including the harvest, preparation, sharing, and consumption of wild foods and materials. Such studies should include current, geographically specific data and document the types of resources, percent of harvest (for caribou), percent of harvesters, timing of activities, and method of transportation for hunters within the study area. We note that such caribou studies are typically done in a ten-year time frames. There is a roughly 12 year data gap since completion of the most recent Kaktovik 10-year study (1996/97-2005/06) of caribou hunting areas as reported by Kaktovik residents.[604] BLM cannot adequately evaluate impacts to caribou without completing further studies.

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[599] *Id*.
[600] *Id*. at 4-172 (quoting Alaska Federation of Natives (2005)).
[601] *Id*.
[602] *Id*. at 4-178.
[603] *Id*. at 4-196.
[604] *See* Stephen R. Braund & Associates, Subsistence Mapping Of Nuiqsut, Kaktovik, And Barrow (2010), 135–43, *available at*: http://www.north-slope.org/assets/images/uploads/Braund%202010%20Beaufort%20maps%20MMS_MP_Final_Report_Apr2010.pdf

Furthermore, how development will impact subsistence's connection to residents' human health, economic circumstances, environmental justice, and sociocultural systems should be analyzed.

Researchers must work with communities to ensure this information is collected in an unobtrusive manner, and must include traditional knowledge in its baseline analysis. BLM should also carefully consider data and findings identified in other relevant NEPA analyses, such as the CCP Final EIS and ROD and the Point Thompson Final EIS.[605]

BLM must identify and fully evaluate all potential impacts to subsistence resources, taking a broad geographic and temporal scope. BLM must consider impacts to subsistence from all phases of oil and gas activities, from seismic exploration to development and transportation (for example, barging impacts). BLM should consider impacts associated with construction and operation of project facilities, vessel, vehicle, and aircraft traffic, and all potential infrastructure. Impacts will vary by season, and may last for multiple generations. These impacts must be accounted for.

Subsistence practices that could be particularly affected by oil and gas development include caribou, bird, and small mammal hunting, as well as fishing. Primary impacts to subsistence will likely be caused by reduced availability of subsistence resources, reduced access to subsistence use areas, and hunter avoidance of industrial areas. Though potential impacts to wildlife resources may be identified as minimal, changes in resource access and availability, including perceived changes in fish and wildlife health due to development, may affect subsistence.[606] This is because subsistence users generally rely on healthy subsistence resources being present in traditional use areas, and some harvesters are often limited in their ability to access resources beyond traditional use areas at the expected time of year.[607] Further, any impacts from development will likely be exacerbated by climate change effects which are already being felt in the Arctic and must be fully evaluated.

2. BLM Must Analyze and Fully Disclose the Impacts of an Oil and Gas Program on Social and Cultural Systems.

BLM must acknowledge and evaluate the impact of oil and gas development on the social and cultural systems to nearby communities. Several factors related to oil and gas activities are

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[605] U.S. Army Corps of Engineers, Alaska District, Point Thomson Project Final Environmental Impact Statement (July 2012).
[606] Point Thompson EIS, vol. 3 at 5-602.
[607] *Id*.

likely to affect socio-cultural systems, as has been demonstrated by communities in the western Arctic that are dealing with oil and gas development. As described above, development would likely cause disruptions to subsistence activities and uses. Subsistence activities are critically important to the cultural identity and social cohesion of the Gwich'in. Disruption of subsistence activities may affect social and kinship ties, many of which are based upon the harvesting, processing, distribution, and consumption of subsistence resources.

Development may also cause increased or variable income among households, such as those that include any ASRC or other ANCSA corporation shareholders or employable individuals versus those households that do not. In addition to the potential for increased tensions within the community due to income disparities, there may also be increased social and political tensions between different population sectors and community institutions that either support or oppose development. Potential new oil and gas development increases the likelihood for such disagreements within the community to occur, thus affecting social cohesion.

BLM must evaluate impacts to local communities from an influx of non-Native residents not associated with existing community, non-resident temporary workers (e.g., oil industry workers), and increased interaction between residents and non-resident workers. This includes research crews, as well as personnel associated with oil and gas permitting processes. BLM must also consider the stress of this and other necessary permitting processes and associated public meetings. BLM should also conduct a social impacts assessment as part of the EIS process.

3. BLM Must Analyze and Fully Disclose the Environmental Justice Impacts of an Oil and Gas Program.

Executive Order No. 12898, issued by President Clinton in 1994, requires that all federal agencies "make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations."

Communities associated with the Arctic Refuge are rural, contain many low-income households, and retain subsistence lifestyles in a mixed, subsistence cash-income economy with high levels of unemployment.[608] Continued traditional and cultural uses of their lands and waters contribute to the physical and spiritual well-being of people and communities helping to maintain their close relationship to the land and sustain their "sense of place."[609] Oil and gas development activities could result in the gradual loss, decline, or change in subsistence resources upon which local low-income and minority residents depend. This would place a disproportionate weight of any adverse effects on low-income and/or minority populations.

BLM must give affected communities opportunities to provide input into the environmental review process. However, it is likely that the potential impacts to subsistence resources by displacement and impacts to access by subsistence users will raise significant Environmental Justice issues. BLM must carefully consider these impacts in a transparent and meaningful manner in this NEPA process.

4. BLM Must Analyze and Fully Disclose the Impacts of an Oil and Gas Program on Public Health.

The BLM must thoroughly analyze in the leasing EIS how all phases of an oil and gas leasing program will impact the health[610] of the region's residents. This analysis should include Kaktovik and all Alaskan and Canadian communities that are connected to the Coastal Plain through ecological and social systems, like the Porcupine Caribou Herd. Arctic Village, Fort Yukon, Venetie, Chalkyitsik, Beaver, and Canadian villages such as Old Crow and Fort McPherson should be formally identified within the EIS as potentially affected communities (PACs).

To adequately analyze human health impacts, BLM must complete a thorough Health Impact Assessment (HIA).[611] HIAs are an internationally used preventative health tool that anticipates the human health impacts of new or existing development projects, programs, or policies. The overall goal of this type of assessment is to identify and minimize negative health

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[608] CCP Final EIS, Chapter 5, at 5-121.

[609] *Id*.

[610] Health, as defined by the World Health Organization, is the "state of complete physical, mental and social well-being and not merely the absence of disease or infirmity." *See* http://www.who.int/about/mission/en/

[611] See: Lock, K. (2000). Health impact assessment. *British Medical Journal*, 320 (7246), 1395.

effects of a particular action. This type of analysis has an established framework and methodology that will allow BLM to take a hard look at the health impacts of various leasing alternatives and compare them to the no action alternative.[612] This analysis should focus on how oil leasing, exploration, construction, operation, and the cumulative effects of development will expose residents to health risks, as well as how direct and indirect determinants that positively contribute to health may be compromised by development-related activities. Feedbacks of health outcomes and responses should also be considered.

Updated health data will be needed to complete a comprehensive HIA, which must not be foregone in favor of BLM's arbitrary timeframe to complete its NEPA process within one year. The HIA should be integrated into the EIS, or released as a stand-alone document for public comment at the same time as the Draft EIS. Allowing public review and comment on the HIA is critically important to ensure the process is transparent and that the document fully analyzes the health concerns raised by the public and local communities.

BLM's HIA should include, but not necessarily be limited to, the following specific elements:

<u>Baseline Conditions</u> When analyzing the effects of an action or actions on human health, comprehensive baseline data is essential. Baseline data allows public health experts to understand pre-development conditions and potential future trends associated with how proposed actions on the landscape and/or within communities may change health outcomes for particular populations.

BLM should consider not allowing any oil and gas activities on the Coastal Plain until all necessary studies are completed and comprehensive baseline data is collected. BLM's failure to comprehensively establish a baseline for PACs would irreversibly compromise how oil development's health impacts are studied and fully understood. Baseline studies should include air and water quality, rates and factors of, among other conditions, asthma, obesity (and overweightness), diabetes, cancer, chronic obstructive pulmonary disease, cardiovascular diseases, cerebrovascular diseases, unintentional injury, substance abuse, depression, and suicide. Comprehensive baseline information pertaining to subsistence resources and practices must also be captured, as described below.[613]

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[612] See: Technical Guidance for Health Impact Assessment in Alaska at: http://dhss.alaska.gov/dph/Epi/hia/Documents/AlaskaHIAToolkit.pdf.

[613] *See infra* Part VI.C.1 and *supra* Part VII.

BLM should also reach out to PACs to gather data on which to base the HIA. Additionally, BLM should survey and relate the experiences of communities in Alaska, like Nuiqsut, that are near oil activities to inform the bases for this HIA.

Subsistence and Human Health While ecosystems are a foundational determinant of the public's health and wellness everywhere, in Alaska's subsistence-based and largely indigenous communities this connection is particularly important.[614] When analyzing human health, BLM must comprehensively examine how oil and gas development will impact the numerous health benefits that subsistence resources and practices provide to regional residents. These benefits, which are discussed in greater detail below, include food security and nutrition, social networks, and mental health.

Food Security and Nutrition BLM must consider how a Coastal Plain leasing program will impact regional residents' food security.[615] All three pillars of food security should be examined: food availability, food access, and food use.[616] Within each of these pillars, attention should be given to the importance of nutrition and traditional foods. Relatedly, the HIA must examine how oil and gas activities will impact the harvest, preparation, sharing, and consumption of wild resources through the lens of dietary change. Specifically, the HIA should address how oil development will lead to changes in diet for regional residents.

Social Networks Social networks contribute significantly to human health outcomes.[617] The HIA must analyze how changes to the harvesting, preparing, sharing, and consumption of wild

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[614] See: Loring, P.A. and Gerlach, S.C. (2009). Food, culture, and human health in Alaska: an integrative health approach to food security. *Environmental Science and Policy*, 12: 466-478.

[615] See: Smith, J., Saylor, B., Easton, P., & Wiedman, D. (2009). Measurable benefits of traditional food customs in the lives of rural and urban Alaska Inupiaq elders. Alaska J Anthropol, 7(1), 89-99.

[616] See: World Health Organization. (2014). Trade, Foreign Policy, Diplomacy, and Health: Food Security, *available at:*
at: http://www.who.int/trade/glossary/story028/en/.

[617] *See* Smith, K.P. and Christakis, N.A. (2003). Social Networks and Health. *The Annual Review of Sociology*, 34: 405-429.

resources will impact social networks and community structure within PACs.[618] How these networks may change and how these alterations will impact residents' health must be considered and described.

<u>Mental Health</u> The act of procuring and providing traditional subsistence resources has positive psychological health benefits at the individual and community level. How an oil development program may disrupt traditional practices, cultural identity, and mental health should be analyzed.[619] Moreover, the anxiety and stress of development should also be considered. Here, BLM should examine how development will impact relationships, including sociocultural and socioeconomic systems relationships to mental health.

<u>Risk of Harm and Injury</u> In the case of Nuiqsut, the disturbances of oil development are forcing hunters to travel further from their community to access caribou and other subsistence resources.[620] This increased travel increases the risk of harm and injury because hunters must travel longer distances and have an increased exposure to harsh and often dangerous conditions. BLM should complete a risk assessment for subsistence practices affected by development.

<u>Climate Change</u> The HIA should address the cumulative impact that oil activities may have on human health when combined with the impacts of climate change. Specifically, BLM must consider how climate change affects the social and environmental determinants of health within the region for PACs.[621] This analysis should include, but not be limited to, mental health, air quality, impacts to subsistence resources and practices, and food security. Ongoing and reasonably foreseeable climate change impacts and stressors must be integrated into BLM's baseline and across all alternatives.

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[618] *See* Kofinas, Gary, Shauna B. BurnSilver, James Magdanz, Rhian Stotts, and Marcy Okada (2016), Subsistence Sharing Networks and Cooperation: Kaktovik, Wainwright, and Venetie, Alaska. BOEM Report 2015-023DOI; AFES Report MP 2015-02. School of Natural Resources and Extension, University of Alaska Fairbanks.

[619] See: McGrath-Hanna, N.K. et al. (2003). Diet and Mental Health in the Arctic: Is Diet an Important Risk Factor for Mental Health in Circumpolar Peoples? – Review. *International Journal of Circumpolar Health*, 63(3): 228-241.

[620] *See* Final Supplemental Environmental Impact Statement for the Greater Mooses Tooth One development project (2014).

[621] *See* Assessment of the Potential Health Impacts of Climate Change in Alaska at: http://www.epi.alaska.gov/bulletins/docs/rr2018_01.pdf

5. BLM Must Analyze and Fully Disclose the Impacts of an Oil and Gas Program on Recreation and Aesthetic Uses.

The Arctic National Wildlife Range was originally designated to "preserv[e the] unique wildlife, wilderness and recreational values" of the area.[622] These original purposes still apply and require DOI to preserve the Refuge's wilderness character, including opportunities for adventure, discovery, and the experience of solitude, isolation and unconfined recreation. Coupled with the additional purposes added by ANILCA, DOI is required to preserve wildlife, wilderness, and recreational values throughout the coastal plain of the Arctic Refuge.

The leasing EIS must fully analyze how oil and gas leasing will affect the visitor experience, recreational opportunities, and the unique wilderness-dependent recreational values that currently exist throughout the Refuge — both in and adjacent to the Coastal Plain. BLM must analyze how any foreseeable changes to the condition of the Coastal Plain and the untrammeled nature of the adjacent designated Wilderness associated with all phases of an oil and gas program will affect the visitor experience and the unique recreation values of the Refuge. This includes direct, indirect, and cumulative impacts to the resources that dictate the recreational experience of Refuge visitors, including but not limited to: viewsheds and aesthetics, soundscapes, air and water quality, wildlife, designated and recommended Wilderness, Wild River nominations and designations, wildness of rivers, watersheds, soils and vegetation, and other wilderness characteristics. BLM must also analyze economic impacts associated with degradation of recreational uses and experiences.

To ensure an adequate baseline for analysis, BLM must compile accurate and up-to-date visitor use and recreation data, along with associated economic benefits. BLM also must address how it will monitor and respond to changes to recreation and the visitor experience.

6. BLM Must Analyze and Fully Disclose the Impacts of an Oil and Gas Program on Archeological and Cultural Resources.

BLM must take a hard look at the impacts on archeological and cultural resources in the EIS. Inventory and consultation under section 106 of the National Historic Preservation Act of

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[622] PLO 2214 at 1.

1966 (NHPA)[623] is necessary to inform the required NEPA analysis. Section 106 requires Federal agencies to consider the effects of their decisions on historic properties. The responsible Federal agency first determines whether the action it is undertaking or authorizing may affect historic properties. Historic properties are properties that are included in the National Register of Historic Places, or that meet the criteria specified in the National Register's Criteria for Evaluation.[624] If the agency action may impact historic properties, it must consult with the appropriate State Historic Preservation Officer/Tribal Historic Preservation Officer (SHPO/THPO). The NHPA's implementing regulations[625] govern the Section 106 process and outlines how Federal agencies engage in consultation, identify historic properties, determine whether and how such properties may be affected, and resolve adverse effects. BLM must allow the SHPO and the Advisory Council on Historic Preservation, a Federal agency, to comment on these proposed activities.

In the Final EIS and CCP for the Arctic Refuge, FWS made it a priority to prepare an Integrated Cultural Resource Management Plan (ICRMP) to improve conservation of cultural resources and provide guidance for cultural resource management on Refuge lands.[626] Only limited areas of the Refuge have been systematically studied for cultural resources, leaving the vast majority of lands unknown to archaeologists.[627] The potential to discover unknown sites is high in the Arctic Refuge. BLM must conduct a survey of the Coastal Plain prior to authorizing any oil and gas activities.

As part of these cultural resource inventories, BLM should consider places eligible for listing in the National Register of Historic Places. Property is eligible for inclusion in the Register if it meets criteria specified in the National Register's Criteria for Evaluation ("Criteria"). The NHPA requires agencies to ensure that properties listed or eligible to be listed on the National Historic Register are preserved to maintain their historic, archaeological, architectural, and cultural values.[628] Thus, BLM must identify historic properties in consultation

[623] 54 U.S.C. § 306108.
[624] 36 C.F.R. § 60.4.
[625] 36 C.F.R. part 800 (Protection of Historic Properties).
[626] CCP Final EIS, Chapter 2 at 2-28.
[627] *Id*. at 2-29.
[628] 54 U.S.C. §306102(b)(2).

with the Alaska SHPO and consider whether such properties are eligible for inclusion on the National Register of Historic Places.

Oil and gas leasing activities in the Arctic Refuge have the potential to affect historic places, due to ground disturbing activities such as seismic exploration, drilling, and excavation of gravel for construction of permanent facilities.[629] BLM must, therefore, consult with the Alaska SHPO and tribes as part of this process and fully comply with the requirements in the NHPA's implementing regulations to determine how proposed activities could impact cultural resources listed on, or eligible for inclusion in, the National Register of Historic Places. BLM must also evaluate the impacts of an oil and gas program on all cultural and archeological resources.

D. BLM Must Analyze and Fully Disclose the Contributions of the Oil and Gas Program to Global Climate Change and the Impacts of Climate Change on the Arctic Refuge.

Oil and gas leasing in the Arctic Refuge is incommensurate with staying within the United States' and global carbon budgets necessary for avoiding the worst impacts of climate change to natural and human communities. The EIS must fully account for the greenhouse gases that will be emitted as a result of Refuge drilling and analyze their climate consequences. The EIS must also analyze the ongoing impacts to Refuge resources and values from climate change and how those harms will act cumulatively and synergistically with the effects of fossil fuel development.

1. Fossil Fuel Extraction from the Refuge Is Not Compatible with Staying Within the United States' and Global Carbon Budgets Necessary for Avoiding the Worst Impacts of Climate Change.

The United States has committed to climate change targets that require the nation to steadily decrease greenhouse gas emissions. Under the Paris Agreement,[630] which the United

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[629] *See* BLM NPR-A Final IAP/EIS, Vol. 4, 98-102 (discussion of oil and gas exploration and development activities which may impact paleontological resources).

[630] United Nations Framework Convention on Climate Change, Conference of the Parties, Nov. 30-Dec. 11, 2015, Adoption of the Paris Agreement Art. 2, U.N. Doc. FCCC/CP/2015/L.9, (Dec. 12, 2015) (Paris Agreement). On December 12, 2015, 197 nation-state and supra-national organization parties meeting in Paris at the 2015 United Nations Framework Convention on

States signed on April 22, 2016, as a legally binding instrument through executive agreement,[631] the United States committed to holding the long-term global average temperature "to well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels."[632] The Agreement requires a "well below 2°C" climate target because 2°C of warming is no longer considered a safe guardrail for avoiding catastrophic climate impacts and runaway climate change.[633] Under the Agreement, the U.S. Nationally Determined Contribution is to reduce net greenhouse gas emissions by 26 to 28 percent below 2005 levels by 2025.[634] Although President Trump has announced his intent to withdraw the United States from the Paris Agreement, that process will take four years and could be overridden in the next presidential election. Moreover, the Paris Agreement represents the international consensus to address greenhouse gas emissions; it remains a relevant consideration in determining our nation's energy needs. Independent of the Paris Agreement, the United States in 2009 set a long-term goal of reducing emissions by 83 percent below 2005 levels by 2050.[635]

United States greenhouse gas commitments are not compatible with authorizing new fossil fuel extraction on federal land or waters in frontier areas such as the Arctic Refuge. According to the Intergovernmental Panel on Climate Change, total cumulative anthropogenic emissions of CO_2 must remain below about 1,000 gigatonnes ($GtCO_2$) from 2011 onward for a 66 percent probability of limiting warming to 2°C above pre-industrial levels, and to 400 $GtCO_2$

Climate Change Conference of the Parties consented to the Paris Agreement committing its parties to take action so as to avoid dangerous climate change.

[631] *See* United Nations Treaty Collection, Chapter XXVII, 7.d Paris Agreement, List of Signatories; U.S. Department of State, Background Briefing on the Paris Climate Agreement, (Dec. 12, 2015).

[632] *See* Paris Agreement at Art. 2.

[633] *See* United Nations Subsidiary Body for Scientific and Technological Advice, "Report on the Structured Expert Dialogue on the 2013-2015 review," FCCC/SB/2015/1NF.1 (2015) (presenting a comprehensive scientific review under the United Nations Framework Convention on Climate Change of the global impacts of 1.5°C versus 2°C warming); *see also* C-F. Schleussner *et al.*, *Differential climate impacts for policy-relevant limits to global warming: the case of 1.5C and 2C*, 7 Earth Systems Dynamics 327 (2016).

[634] U.S. Nationally Determined Contribution submitted to the United Nations Framework Convention on Climate Change (undated).

[635] U.S. Department of State, US Climate Action Report 2010 at 3 (June 2010); The White House, *President to Attend Copenhagen Talks: Administration Announces US Emission Target for Copenhagen* (Nov. 25, 2009).

from 2011 onward for a 66 percent probability of limiting warming to 1.5°C.[636] These carbon budgets have been reduced to 850 $GtCO_2$ and 240 $GtCO_2$, respectively, from 2015 onward.[637]

There is a large body of scientific research that concludes that the vast majority of global and U.S. fossil fuels must stay in the ground in order to hold temperature rise to well below 2°C.[638] Scientific studies have estimated that 68 to 80 percent of global fossil fuel reserves must not be extracted and consumed to limit temperature rise to 2°C based on a 1,000 $GtCO_2$ carbon budget.[639] An estimated 85 percent of known fossil fuel reserves must stay in the ground for a 50 percent chance of limiting temperature rise to 1.5°C.[640] Effectively, to limit temperature rise to 2°C, fossil fuel emissions must be phased out globally by mid-century.[641]

In addition, a 2016 analysis found that carbon emissions from developed reserves in currently operating oil and gas fields and coal mines would lead to global temperature rise

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[636] Intergovernmental Panel on Climate Change (IPCC), Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, at 63-64 & Tbl. 2.2 (2014).

[637] J. Rogelj *et al*., *Differences between carbon budget estimates unraveled*, 6 NATURE CLIMATE CHANGE 245, 245, Tbl. 2 (2016).

[638] The IPCC estimates that global fossil fuel reserves exceed the remaining carbon budget for staying below 2°C by 4 to 7 times, while fossil fuel resources exceed the carbon budget for 2°C by 31 to 50 times. *See* T. Bruckner *et al*., *Energy Systems*, *in* CLIMATE CHANGE 2014: MITIGATION OF CLIMATE CHANGE, Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, at 525, Table 7.2 (2014) (estimates of fossil reserves and resource and their carbon content).

[639] To limit temperature rise to 2°C based on a 1,000 $GtCO_2$ carbon budget from 2011 onward, studies indicate that 80 percent (Carbon Tracker Initiative 2013), 76 percent (Raupach et al. 2014), and 68 percent (Oil Change International 2016) of global fossil fuel reserves must stay in the ground. *See generally* Carbon Tracker Initiative, Unburnable Carbon – Are the world's financial markets carrying a carbon bubble? at 2 (2013); M. Raupach *et al*., *Sharing a quota on cumulative carbon emissions,* 4 NATURE CLIMATE CHANGE 873 (2014); Oil Change International, The Sky's Limit: Why the Paris Climate Goals Require a Managed Decline of Fossil Fuel Production at 6 (Sept. 2016) (Oil Change International).

[640] Oil Change International at 6.

[641] Rogelj *et al*. 2015 estimated that a reasonable likelihood of limiting warming to 1.5° or 2°C requires global CO_2 emissions to be phased out by mid-century and likely as early as 2040-2045. *See* J. Rogelj *et al*., *Energy system transformations for limiting end-of-century warming to below 1.5°C*, 5 NATURE CLIMATE CHANGE 519 (2015).

beyond 2°C.[642] Excluding coal, currently operating oil and gas fields alone would take the world beyond 1.5°C.[643] To stay well below 2°C, the study recommends that no new fossil fuel extraction or transportation infrastructure should be built, and governments should grant no new permits for new fossil fuel extraction and infrastructure.[644] Moreover, some fields and mines, primarily in rich countries, must be closed before fully exploiting their resources.[645] Importantly, a 2015 scientific and economic study found that "all Arctic [oil and gas] resources should be classified as unburnable," because "development of [oil and gas] resources in the Arctic . . . [is] incommensurate with efforts to limit average global warming to 2°C."[646]

A recent study in the journal Climatic Change analyzed the effectiveness of policies to restrict fossil fuel supply and concluded "restrictive supply-side policy instruments (targeting fossil fuels) have numerous characteristic economic and political advantages over otherwise similar restrictive demand-side instruments (targeting greenhouse gases)."[647]

On November 3, 2017, the U.S. Global Change Research Program — comprised of the nation's top climate scientists — published a final report "designed to be an authoritative assessment of the science of climate change, with a focus on the United States, to serve as the foundation for efforts to assess climate-related risks and inform decision-making about responses."[648] The report explicitly does not include policy recommendations,[649] but its findings unambiguously compel the conclusion that expanded Arctic fossil fuel development would seriously hinder our ability to avoid the worst effects of climate change.

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[642] Oil Change International at 5.
[643] *Id.*
[644] *Id.*
[645] *Id.*
[646] C. McGlade & P. Ekins, *The geographical distribution of fossil fuels unused when limiting global warming to 2°C*, 517 NATURE 187, 187, 190 (2015).
[647] F. Green & R. Denniss, *Cutting with both arms of the scissors: The economic and political case for restrictive supply-side climate policies*, CLIMATIC CHANGE (2018).
[648] U.S. GLOBAL CHANGE RESEARCH PROGRAM, CLIMATE SCIENCE SPECIAL REPORT 1 (Nov. 4, 2017).
[649] *Id.*

The report confirms the basics — that "[t]he global, long-term, and unambiguous warming trend has continued during recent years"[650] that "it is *extremely likely* that human influence has been the dominant cause of the observed warming since the mid-20th century . . . [and that] there is no convincing alternative explanation supported by the extent of the observational evidence."[651] It also confirms that the Arctic is particularly hard-hit: it "is warming at a rate approximately twice as fast as the global average;"[652] "Arctic sea ice loss is expected to continue through the 21st century, *very likely* resulting in nearly sea ice-free late summers by the 2040s (*very high confidence*);"[653] and "multiple lines of evidence provide *very high confidence* of enhanced Arctic warming with potentially significant impacts on coastal communities and marine ecosystems."[654] The report concludes "[i]t is *very likely* that human activities have contributed to Arctic surface temperature warming, sea ice loss since 1979, glacier mass loss, and Northern Hemisphere snow extent decline observed across the Arctic."[655]

The report highlights the urgent need to act if we are to address climate change. It concludes "[t]he present-day emissions rate of nearly 10 [gigatonnes of carbon (GtC)] per year suggests that there is no climate analog for this century any time in at least the last 50 million years."[656] If we are to avoid the worst effects of climate change, nations must drastically and rapidly limit the amount of carbon they emit into the atmosphere. The report confirms that there is a limit to the amount of carbon that can be emitted — "CO_2 emissions must stay below about 800 GtC in order to provide a two-thirds likelihood of preventing 3.6 [degrees Fahrenheit (2 degrees Celsius)] of warming."[657] It tells us how much more can be emitted until that limit is reached — approximately 230 GtC.[658] And it provides an estimate of how long, under standard projection scenarios, it will take to reach that threshold — "this cumulative carbon threshold would be exceeded in approximately two decades."[659] Thus, "[s]tabilizing global mean temperature to less than 3.6 [degrees Fahrenheit (2 degrees Celsius)] above preindustrial levels

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[650] *Id.* at 13.
[651] *Id.* at 12.
[652] *Id.* at 23.
[653] *Id.* at 29.
[654] *Id.* at 316; *see also id.* at 28–29, 195, 307-08, 316 & 318 (describing evidence).
[655] *Id.* at 319.
[656] *Id.* at 31.
[657] *Id.* at 31–32.
[658] *Id.* at 32.
[659] *Id.*; *see also id.* at 16 (describing scenarios).

requires substantial reductions in net global CO_2 emissions prior to 2040 relative to present-day values and likely requires net emissions to become zero or possibly negative later in the century."[660]

The report supports key truths about oil development and the Arctic: (i) the Arctic is ground zero for climate change and thus no place to burden with fossil fuel development, particularly black carbon production that has local effects; and, (ii) even if it could be developed safely, Arctic oil and gas, which is years away from production under the best scenarios, *cannot* be part of our energy future because by then the nation must be well on its way to transitioning away from fossil fuels to avoid the worst effects of climate change.

The United States recognizes that Arctic development must be consistent with national and international climate goals. In a joint statement with Canadian Prime Minister Trudeau, President Obama agreed that in the Arctic "commercial activities will occur only when the highest safety and environmental standards are met, including national and global climate and environmental goals, and Indigenous rights and agreements."[661] Additionally, if, as the Joint Statement commits, Canada and the United States develop a "science-based standard for considering the life-cycle impacts of commercial activities in the Arctic,"[662] it will disclose both the potential for expansion of fossil fuel supplies to compete directly for market share with clean alternatives and efficiency technology, and the deleterious investment signals stemming from perpetuation of federal involvement in promoting carbon-intensive energy sources.

2. NEPA Requires BLM to Analyze How Leasing in the Refuge Will Contribute to Climate Change.

NEPA requires BLM to assess the indirect and cumulative effects of leasing in the Refuge, including the climate effects. Indirect effects are those "caused by the action, and later in time or further removed in distance, but still reasonably foreseeable."[663] Cumulative effects are the incremental effects of the action in combination with "other past, present, and reasonably

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[660] *Id.* at 31, 393.
[661] The White House, *U.S.-Canada Joint Statement on Climate, Energy, and Arctic Leadership* (Mar. 10, 2016).
[662] *Id.*
[663] *S. Fork Band Council of W. Shoshone of Nev. v. U.S. Dep't of the Interior*, 588 F.3d 718, 725 (9th Cir. 2009) (quoting 40 C.F.R. § 1508.8(b)).

foreseeable future actions."[664] The cumulative impact analysis "must be more than perfunctory"; it must provide a "useful analysis of the cumulative impacts of past, present, and future projects."[665]

NEPA also requires agencies to describe "connected" or "cumulative" actions in a single environmental review.[666] The purpose of this requirement "is to prevent an agency from dividing a project into multiple 'actions,' each of which individually has an insignificant environmental impact, but which collectively have a substantial impact."[667] NEPA requires "reasonable forecasting," which includes the consideration of "reasonably foreseeable future actions . . . even if they are not specific proposals."[668] "Because speculation is implicit in NEPA," agencies may not "shirk their responsibilities under NEPA by labeling any and all discussion of future environmental effects as crystal ball inquiry."[669]

It is now well established that when an agency considers a decision that has the potential to cause greenhouse gas emissions that contribute to climate change, NEPA requires the agency to analyze and disclose the effects of these emissions as indirect or cumulative effects. BLM must, accordingly, quantify and analyze the climate impacts from the potential emissions for this action, including analyzing those impacts for reach alternative. In *Center for Biological Diversity v. National Highway Traffic Safety Administration*, the Ninth Circuit held that "[t]he impact of greenhouse gas emissions on climate change is precisely the kind of cumulative impacts analysis that NEPA requires agencies to conduct."[670] There the court held that the EPA must assess the climate impacts of a fuel economy rule (CAFE) "in light of other CAFE rulemakings and other past, present, and reasonably foreseeable future actions, regardless of what agency or person

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[664] *See Klamath-Siskiyou Wildlands Ctr. v. Bureau of Land Mgmt.*, 387 F.3d 989, 993 (9th Cir. 2004) (quoting 40 C.F.R. § 1508.7).

[665] *Kern v. U.S. Bureau of Land Mgmt.*, 284 F.3d 1062, 1075 (9th Cir. 2002) (internal citation omitted).

[666] 40 C.F.R. § 1508.25(a); *Klamath-Siskiyou*, 387 F.3d at 999.

[667] *Great Basin Mine Watch v. Hankins*, 456 F.3d 955, 969 (9th Cir. 2006) (internal quotation marks omitted).

[668] *N. Plains Res. Council, Inc. v. Surface Transp. Bd.*, 668 F.3d 1067, 1079 (9th Cir. 2011) (citation omitted).

[669] *Id.* (internal quotations omitted).

[670] 538 F.3d 1172, 1217 (9th Cir. 2008).

undertakes such other actions."[671] Numerous other courts have affirmed the necessity of analyzing the climate consequences of an action under NEPA, in a wide variety of contexts.[672]

In sum, BLM's EIS must include an accurate assessment of the serious effects of burning the oil and gas that could be developed in the Refuge. More broadly, oil and gas development in the Arctic is a critical issue for the current administration to reexamine as it assesses how to bring its supply-side policies in line with international commitments to combat climate change, and how to meet climate targets based on sound science and economics. This analysis must assess how reducing the supply of oil from federal lands can affect global oil markets and lead to a reduction in demand and a resulting reduction in greenhouse gas emissions.[673] Recent scholarship has calculated that a cessation of fossil fuel extraction on federally owned lands would reduce global carbon dioxide emissions by an estimated 280 million tons annually by 2030, and has provided analytical tools for the assessment of such supply-side restrictions which

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[671] *Id.*

[672] *See, e.g.*, *Sierra Club v. Fed. Energy Regulatory Comm'n*, 867 F.3d 1357, 1373 (D.C. Cir. 2017) (holding that agencies must analyze the climate effects of burning fossil fuels conveyed by pipeline projects they approve and reasoning that the consumption of those fuels was not just "reasonably foreseeable" but was "the project's entire purpose"); *WildEarth Guardians v. BLM*, 870 F.3d 1222, 1226, 1233–34 (10th Cir. 2017) (rejecting BLM's argument that it could ignore the climate effects of extracting coal in Wyoming's Powder River Basin because, if BLM had not issued the leases in question, demand would be met with coal from another source); *Mid States Coalition for Progress v. Surface Transportation Board*, 345 F.3d 520, 549–50 (8th Cir. 2003) (holding that NEPA required an agency deciding whether to approve a railroad line providing access to coal mining areas to disclose and analyze the impacts of future combustion of the mined coal); *Mont. Envtl. Info. Ctr. v. U.S. Office of Surface Mining*, 274 F. Supp. 3d 1074, 1094–99 (D. Mont. 2017), *amended in part, adhered to in part sub nom. Montana Envtl. Info. Ctr. v. U.S. Office of Surface Mining*, No. CV 15-106-M-DWM, 2017 WL 5047901 (D. Mont. Nov. 3, 2017) (holding that an agency must quantify the costs of greenhouse gas emissions from a fossil-fuels-extraction project if it quantifies the benefits in a NEPA document); *High Country Conservation Advocates v. U.S. Forest Serv.*, 52 F. Supp. 3d 1174, 1196-98 (D. Colo. 2014) (holding that NEPA required analysis of the climate effects of burning fossil fuels that could be produced as a result of land management decision).by pipeline projects they approve and reasoning that the consumption of those fuels was not just "reasonably foreseeable" but was "the project's entire purpose").

[673] *See* The Wilderness Society, Federal Lands Emissions Accountability Tool (emissions from the production and combustion of fossil fuels on federal lands are equivalent to 20% of all U.S. GHG emissions), *available at*: https://wilderness.org/federal-lands-emissions-accountability-tool.

could be used to inform environmental review of the individual and cumulative impacts of federal leasing decisions.[674]

Oil and gas production requires investments in capital-intensive, high-carbon fuel infrastructure that resists being shut down and locks in long-term fuel supplies, making it more difficult and expensive to later shift to a low-carbon pathway and reach greenhouse gas targets.[675] Leasing in the Refuge, which could lead to oil production for many years into the future, would undermine the country's — and the world's — urgently needed implementation of its goals for moving swiftly away from dependence on carbon-based fuels.[676] BLM's NEPA analysis will have to ask and answer a set of questions about how the choice to authorize leasing in the Refuge relates to the nation's overall carbon budget and to decisions about whether to

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[674] *See* Erickson, P. & Lazarus, M. Climatic Change (2018). https://doi.org/10.1007/s10584-018-2152-z ("Our findings here indicate that restricting future lease issuance and renewal could lead to reductions in federal fossil fuel production of about 37% in 2030. This restriction would lead to slightly higher fossil fuel prices, stimulating added production from other sources, resulting in a lesser overall net effect on global fossil fuel use and CO_2 emissions. (Market-induced emissions leakage is not unique to action on the supply side: it also occurs for demand-side policies, though often smaller in magnitude.) Considering these effects, we estimate that the lease restriction policy would reduce global CO_2 emissions by 280 Mt in 2030, an amount on par with, and in many cases greater than, that of other major policies in President Obama's climate action plan…. The analytical tools used here can also help inform the environmental review of projects that would affect future fossil fuel supply. Many environmental review processes have assumed perfect substitution, i.e., that each ton of coal or barrel of oil delivered to the market by a new project would simply offset, one-for-one, a ton or barrel produced elsewhere, with no net effect on greenhouse gas emissions (Burger and Wentz 2017). As a US appeals judge wrote, however, this assumption of perfect substitution assumption is 'irrational,' in that it contradicts basic supply and demand principles (Briscoe 2017). Further, as our analysis shows, the assumption of perfect substitution is also unnecessary, as methods exist to provide estimates of net production and CO_2 impacts. Indeed, our analysis developed no new methods; it simply used existing tools to look at the question of substitution for multiple fuels for a particular policy context.").

[675] P. Erickson et al., Stockholm Environment Institute, Making future US offshore oil leasing more consistent with climate goals, Discussion Brief (2016).

[676] *See* The Wilderness Society, In the Dark (Lifecycle emissions from energy production on federal lands lag far behind where they need to be in order to meet domestic and international climate goals. Leasing in the Refuge would lead us further off course), *available at*: https://wilderness.org/sites/default/files/IntheDarkReport_FINAL_Jan_2018.pdf.

pursue other fossil fuels in light of the reality that a vast majority of already-discovered — much less undiscovered — fossil fuels must be left undeveloped.

3. NEPA Requires BLM to Assess Climate Change Impacts to the Proposed Action, and the Cumulative and Synergistic Effects of Oil and Gas Development and Climate Change in the Refuge.

In addition to analyzing the indirect and cumulative impacts of the greenhouse gas emissions that will result from developing the Refuge, BLM must also analyze how the ongoing and increasing effects from climate change into the baseline against which the alternatives will be evaluated and how existing and increasing climate change impacts will act cumulatively and synergistically with effects from drilling in the Refuge.[677]

Alaska has warmed more than twice as fast as the rest of the United States over the past 60 years, and the Arctic is expected to warm by an additional 10°F to 12°F.[678] This rapid warming presents myriad disruptions to Arctic ecosystems, including in the Refuge. In the Arctic, climate change is causing, and will continue to cause, sea-level rise, sea-ice melt, river flow (which cause strudel scour) changes, and permafrost thaw.

Permafrost plays an essential role in the Refuge by making the ground watertight and maintaining the vast network of wetlands and lakes across the tundra that provide habitat for animals and plants. Permafrost underlies 80% of the land surface in Alaska, and permafrost thaw is already underway in interior and southern Alaska where permafrost temperatures are near the thaw point.[679] In northern Alaska, permafrost temperature has increased by up to 2 to 3°C since the 1980s, including areas of the Refuge.[680] Models project that permafrost in Alaska will continue to thaw, and that near-surface permafrost may be entirely lost from large parts of

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[677] *See Klamath-Siskiyou Wildlands Ctr.*, 387 F.3d at 993.

[678] Melillo, Jerry M, Terese (T.C.) Richmond & Gary W. Yohe (eds.), Climate Change Impacts in the United States: The Third National Climate Assessment, U.S. Global Change Research Program at 45(2014); USGCRP, Fourth National Climate Assessment, Volume I at 345-346.

[679] Melillo et al., *supra*.

[680] Jorgenson, M. T., Shur, Y. L., & Pullman, E. R. (2006). Abrupt increase in permafrost degradation in Arctic Alaska. Geophysical Research Letters, 33(2); Osterkamp, T. E., & Jorgenson, J. C. (2006). Warming of permafrost in the Arctic National Wildlife Refuge, Alaska. Permafrost and Periglacial Processes, 17(1), 65-69.

Alaska by the end of the century.[681] As permafrost thaws, it releases carbon dioxide and the powerful greenhouse gas methane into the atmosphere, which contribute to further warming in a reinforcing feedback loop.[682]

Alaskan shorelines are eroding at an accelerating rate due to the combined effects of sea-ice loss, increasing sea surface temperatures, increasing terrestrial permafrost degradation, rising sea levels, and increases in storm power and corresponding wave action.[683] Indeed, coastal erosion rates have doubled since the 1950s along the Beaufort Sea shoreline.[684] Increasing coastal erosion jeopardizes species that use coastal habitats for breeding, such as the polar bear, which uses the Coastal Plain of the Refuge for denning.[685]

The EIS must analyze oil and gas activities in the Refuge in the context of these and other ongoing climate impacts.[686] BLM's analysis of these cumulative effects must be in-depth and must incorporate the best available science.[687] The harmful effects of climate change will act cumulatively and synergistically with the effects of drilling in the Refuge, leading to a significant

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[681] Melillo et al. (2014).

[682] Koven, C. D., Ringeval, B., Friedlingstein, P., Ciais, P., Cadule, P., Khvorostyanov, D., & Tarnocai, C. (2011). Permafrost carbon-climate feedbacks accelerate global warming. Proceedings of the National Academy of Sciences, 108(36), 14769-14774; Schaefer, K., Zhang, T., Bruhwiler, L., & Barrett, A. P. (2011). Amount and timing of permafrost carbon release in response to climate warming. Tellus B, 63(2), 165-180.

[683] B. M. Jones et al., Increase in the rate and uniformity of coastline erosion in Arctic Alaska, 36 Geophysical Research Letters at 3 (2009) (Jones et al. 2009); C. D. Koven et al., Permafrost carbon-climate feedbacks accelerate global warming, 108 Proceedings Nat. Academy Sci. 14769 (2011); N. J. Pastick et al., Distribution of near-surface permafrost in Alaska: Estimates of present and future conditions, 168 Remote Sensing of Environment 301 (2015); K. R. Barnhart et al., The effect of changing sea ice on the physical vulnerability of Arctic coasts, 8 The Cryosphere 1777 (2014); K. R. Barnhart et al., Modeling erosion of ice-rich permafrost bluffs along the Alaskan Beaufort Sea coast, 119 J. Geophys. Res. Earth Surf. 1155 (2014).

[684] H. Lantuit & W. H. Pollard, Fifty years of coastal erosion and retrogressive thaw slump activity on Herschel Island, southern Beaufort Sea, Yukon Territory, Canada, 95 Geomorphology 84, at 92, 96, 97 (2008); J. C. Mars & D. W. Houseknecht, Quantitative remote sensing study indicates a doubling of coastal erosion rate in past 50 yr along a segment of the Arctic coast in Alaska, 35 Geology 583 (2008); cf. Jones et al. 2009.

[685] Durner, G. M., Amstrup, S. C., & Ambrosius, K. J. (2006). Polar bear maternal den habitat in the Arctic National Wildlife Refuge, Alaska. Arctic, 31-36.

[686] 40 C.F.R. § 1508.7.

[687] *Kern*, 284 F.3d at 1075.

increase in threats to Arctic species and ecosystems. Moreover, BLM must grapple with the fact that these threats will grow over time, as the impacts from climate change become more severe, and the survival of many Arctic species becomes more and more precarious.

Furthermore, BLM is obligated under NEPA to evaluate how climate change will affect proposed leasing, exploration, and development of oil and gas on the Coastal Plain. Warming temperatures are causing shorter ice road seasons, which are presenting challenges to current operations which will likely continue to worsen. Permafrost degradation may impair the integrity of oil and gas infrastructure and any gravel roadways used for access. Climate change is leading to increased storm intensity, which may make accessing remote sites by aircraft challenging in the event of an emergency. BLM must carefully consider how a changing climate will impact development in each exploration and development scenario or alternative analyzed in the EIS.

4. BLM Must Consider the Cumulative Impacts of Climate Change on Biological Resources in the Refuge.

Under NEPA, the BLM must consider direct, indirect, and cumulative effects;[688] the latter referring to "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions." The required "hard look" at these impacts must be structured in the context of a changing environment and the impacts of climate change. The overwhelming weight of scientific evidence allows no other conclusion but that the impacts of climate change are not only "reasonably foreseeable," but indeed already upon us. In accordance with established CEQ Guidance for assessing cumulative impacts,[689] BLM must address the additive, synergistic, and countervailing impacts between the effects of climate change and the effects of the various alternatives.

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[688] 40 C.F.R. § 1508.25(c)

[689] Council on Environmental Quality (CEQ). 1997. Considering Cumulative Effects Under the National Environmental Policy Act. Council of Environmental Quality, Executive Office of the President, Washington, D.C.

a. BLM Must Utilize Recent, Credible and Comprehensive Information, Such as the "2017 Climate Science Special Report," As the Information Basis for Assessment of Climate Change and its Impacts on the North Slope of Alaska.

As described above in this section, in November of 2017, the multi-agency U.S. Global Change Research Program released Volume I of the congressionally mandated Fourth National Climate Assessment. This volume, the "Climate Science Special Report" (CSSR),[690] is a stand-alone report on the state of science relating to climate change and its physical impacts and forms the scientific underpinnings of the upcoming Volume II of NCA4 — "Climate Change Impacts, Risks, and Adaptation in the United States," a draft of which was released in early 2018 for public review but has not yet been finalized. The CSSR was compiled by multiple authors representing federal science agencies, national laboratories, and universities, following strict standards of utility, transparency and traceability, objectivity, and integrity and security in the evaluation and inclusion of scientific information. The CSSR thus represents the best available information on the state of the climate and its impacts in the United States, superseding previous editions of the National Climate Assessment and the synthesis reports of the Intergovernmental Panel on Climate Change.

The key findings of the CSSR are that: 1) "Global annually averaged surface air temperature has increased by about 1.8°F (1.0°C) over the last 115 years (1901–2016). This period is now the warmest in the history of modern civilization;" and 2) This assessment concludes, based on extensive evidence, that it is extremely likely that human activities, especially emissions of greenhouse gases, are the dominant cause of the observed warming since the mid-20th century."[691]

Impacts to Alaska and the Arctic are covered in Chapter 11 of the CSSR.[692] In general, Alaska is warming faster than the rest of the nation, and the northern part of the state and

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[690] USGCRP, 2017: Climate Science Special Report: Fourth National Climate Assessment, Volume I [Wuebbles, D.J., D.W. Fahey, K.A. Hibbard, D.J. Dokken, B.C. Stewart, and T.K. Maycock (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, 470 pp., doi: 10.7930/J0J964J6, *available at*: https://science2017.globalchange.gov/.

[691] *Id* at 10.

[692] Taylor, P.C., W. Maslowski, J. Perlwitz, and D.J. Wuebbles, 2017: Arctic changes and their effects on Alaska and the rest of the United States. [pp. 303-332 In *ibid*.].

adjacent waters, including the North Slope, is warming faster than the rest of the state. The authors conclude with "*high confidence*" that human activities are driving these effects and that it is "very likely" that the trend of Alaska's warming outpacing lower latitude warming through the coming decades. Key findings are quoted below, with the authors' confidence level in parentheses:

Temperature: "Annual average near-surface air temperatures across Alaska and the Arctic have increased over the last 50 years at a rate more than twice as fast as the global average temperature (*very high confidence*)." Furthermore, according to research published in 2014,[693] the warming signal has been strongest in the northernmost part of the state: "Especially strong warming has occurred over Alaska's North Slope during autumn. For example, Utqiagvik's (formally Barrow) warming since 1979 exceeds 7°F (3.8°C) in September, 12°F (6.6°C) in October, and 10°F (5.5°C) in November."

Permafrost: "Rising Alaskan permafrost temperatures are causing permafrost to thaw and become more discontinuous; this process releases additional carbon dioxide and methane, resulting in an amplifying feedback and additional warming (*high confidence*)." As with temperature, the effects are most pronounced in the northern part of the state, including the area of the Arctic Refuge: "[P]ermafrost on the North Slope is warming more rapidly than in the interior. Permafrost temperatures across the North Slope at various depths ranging from 39 to 65 feet (12 to 20 meters) have warmed between 0.3° and 1.3°F (0.2° and 0.7°C) per decade over the observational period."

Sea Ice: "Arctic land and sea ice loss observed in the last three decades continues, in some cases accelerating (*very high confidence*)." "Since the early 1980s, annual average arctic sea ice has decreased in extent between 3.5% and 4.1% per decade, become thinner by between 4.3 and 7.5 feet, and began melting at least 15 more days each year. September sea ice extent has decreased between 10.7% and 15.9% per decade (*very high confidence*). Arctic-wide ice loss is expected to continue through the 21st century, very likely resulting in nearly sea ice-free late summers by the 2040s (*very high confidence*)." Again, the declines have been most pronounced at the highest latitudes, with ice loss in the Beaufort Sea averaging on the high end of the

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[693] Wendler, G., B. Moore, and K. Galloway, Strong temperature increase and shrinking sea ice in Arctic Alaska, The Open Atmospheric Science Journal, 8, 7-15 (2014), http://dx.doi.org/10.2174/1874282301408010007.

statewide average, at 4.1% per decade. Observed data in the months since the publication of the CSSR indicate that this trend continues unabated. According to the Snow and Ice Data Center, sea ice extent has set a daily record low every single day through the first four months of 2018 (January 1 through April 30).[694]

Ocean Impacts: The two most important ocean impacts are temperature change, which affects sea ice, oxygen content, metabolic activity and patterns of nutrient upwelling; and acidification, which interferes with calcium uptake in shell-building organisms, including plankton, mollusks and crustaceans. "Satellite-observed Arctic Ocean sea surface temperatures, poleward of 60°N, exhibit a trend of 0.16° ± 0.02°F (0.09° ± 0.01°C) per decade." The deeper water of the Arctic Ocean, "between 150 and 900 meters—has warmed by 0.86° ± 0.09°F (0.48° ± 0.05°C) per decade; the most recent decade being the warmest" of the "last 1,150 years for which proxy indicators provide records." Regarding acidification, "Coastal Alaska and its ecosystems are especially vulnerable to ocean acidification because of the high sensitivity of Arctic Ocean water chemistry to changes in sea ice, respiration of organic matter, upwelling, and increasing river runoff. Sea ice loss and a longer melt season contribute to increased vulnerability of the Arctic Ocean to acidification by lowering total alkalinity, permitting greater upwelling, and influencing the primary production characteristics in coastal Alaska."

We also recommend that BLM conduct downscaled modeling, according to the methodology with in the NPRA Final EIS Appendix C,[695] for a more detailed and fine-scale understanding of climate changes within the Arctic National Wildlife Refuge.

b. BLM Must Consider the Impacts of Climate Changes on Terrestrial, Aquatic and Marine Habitats and Wildlife

The changes to temperature, sea ice, permafrost and ocean chemistry described above are already having, and are projected to continue to have, myriad profound effects on the biological environment. As described in more detail in the Polar Bears section of this document, loss of sea ice due to climate warming is a primary threat to that species.[696] This is a critically important

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[694] National Snow and Ice Data Center, Arctic Sea Ice News & Analysis, Charctic Interactive Sea Ice Graph, *available at*: https://nsidc.org/arcticseaicenews/charctic-interactive-sea-ice-graph/.

[695] NPRA IAP EIS, at app.C.

[696] 73 Fed. Reg. 28,212 (May 15, 2008).

climate change effect, but unfortunately is only one of many faced by wildlife. A sampling of potential other climate effects includes:

Warming temperatures: Higher temperatures benefit the already-prodigious insect populations of the Arctic,[697] to the point where mosquito and black fly harassment can interfere with feeding activities, as has been observed in caribou.[698] Other species may also exhibit physiologic or stress responses to warming temperatures. Warming may also hasten the drying of small ponds and lakes, leading to a loss of habitat for nesting waterfowl.[699] Warming summer temperatures also dry out vegetation and enhance susceptibility to fire.[700]

Sea Ice Loss and Ocean Changes: In addition to the high-profile impacts on polar bear habitat, changes in the timing and pattern of sea ice melt impact phytoplankton growth,[701] which may have food web impacts that resonate through the marine ecosystem, with effects on zooplankton, fish, marine mammals and sea birds. Marine ecosystem dynamics are also undoubtedly influenced by acidification. Sea ice retreat also leaves coastal regions vulnerable to the erosive effects of storms and waves, which may negatively impact coastal habitats, including that of breeding birds.

Changes in Precipitation Timing and Amount: Precipitation changes could be among the most significant impacts for Arctic ecosystems and wildlife. Warming can shift the winter and spring precipitation regime from snow to freezing rain and ice, which interferes with caribou

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[697] Frazier, M.R. et al. 2006. Thermodynamics constrains the evolution of insect population growth rates: Warmer is better. American Naturalist 168(4):521-530.

[698] Skarin A, et al. 2004. Insect avoidance may override human disturbances in reindeer habitat selection. Rangifer 24(2):95-103.

[699] Riordan, B. et al. 2006. Shrinking ponds in subarctic Alaska based on 1950-2002 remotely sensed images. Journal of Geophysical Research: Biogeosciences 111:G4.

[700] Young, A.M. et al. 2017. Climatic thresholds shape northern high-latitude fire regimes and imply vulnerability to future climate change. Ecogeography 40(5):606-617.

[701] Nat'l Snow & Ice Data Ctr., Wildlife: Phytoplankton, https://nsidc.org/cryosphere/seaice/environment/phytoplankton.html (last visited June 5, 2018).

foraging success[702] and reduces nestling survival in early-nesting birds like ptarmigan.[703] Type, timing, amount, spatial distribution and persistence of precipitation fundamentally impact all aspects of life in the Arctic, and BLM's analysis of the effects of oil and gas exploration and development must address the effects of these changes as a cumulative impact.

c. BLM Should Utilize Existing Information on Climate Change Vulnerability to Assess Climate Change Cumulative Effects, and Supplement with New Information Where Needed.

The EIS must robustly analyze both the effects of oil and gas development on climate change, and assess cumulative effects by describing the interactions between those activities and the various impacts of climate change on biological resources, wildlife and habitats within the Refuge. Fortunately, a substantial amount of information is already available to address these questions. The most relevant and recent information can be found in the Arctic National Wildlife Refuge Revised Comprehensive Conservation Plan, which addresses climate change in detail, particularly in the "Affected Environment" chapter.[704] The Plan discusses climate change impacts to Vegetation (section 4.3.3), Fish (4.3.5.4), Birds (4.3.6.11) and Mammals (4.3.7).

Another model for inclusion of the climate change context in cumulative impacts analysis is the National Petroleum Reserve-Alaska Final Integrated Activity Plan/Environmental Impact Statement.[705] The Environmental Consequences Chapter touches on the interaction between exploration and development activities and climate change effects on Vegetation (section 4.8.7.5), Wetlands and Floodplains (4.8.7.6), Fish (4.8.7.7), Birds (4.8.7.8), Terrestrial Mammals (4.8.7.9), and Marine Mammals (4.8.7.10). The treatment, however, is somewhat cursory and addresses neither the full range of species affected nor the full range of potential climate effects.

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[702] Kolder, J. and R. Aanes. 2004. Effect of winter snow and ground-icing on a Svalbard reindeer population: Results of a simple snowpack model. Arctic, Antarctic, and Alpine Research 36(3):333–341.

[703] Wann, G.T. 2012. Long-term demography of a white-tailed ptarmigan (Lagopus leucura) population in Colorado. MS thesis. Colorado State Univ. Ft. Collins, CO, *available at*: http://hdl.handle.net/10217/68138.

[704] CCP Final EIS, *supra*, at vol.1, ch.4.

[705] NPRA IAP/EIS, *supra*, at vol.4.

Defenders of Wildlife has assessed the climate change vulnerability of every mammal species that utilizes the terrestrial habitats of the Arctic National Wildlife Refuge. That report, titled "No Refuge from Warming,"[706] utilized a standard methodology, NatureServe's Climate Change Vulnerability Index,[707] and found that 16 of the 38 mammal species found on the Refuge are Extremely or Highly Vulnerable to climate change. Six species—polar bear, arctic fox, muskox, tundra vole, brown lemming and collared lemming—are "extremely vulnerable" to climate change, indicating an extremely high likelihood that their numbers or range within the refuge will substantially decrease or disappear by 2050. Ten species—lynx, wolverine, caribou, Dall sheep, Alaska marmot, arctic ground squirrel, singing vole, northern bog lemming, tundra shrew and barren ground shrew—were assessed as "highly vulnerable," their abundance or range likely to decrease significantly by 2050. In general, species whose habitats are on the North Slope and Coastal Plain were more likely to be threatened by climate change than those whose ranges extend into the southern part of the Refuge.

The Arctic has warmed more than much of the rest of the country in recent years, and future climate change projections indicate that this trend will continue. This drastic and destabilizing change makes it of vital importance to maintain habitat connectivity by protecting Arctic habitats from disturbance and destruction. Some of the more climate-vulnerable species in the Refuge may need to move to broader expanses of tundra to the east and west that may persist longer into the future. It is thus important to maintain connectivity between the Refuge and these other areas, particularly on the Canadian side, where islands stretch the northern extent of terrestrial habitats.

The results of the report's assessment are summarized in Table 1a and 1b below, and the full report and supplementary information are included as an attachment to these comments.

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[706] Aimee Delach & Noah Matson, Defenders of Wildlife, *No Refuge from Warming, Climate Change Vulnerability of the Mammals of the Arctic National Wildlife Refuge*, *available at*: https://defenders.org/publications/no_refuge_from_warming_climate_change_vulnerability_of_the_mammals_of_the_arctic_national_wildlife_refuge.pdf.

[707] Nature Serve, Climate Change Vulnerability Index: Overview, http://www.natureserve.org/conservation-tools/climate-change-vulnerability-index (last visited June 5, 2018).

5. BLM Must Evaluate the Extent to which Drilling Activities Will Contribute to Climate-Forcing "Black Carbon."

According to EPA, black carbon "is now recognized as an important climate-forcing agent with particular impact on the arctic region."[708] Black carbon, or more colloquially, "soot," is comprised of "small dark particles that remain after incomplete combustion of fossil fuel or biomass."[709] Black carbon "darkens the surface" of snow and ice, "directly absorbing light [and] reducing the reflectivity ('albedo') of snow and ice," both of which "are widely understood to lead to climate warming."[710] EPA has found that this increased absorption of solar radiation is a significant contributor to local warming, and importantly, to the hastening of snow and ice melt, and that "[s]ensitive regions such as the Arctic . . . are particularly vulnerable to the warming and melting effects of [black carbon]."[711] Indeed, "[s]tudies have shown that [black carbon] has especially strong impacts in the Arctic, contributing to earlier spring melting and sea ice decline."[712] The acceleration of melting due to black carbon deposition is "believed to contribute significantly to the rapid melting of Arctic and Himalayan glaciers."[713]

"[Black carbon]'s short atmospheric lifetime (days to weeks) and heterogeneous distribution . . . result in regionally concentrated climate impacts," meaning "the location of emissions releases is a critical determinant of [black carbon]'s impacts, which is not the case for long-lived and more homogeneously distributed" greenhouse gas like carbon dioxide.[714] As a result, according to EPA, "[t]here is general scientific consensus that mitigation of [black carbon] will lead to positive regional impacts" and that "[t]he Arctic . . . may benefit more than other regions from reducing emissions of [black carbon]," with mitigation of "sources near to or within the Arctic having particularly significant impacts per unit of emissions."[715]

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[708] EPA Region 10, Response to Comments for Outer Continental Shelf Permit to Construct and Title V Air Quality Operating Permit, Conical Drilling Unit Kulluk at 121 (Oct. 21, 2011).

[709] Rao, R. and J.H. Somers. Undated. Black Carbon as a Short-Lived Climate Forcer: A Profile of Emission Sources and Co-Emitted Pollutants. Environmental Protection Agency. https://www3.epa.gov/ttnchie1/conference/ei19/session5/rao.pdf.

[710] EPA, REPORT TO CONGRESS ON BLACK CARBON at iii, xxviii, 3, 17 (Mar. 2012).

[711] *Id.* at iii, 18.

[712] *Id.* at 4.

[713] Rao & Somers, *supra*, at 10.

[714] *Id.* at 12.

[715] *Id.* at 13–14.

Several types of fuel sources, including fossil and biomass, emit black carbon, but in differing ratios. Diesel engines are a particularly important source, with up to 80% of its sub-2.5 micrometer particulate matter (PM2.5) composed of black carbon.[716] PM2.5 (and smaller), in addition to being a climate-forcing material through altered albedo, is also associated with human health impacts, particularly cardiovascular and respiratory ailments.[717] The flaring of natural gas is another important source of black carbon, particularly in the Arctic, where it contributes 42% of the annual mean black carbon concentration, and 52% of the concentration in March,[718] when it could have significant effects on early spring ice dynamics.

Given these impacts, the eight-nation Arctic Council in April 2015 adopted a framework agreement to hasten reduction of black carbon and methane emissions, in which those nations (including the U.S.) committed to taking "enhanced, ambitious, national and collective action to accelerate the decline in our overall black carbon emissions." [719] The Framework established an Expert Group on Black Carbon and Methane, which met in 2017 and recommended "that black carbon emissions be further collectively reduced by at least 25-33 percent below 2013 levels by 2025.[720] The EIS must fully analyze potential black carbon emissions in light of these commitments.

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[716] *Id.* at 2.

[717] *Id.*

[718] Stohl, et al. 2013. Black carbon in the Arctic: the underestimated role of gas flaring and residential combustion emission. Atmospheric Chemistry & Physics 13:8833-8855.

[719] Enhanced Black Carbon and Methane Emissions Reductions: An Arctic Council Framework for Action. Annex 4. IQALUIT 2015 SAO Report to Ministers, https://oaarchive.arctic-council.org/bitstream/handle/11374/610/ACMMCA09_Iqaluit_2015_SAO_Report_Annex_4_TFBCM_Framework_Document.pdf?sequence=1&isAllowed=y.

[720] Arctic Council Secretariat, 2017. Expert Group on Black Carbon and Methane: Summary of progress and recommendations. 49 pp. https://oaarchive.arctic-council.org/bitstream/handle/11374/1936/EDOCS-4319-v1-ACMMUS10_FAIRBANKS_2017_EGBCM-report-complete-with-covers-and-colophon-letter-size.pdf?sequence=5&isAllowed=y

E. BLM MUST ANALYZE AND FULLY DISCLOSE THE IMPACTS OF AN OIL AND GAS PROGRAM FROM ALL PHASES OF OIL AND GAS ACTIVITIES ON BOTH FEDERAL AND PRIVATE LANDS.

The NOI indicated that it will address leasing.[721] This is too narrow a scope for the EIS. While the leasing decision may not authorize any on-the-ground activities, those activities are a reasonably foreseeable consequence of the lease sale — indeed, they are its point. Accordingly, BLM must clearly describe these activities and their impacts for the decision maker and the public.[722] This requires BLM to look at the impacts from activities associated with all phases of oil and gas: leasing, exploration (including pre- and post-leasing seismic and drilling), development, production, and transportation. Consideration of the effects of all phases is necessary to meet BLM's obligations under NEPA to take a "hard look" at the direct, indirect, and cumulative impacts of the action.[723] Subsequent phases of oil and gas are an indirect effect of leasing the Coastal Plain that must be considered.[724] There are also private lands held by the Kaktovik Inupiat Corporation and the Arctic Slope Regional Corporation and native allotments within the Arctic Refuge. Impacts from any development activities on private lands held by the Kaktovik Inupiat Corporation and the Arctic Slope Regional Corporation within the Arctic Refuge must also be considered.

1. BLM Must Analyze and Fully Disclose the Impacts of an Oil and Gas Program from All Phases of Oil and Gas Development and Activities.

a. Leasing Impacts

Issuing an oil and gas lease can be an irretrievable commitment of resources.[725] This is because oil and gas leases confer "the right to use so much of the leased lands as is necessary to explore for, drill for, mine, extract, remove and dispose of all the leased resource in a leasehold," subject to stipulations and other laws.[726]

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[721] 83 Fed. Reg. 17562.

[722] *See, e.g.*, *Native Vill. of Point Hope v. Jewell*, 740 F.3d 489, 503 (9th Cir. 2014); *Com. of Mass. v. Watt*, 716 F.2d 946, 950 (1st Cir. 1983). *Com. of Mass. v. Watt*, 716 F.2d 946, 950 (1st Cir. 1983).

[723] *Native Ecosystems Council v. U.S. Forest Serv.*, 428 F.3d 1233, 1240–41 (9th Cir. 2005).

[724] 40 C.F.R. § 1508.8(b).

[725] *See, e.g.*, *New Mexico ex rel. Richardson v. BLM*, 565 F.3d 683, 718 (10th Cir. 2009); *Pennaco Energy, Inc. v. U.S. Dep't of the Interior*, 377 F.3d 1147, 1160 (10th Cir. 2004).

[726] *New Mexico ex rel. Richardson*, 565 F.3d at 718.

The manner in which federal agencies interpret this conveyance has significant impacts on how land will be managed — and also how it will not be managed. In short, once leased, and regardless of development potential or actual ongoing development, leased land often is not proactively managed for wildlife, recreation, or land conservation. For example, in the Grand Junction Resource Management Plan (RMP) in Colorado, the BLM described that even undeveloped leases on low-potential lands prevented management of those lands to protect wilderness characteristics, stating:

> 139,900 acres of lands with wilderness characteristics have been classified as having low, very low, or no potential . . . . While there is no potential for fluid mineral development in most of the lands with wilderness characteristics units, the majority of the areas, totaling 101,100 acres (59 percent), are already leased for oil and gas development.[727]

Similarly, in the Bighorn Basin RMP in Wyoming, the BLM considered whether to manage 43 inventoried units, totaling over 476,000 acres, to protect their wilderness characteristics. Ultimately, none of the units are being managed to protect wilderness characteristics because they contain oil and gas leases.[728] Consequently, once BLM leases land to the fossil fuel industry, management for conservation even on sensitive lands with important wildlife habitat, wilderness values, or cultural resources is, as a practical matter, much more difficult.

As part of analyzing the likely impacts of leasing on the Coastal Plain, BLM must consider the impacts from leasing to management for other resources, including wildlife habitat, subsistence, recreation, and tourism.

b. Seismic Exploration Impacts

Seismic surveys taking place during the winter could industrialize the Coastal Plain. Source and receiver lines typically would be placed just a few hundred feet apart. Some of the

[727] *See* Grand Junction Proposed RMP, at 4-289 to 4-290.

[728] *See* Bighorn Basin Proposed RMP, Appendix S at Table S-1 ("Rationale for Not Managing Lands with Wilderness Characteristics for Naturalness, Outstanding Opportunities for Solitude, and Primitive and Unconfined Recreation, by Field Office and Unit" includes statement with respect to a leased area that "[i]t is recommended not to manage for wilderness characteristics because of the existing leases for oil and gas.").

significant adverse impacts from seismic activities include noise and other impacts on wildlife, including denning polar bears, damage to the tundra by moving heavy equipment and operating a mobile camp with hundreds of people, use of large amounts of water in a water-limited region, discharge of wastewater to the environment, and effects to wildlife energetics and activities by performing seismic work beyond the short winter season. Seismic exploration is a component of oil and gas leasing activities on the North Slope, and these impacts must be analyzed as part of the EIS.

Recent news articles have indicated the possibility that seismic activities on the Coastal Plain may begin prior to leasing.[729] The EIS needs to study the impacts of these activities, which would impact the baseline analysis. Seismic activities should not be authorized prior to completion of the leasing EIS.

c. Infrastructure Impacts

Oil and gas exploratory drilling and production would have a variety of significant impacts associated with infrastructure. These include impacts associated with the physical footprint of the infrastructure, acquisition of materials such as gravel to build the infrastructure, the infrastructure itself, and infrastructure operations. BLM must assess full development scenarios, including exploratory and production-related drilling infrastructure. Such development could potentially sprawl over vast stretches of the Coastal Plain. The Tax Act does not contain requirements to consolidate operations or avoid duplicative infrastructure — actions which will be necessary to minimize infrastructure footprints and associated significant impacts — but BLM should consider scenarios that assess such development.[730] BLM must thoroughly analyze impacts associated with infrastructure under all development scenarios considered, including providing estimates of surface acreage disturbance. Further, BLM must explain how it will allocate acreage between potential lessees, both from an initial lease sale and between lessees from different lease sales given the cumulative 2,000-acre limitation on surface development.

Road infrastructure, in particular, has significant, adverse effects on wildlife and other resources that must be fully analyzed. Permanent road construction and maintenance requires gravel transport and mining, with associated impacts on wildlife habitat. Stream crossings for roads require bridges or adequately sized and maintained culverts to ensure water flow and

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[729] Steven Mufson & Juliet Eilperin, "Companies take first steps to drill for oil in Arctic National Wildlife Refuge," *Washington Post* (May 31, 2018).

[730] *See supra* Part V.D.1c.

adequate fish passage and to prevent the alteration or creation of flooded wetlands. Roads fragment habitat, with associated avoidance behavior by caribou and other wildlife. Raised permanent roads built to protect permafrost make subsistence travel more difficult and can also have a deterrent effect on migratory species like caribou. Temporary ice roads require significant water and ice withdrawals which can adversely impact over-wintering fish in lakes. Temporary, compacted snow roads can harm tundra growth, as the snow overlying those areas likely will require more time to melt during the very short growing season, and snow compaction can affect surface flows. Similarly, gravel well pad construction and operation will adversely affect wildlife habitat. Wildlife generally avoid pads because they are noisy areas with humans around. Pads and roads also require significant quantities of mined gravel. BLM must fully analyze all of these infrastructure impacts.

Finally, BLM must consider and account for the fact that transmission pipelines can be constructed and monitored without roads. There are two crude oil transmission pipelines in the Arctic without roads, the Alpine to Kuparuk pipeline (34 miles long, 95,000 bbl/day) and the Badami to Endicott pipeline (25 miles long, peak transmission was 7,450 bbl/day).

BLM must examine the full range of other infrastructure and activities associated with gravel mining sites and activities necessary to build pads, roads, airstrips, and other infrastructure. All oil and gas leasing action alternatives considered in the EIS should include estimates of cubic yards of gravel required for eventual exploration and development activities, based on BLM's Exploration and Development Scenario. It is likely that eventual exploration and development will require vast amounts of gravel to complete.

BLM must also identify potential material sites, as gravel extraction may significantly impact surrounding areas. Gravel extraction is generally done in large, open pit mines typically located away from major streams and lakes. Although direct stream impacts may be mostly mitigated, open pit mines require extensive overburden removal — for example, over 50 feet of vegetation and soil needed to be excavated to reach suitable gravel in the mines created for Kuparuk.[731] The resulting overburden stockpile disturbs tundra, and the gravel pit itself causes

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[731] BENJAMIN SULLENDER, AUDUBON ALASKA, ECOLOGICAL IMPACTS OF ROAD- AND AIRCRAFT-BASED ACCESS TO OIL INFRASTRUCTURE 19 (July 2017), *available at* http://ak.audubon.org/sites/g/files/amh551/f/road_aircraft_access_report_final_0.pdf (internal citations omitted).

permanent changes to the area's thermal regime due to "thaw bulbs" forming in the permafrost around the unfrozen water during flooding.[732] Indirect effects such as these have led some researchers to approximate that a one acre (0.4 ha) gravel pit may impact as much as 25 acres surrounding the site.[733] BLM must fully analyze the impacts from gravel extraction activities.

Gravel extraction sites located on BLM-managed lands are subject to regulations governing contracts and permits for mineral materials (*see* 43 C.F.R. Subparts 3601-3604). BLM must identify whether it will apply these regulations to any material sites that may be identified within the Coastal Plain. We also note that provisions of the Chandler Lake Agreement grant ASRC extensive rights to develop and sell sand and gravel from their lands. BLM must analyze the likely impacts from the exercise of those rights as currently written.[734] To the extent BLM anticipates gravel resources being transported from outside of the Arctic Refuge, it must also identify these areas and discuss potential options and impacts of transportation.

d. Spill Impacts

Oil exploration and production is an inherently complicated and messy business that will inevitably result in releases of crude oil, other toxic materials, air pollutants, and wastes and wastewaters. Even the highest-performing and most well-financed operators suffer from crude oil, hazardous materials, and produced water spills that adversely affect the tundra and, in many cases, the region's surface waters. Operators, for example, cannot prevent all exploratory and production-related blowouts, also known as losses of well control, because companies may encounter unexpected or changing subsurface conditions that have not been adequately addressed during drilling. Similarly, major and minor spills can occur from corrosion, human errors, inadequate maintenance, earthquakes, infrastructure failures, and freezing. Inadequate leak detection and valve placement for gathering and transmission pipelines can also lead to larger spills. Management and disposal of drilling muds and cuttings, produced water and other forms of wastewater including oil-contaminated storm-water, and hydraulic fracturing related chemicals and wastes can have significant impacts as well. Appendix 6 catalogues relevant

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[732] *Id*. (internal citations omitted).
[733] *Id*. (internal citations omitted).
[734] *See* Chandler Lake Land Exchange Agreement, Appendix 2. C., pp. 29-32 (1983); *see supra* Part VI.E.2.

blowouts and spill data and demonstrates their ubiquitous nature. BLM must analyze all reasonably foreseeable impacts associated with potential blowouts and spills.

Leak detection and spill response for transmission pipelines can be accomplished without roads or increased air traffic. Leak detection can be done electronically. Helicopters and snow-machines could be used in the winter for access spill response, and low-ground-pressure vehicles and hovercraft could be used in the summer.[735] The effectiveness of and impacts from spill response should be evaluated.

BLM must also fully assess the impacts (including cumulative impacts) of oil spills reaching the coast and Beaufort Sea, either through spills into streams that flow to the sea or directly into the sea from ships or pipelines associated with Refuge development.[736] As described above, there is no effective way to clean up spilled oil in the icy and stormy conditions that often prevail in the Arctic Ocean.

Finally, BLM must fully analyze and consider how it will ensure operators will comply with all relevant lease stipulations, and state and federal regulatory requirements, particularly given the remoteness of the region and associated challenges with and costs of performing regulatory inspections.

e. Other Impacts

Beyond infrastructure and spill impacts, oil development creates air pollution and noise from generators, trucks, aircraft, and processing facilities; generates waste streams and wastewaters from drilling operations and living quarters; uses substantial quantities of surface water; restricts access for subsistence, sport hunting and fishing and other forms of recreation; and creates safety and fire risks. BLM must fully analyze all of these impacts.

BLM may not rely on directional or extended reach drilling to claim that numerous significant impacts associated with development will be eliminated or mitigated. Directional or extended reach drilling for oil has the same impacts as vertical well drilling with one exception — smaller well pads. Directional drilling requires surface occupancy for drill rigs, well pads, pipelines, roads and human infrastructure at locations near to but not immediately above oil and gas reservoirs. Permanent gravel roads and airstrips are still used, pipelines are still required, and

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[735] *See* NPRA draft IAP, Chapter 4 at 46.
[736] *See supra* Part VI.A.6.b.

air pollution and spills are still inevitable. As a result, there still will be wildlife habitat losses and adverse impacts to subsistence from directional drilling that need to be considered as part of this EIS. Even at the supposedly state-of-the-art Alpine facility, ConocoPhillips has still relied heavily on gravel roads, gravel pads, and other permanent infrastructure to support its oil operations — all of which has had serious adverse impacts to subsistence and other resources.

For technical reasons, directional drilling only has a range of a few miles. The maximum horizontal distance drilled to date on the North Slope is approximately five miles. Even the new, costly "state-of-the-art" drilling rig Doyon is building, which is expected to be operational in 2020, only will be able to drill wells 6.25 miles away. Moreover, that distance would be the exception, not the rule.

Because of higher costs due to longer wells, directional drilling may or may not be used by industry for exploratory drilling. As discussed by Mr. Kevin Banks of DNR during the May 10, 2011 Senate Energy and Natural Resources Committee hearing, oil companies actually prefer not to use directional drilling for exploratory wells because doing so would provide less technical information about subsurface conditions. The EIS must acknowledge the realities and shortcomings of directional drilling, , as well as the limited number of rigs capable of extended reach drilling that are likely to be used in the Coastal Plain.

2. BLM Must Analyze and Fully Disclose the Impacts of an Oil and Gas Program from Activities on Private Corporation Lands and Native Allotments.

Under the Alaska Native Claims Settlement Act (ANCSA), Kaktovik Inupiat Corporation (KIC) — an Alaska Native village corporation — could select 92,160 acres of surface land. Originally, only 69,120 of those acres could be within the Arctic Refuge.[737] That changed in 1980 with the passage of the Alaska National Interest Lands Conservation Act (ANILCA). In ANILCA, Congress authorized KIC to select an additional 23,040 surface acres within the Arctic Refuge. In general, regional corporations like ASRC were entitled to acquire the subsurface rights to lands selected by village corporations like KIC.[738] But Congress prohibited regional corporations — like ASRC — from acquiring the subsurface rights to surface lands selected by a village corporation if those surface lands where within a pre-ANCSA refuge like the Arctic Refuge.[739]

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[737] *See* 43 U.S.C. §§ 1611(a)(1), 1613(a).
[738] 43 U.S.C. § 1613(f).
[739] 43 U.S.C. §§ 1611(a)(1), 1613(f).

Despite these legal prohibitions barring ASRC from gaining the subsurface estate in the Arctic Refuge, in 1983 DOI Secretary Watt entered into a legally questionable land exchange with ASRC called the Chandler Lake Agreement that also addressed oil and gas development on private lands within the Arctic Refuge. As a result of this exchange, ASRC obtained an interest in 92,160 acres of subsurface estate below the KIC surface lands and most allotments within the Arctic Refuge. Congress amended ANILCA in 1988 to specifically prohibit the Secretary from conveying or exchanging any additional lands within the Arctic Refuge without congressional approval (other than lands selected prior to 1987).[740] The General Accounting Office later found that the land exchange was not in the public interest for multiple reasons.[741]

The Chandler Lake Agreement extensively addresses possible oil and gas development on the lands in the Arctic Refuge that ASRC obtained under that Agreement. Provisions of the Chandler Lake Agreement clearly and definitively state that no exploratory drilling, production, leasing, or other development leading to production of oil and gas is allowed on ASRC lands until Congress authorizes such activities on Refuge lands, the Coastal Plain or on ASRC lands, or both. The Chandler Lake Agreement also acknowledged that the land was always subject to section 22(g) of ANCSA, which requires that land within the boundaries of a refuge "remain subject to the laws and regulations governing use and development" of that refuge.[742] The Chandler Lake Agreement also sets out extensive details on how oil and gas could be developed on the ASRC lands, including some stipulations and practices that may no longer be considered desirable or advisable. Importantly, the Agreement specifies that its provisions can be superseded by Congress or regulations.

The EIS must explain the legal status of these lands and, if DOI believes that these lands are now open to oil and gas, explain the legal basis for that conclusion as well as account for the impacts to the Coastal Plain from any activities that may take place on the corporation lands.

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[740] 16 U.S.C. § 3192(h)(2) & Public Law 100-395 (Aug. 16, 1988).

[741] *See* U.S. General Accounting Office, Federal Land Management, Chandler Lake Land Exchange Not in the Government's Best interest, Report to the Chairman, Subcommittee on Water and Power Resources, Committee on Interior and Insular Affairs, House of Representatives, GAO/RCED-90-5 (Oct. 1989) [GAO Report], *available at*: https://www.gao.gov/products/RCED-90-5.

[742] 43 U.S.C. § 1621(g).

BLM should also address how it will conduct the compatibility determination called for under ANCSA section 22(g) for these lands.[743] BLM must also explain how it interprets the application of the stipulations and conditions in the 1983 Agreement and other environmentally protective measures to these lands in light of the 1983 Agreement.

There are also a number of native allotments on the Coastal Plain. These lands are privately held, with the subsurface held by ASRC. The EIS must describe how many allotments occur within the Coastal Plain and identify their locations and acreage. BLM should also consider the impacts of oil and gas activities on native allotments and describe how the BLM can protect the resources and values of the allotments from oil and gas activities, and the impacts of such activities on the Coastal Plain. Furthermore, there are a large number of unresolved Native allotment claims on the Coastal Plain of the Arctic Refuge. BLM must also address how it will address those, including address how long will it take to adjudicate these claims and the potential impacts to the rights of claimants.

F. BLM MUST ANALYZE AND FULLY DISCLOSE THE CUMULATIVE IMPACTS FROM OIL AND GAS ACTIVITIES AND REASONABLY FORESEEABLE PROJECTS.

NEPA requires that BLM "consider the cumulative impacts of [this] project together with 'past, present and reasonably foreseeable future actions.'"[744] "Cumulative actions" are those "which when viewed with other proposed actions have cumulatively significant impacts."[745] "Cumulative impact" is defined as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions."[746] Such impacts can result from individually minor but collectively significant actions taking place over a period of time.[747]

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[743] 43 U.S.C. § 1621(g); *see also* Agreement Between Arctic Slope Regional Corporation and the United States of America, Appendix 1 at 1 (Aug. 9, 1983) (stating that section 22(g) of ANCSA applies to the exchanged lands).

[744] *Native Ecosystems Council v. Dombeck*, 304 F.3d 886, 895 (9th Cir. 2002) (quoting 40 C.F.R. § 1508.7).

[745] 40 C.F.R. § 1508.25(a)(2).

[746] *Id*. § 1508.7.

[747] *Id.*

The cumulative impacts from oil and gas activities are considerable. Following a request from Congress, in 2003, the National Academy of Sciences published a report on the cumulative impacts of the environmental effects of oil and gas activities on the North Slope.[748] In that report, the National Academy recognized that there was an essential trade-off with industrialization and the intact physical environment: "The effects of North Slope industrial development on the physical and biotic environments and on the human societies that live there have accumulated, despite considerable efforts by the petroleum industry and regulatory agencies to minimize them."[749] The National Academy also noted that the effects on the physical environment from oil and gas activities and infrastructure extend well beyond the footprint, and accumulate and persist even after the activity may cease.[750]

BLM must identify and fully consider the potential cumulative effects of leasing, which requires considering all subsequent phases of oil and gas activities on the Coastal Plain, in addition to all reasonably foreseeable future actions, to meet its obligations under NEPA to evaluate the cumulative impacts of leasing the Coastal Plain.[751] This means that BLM must create development scenarios for the Coastal Plain based on occurrences of economically recoverable oil and activities associated with exploration, development, production, and transportation.[752] It is vital that the BLM thoroughly consider the impacts from all phases in this EIS so that the agency can craft appropriate lease stipulations and conditions now to address impacts at later phases and meet statutory duties.

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[748] National Research Council of the National Academies, Cumulative Environmental Effects of Oil and Gas Activities on Alaska's North Slope, Committee on Cumulative Environmental Effects of Oil and Gas Activities on Alaska's North Slope (2003).

[749] *Id.* at 10.

[750] *Id.* at 156.

[751] *See* IAP at Chapter 4, p. 1 (stating that when evaluating the cumulative effects of oil and gas, the BLM would look at "not only those actions that may follow from the decisions in this plan, but also actions undertaken by others within and outside the planning area"); *see also* Council on Environmental Quality, Executive Office of the President, Considering Cumulative Effects Under the National Environmental Policy Act at 1 (Jan. 1997) ("The range of actions that must be considered includes not only the project proposal but all connected and similar actions that could contribute to cumulative effects. Specifically, NEPA requires that all related actions be addressed in the same analysis.").

[752] *See supra* Part VI.E.1.

There are a number of foreseeable developments and decisions that could further exacerbate the cumulative impacts to the region that BLM must consider. These include:

- pre-leasing seismic activities that could occur,
- the Arctic Strategic Transportation and Resources (ASTAR) project in which the State of Alaska is proposing to construct a series of interconnected gravel roads or rights-of-way spanning portions of the North Slope Borough, possibly including the Coastal Plain,[753]
- oil and gas activities occurring in the near shore (i.e., state waters) and OCS areas of the Beaufort Sea, including the potential for additional leasing and oil and gas activities and infrastructure in those areas and additional support infrastructure and activities within or adjacent to the Refuge,
- the Alaska Natural Gas Pipeline and other commercial natural gas pipelines and related activities,
- expanded oil and gas development to the west of the Arctic Refuge boundary,
- expanded oil and gas leasing and development in the National Petroleum Reserve–Alaska, and
- increased vessel traffic in the Beaufort, Bering, and Chukchi seas.

Particularly given the migratory nature of much of the wildlife that relies on the Coastal Plain and adjacent waters, a full assessment of the effects from these projects is vital to an assessment of the cumulative impacts. BLM must also describe and assess how development in the Coastal Plain could catalyze additional development in other areas throughout the Arctic. For example, infrastructure related to Coastal Plain development may facilitate development of oil and gas offshore adjacent to the Refuge in state and federal waters.

1. BLM Must Acknowledge that impacts of permitted development across the Arctic have a long history of being worse than what agencies predicted.

BLM must acknowledge that there is a pattern of agencies underestimating the effects of oil and gas projects across the North Slope.[754] According to the National Research Council, "[t]he effects of industrial activities are not limited to the footprint of a structure or to its

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[753] Shady Grove Oliver, *Cost Comes Into Focus Amid ASTAR Testimony*, ARCTIC SOUNDER, Apr. 27, 2018, available at http://www.thearcticsounder.com/article/1817cost_comes_into_focus_amid_astar_testimony.

[754] *See generally* The Wilderness Society, Broken Promises, available at https://wilderness.org/resource/broken-promises-reality-oil-development-americas-arctic.

immediate vicinity; a variety of influences can extend some distance from the actual footprint."[755] Thus, "[t]he common practice of describing the effects of particular projects in terms of the area directly disturbed by roads, pads, pipelines, and other facilities ignores the spreading character of oil development on the North Slope and the consequences of this to wildland values. All of these effects result in the erosion of wildland and other values over an area far exceeding the area directly affected."[756]

Examples of underestimated effects abound:

- In the recent EIS for the GMT1 development project in the NPRA, BLM acknowledged that "the intensity of [development] impacts and the overall degree of impacts may be higher than previously anticipated" in earlier EISs assessing development in the Reserve.[757]
- The original Alpine field — specifically promoted as a "roadless development" when initially proposed — had three miles of roads when it began pumping crude in 2000, but now has many more miles of roads and other infrastructure built since then.[758]
- New discoveries in the Western Arctic on state and federal lands have been dubbed a "string of pearls" and are resulting in new processing facilities and increased industrial activity significantly farther west than Alpine.[759]

Thus, in assessing cumulative impacts, BLM cannot simply rely on the description of effects from prior NEPA analyses for projects in the Arctic. It must analyze anew the potential effects of development based on updated projections of impacts that take into account past understatements and the way development is actually proceeding.

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[755] NRC Report at 9.

[756] *Id.* at 148.

[757] BLM, Supplemental Environmental Impact Statement for the Alpine Satellite Development Plan for the Proposed Greater Mooses Tooth One Development Plan at Vol I, p 423 (Oct. 2014), *available at:* https://eplanning.blm.gov/epl-front-office/projects/nepa/37035/50832/55575/GMT1_Final_SEIS_Volume_1_Oct_2014_(2)_508.pdf

[758] Broken Promises at 8-9.

[759] Tim Bradner, *Ratcheting Up*, FRONTIERSMAN, April 21, 2018, available at http://www.frontiersman.com/business/ratcheting-up/article_dda92c24-45b7-11e8-a008-0b176b106442.html

G. BLM MUST ANALYZE AND FULLY DISCLOSE THE CROSS-BORDER, TRANSBOUNDARY, AND INTERNATIONAL IMPACTS OF AN OIL AND GAS PROGRAM.

The NEPA requirement to consider transboundary effects has long been recognized in the federal courts.[760] For example, in a case involving DOI and the provincial government of Manitoba, the D.C. District Court ruled that "NEPA requires agencies to consider reasonably foreseeable transboundary effects resulting from a major federal action taken within the United States." [761] Reflecting the NEPA case law, in 1997, CEQ "determined that agencies must include analysis of reasonably foreseeable transboundary effects of proposed actions in their analysis of proposed actions in the United States."[762] CEQ advised federal agencies to "be particularly alert to actions that may affect migratory species, air quality, watersheds, and other components of the natural ecosystem that cross borders, as well as to interrelated social and economic effects." To obtain information about potential transboundary effects, CEQ said federal agencies "should contact agencies in the affected country with relevant expertise."

As discussed elsewhere in these comments, resources that are likely to be particularly affected by oil and gas activities in the Arctic Refuge Coastal Plain, causing reasonably foreseeable transboundary effects that must be considered, include but are not limited to:

- Caribou,
- Polar Bear,
- Migratory Birds, such as snow geese,
- Fish,
- Water resources,
- Air quality,
- Human health and food security, and
- Socio-economic/Subsistence.

In the EIS, BLM must address how it, along with other U.S. government agencies, will coordinate and cooperate with the Canadian federal, territorial, and First Nation governments to

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[760] *See, e.g.*, *Swinomish Tribal Cmty. v. FERC*, 627 F.2d 499, 510-12 (D.C. Cir. 1980)(concluding that the agency took a "hard look" at the Canadian impacts of dam construction in Washington State); *Wilderness Soc'y v. Morton*, 463 F.2d 1261, 1261-63 (D.C. Cir. 1972) (granting intervenor status to Canadian environmental groups seeking to challenge the trans-Alaska pipeline under NEPA).

[761] *Manitoba v. Salazar*, 691 F. Supp. 2d 37 (D.D.C. 2010).

[762] Council on Environmental Quality Guidance on NEPA Analyses for Transboundary Impacts, http://ceq.hss.doe.gov/nepa/regs/transguide.html.

ensure that all reasonably foreseeable transboundary effects are identified, documented, and carefully evaluated in the EIS.

H. BLM Must Analyze and Fully Disclose the Economic Impacts of an Oil and Gas Program and Conduct an Analysis of Potential Oil Development.

1. BLM Must Analyze and Fully Disclose the Economic Impacts of Potential Oil Development.

Proponents of drilling for oil and gas in the Coastal Plain of the Arctic Refuge commonly make inaccurate and misleading claims that Arctic drilling will displace oil imports, lower domestic gas prices, raise revenue to bring down the federal deficit, and create thousands of jobs. These promised economic benefits, however, are based on outdated or inaccurate information, faulty assumptions, and a skewed economic perspective on the short- and long-term commodity and subsistence values of the Refuge. Given the enormous risk to wildlife, ecosystems, and human welfare that such oil exploration and development would impose, the EIS must closely, carefully, and critically examine these asserted benefits.

Attached to these scoping comments is a report prepared for The Wilderness Society by economists Dr. Carolyn Alkire and Anna Perry with Key-Log Economics, titled "Arctic National Wildlife Refuge: Economics of Potential Oil Development." Published in November 2017, the report contains up-to-date information regarding several economic issues that must be addressed in the EIS. We urge the BLM to utilize this information in the economic effects analysis of the proposed oil and gas program and alternatives in the EIS, including the following issues.

First, the EIS must acknowledge that the economic context of U.S. domestic oil production, both currently and in the long-term, has changed dramatically in recent years. Since 2010, "tight oil" produced through hydraulic fracturing has greatly expanded oil output and recoverable reserves in the lower 48 states.[763] Alaska accounted for 20% to 25% of total U.S. production in the 1980s and 1990s, but as of 2016, Alaskan crude oil production made up only

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[763] See, e.g., D. Murphy. 2017. The Case Against Oil Production within the Arctic National Wildlife Refuge, available at: http://akbriefing.wikispaces.com/file/view/Oil+Production+in+ANWR+-+Impacts+on+Deficit+and+National+Energy+Security.pdf/620673185/Oil%20Production%20in%20ANWR%20-%20Impacts%20on%20Deficit%20and%20National%20Energy%20Security.pdf.

5.5% of total U.S. supply. Regardless of oil and gas leasing in the Coastal Plain, Alaskan oil production will likely continue to be dwarfed by tight, or shale, oil production in the lower 48 states in coming decades. Oil reserves in the Permian Basin of Texas alone are estimated to hold 60 to 70 billion barrels while the NPRA and adjacent lands and waters are estimated to contain a mean of 8.7 billion barrels of undiscovered, technically recoverable oil.[764]

One of the most important trends over the past few years has been the growing disparity in the relative production costs of tight oil in the lower 48 compared to Alaskan Arctic oil. The break-even price for North American tight oil is $40-$60 per barrel, whereas the average cost of extracting oil from the Arctic is $75 per barrel.[765] Since tight oil is out-competing Arctic oil, any oil production in the Coastal Plain could be economically inefficient compared to tight oil in the lower 48. Therefore, the EIS should estimate *economically* recoverable oil — that portion of technically recoverable oil which can be produced for less than the price of oil in the market — and the degree to which Arctic production costs and global market prices would affect the volume produced.

Second, the EIS must critically examine the disingenuous claim of Arctic Refuge oil drilling proponents that Arctic oil would reduce U.S. "dependence" on foreign oil imports. In fact, production of tight oil from the lower 48 has increased so much in recent years that the U.S. began exporting oil in 2016, after a 40-year ban on such exports.

Furthermore, the assumption that oil from the Arctic Refuge would displace U.S. imports neglects existing infrastructure capacity and the flow of oil from Alaska's North Slope to end-consumers on the West Coast. A recent analysis by DeRosa and Flanagan (2017) using the National Transportation Fuels Model shows that North Slope oil would primarily either be exported or shipped to West Coast ports, resulting in minor declines in the flow of both foreign imports and tight oil from the Bakken basin.

Third, the EIS must be upfront that there is very little chance that oil production from the Refuge would have any effect on oil prices or downstream gas prices for consumers. The reality is that oil prices in the U.S. are determined in world markets. A decade-old analysis of Arctic

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[764] USGS, 2017. Assessment of undiscovered oil and gas resources in the Cretaceous Nanushuk and Torok Formations, Alaska North Slope, and summary of resource potential of the National Petroleum Reserve in Alaska, 2017, available at: .https://pubs.er.usgs.gov/publication/fs20173088.

[765] *See* D. Murphy, The Case Against Oil Production within the Arctic National Wildlife Refuge at 6.

drilling by the Energy Information Administration found that any impact on prices at the pump — perhaps 1% at most — would likely only be felt during a single peak production year, no sooner than 2033. Moreover, the Organization of Petroleum Exporting Countries (OPEC) could easily neutralize any price impact by decreasing supplies to match additional production from Alaska.

Future global oil prices and OPEC production are much more likely to affect Arctic drilling than vice versa, i.e., Alaska is a price-taker, not a price-maker. That is partially because, as noted earlier, the average cost of extracting oil from the Arctic is $75/barrel, which is almost three times the cost of extraction in the Middle East. As a high-cost producer, Arctic oil production is more economically vulnerable to downturns in world oil prices than less-costly tight oil production in the lower 48.

Fourth, the EIS must take a hard look at the magnitude and timing of impacts of the proposed oil and gas leasing program and alternatives on the federal deficit. The premise for including the Coastal Plain oil and gas leasing program in the Tax Act was an assumption — based on a controversial estimate by the Congressional Budget Office[766] — that the program would generate $2.2 billion in "bonus bids" by 2027 (ten years from enactment of legislation), of which $1.1 billion would reduce the federal deficit.[767] That amounts to an average bonus bid of $2,750/acre for the 800,000 acres required to be leased by the Tax Act.

However, the recent history of bidding on oil and gas leases in Alaska's North Slope region indicates that the CBO estimate is wildly optimistic. On-shore bonus bids between 2000 and 2016 averaged just $34/acre, including 4.7 million acres that were leased in the NPR-A for a total of $197 million, or $42/acre.[768] The BLM should therefore undertake an independent analysis of likely bonus bids for oil and gas leasing in the Coastal Plain using the latest available bidding data in the region.

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[766] Congressional Budget Office, Cost Estimate, A Legislative Proposal Related to the Arctic National Wildlife Refuge (Nov. 8, 2017), *available at*: https://www.energy.senate.gov/public/index.cfm/files/serve?File_id=3454269F-6DC5-4E6C-9F23-99D1E3E64698. The CBO based its estimate on "historical information about oil and gas leasing in the United States and on information from DOI, EIA, and individuals working in the oil and gas industry about factors that affect the amounts that companies are willing to pay to acquire oil and gas leases."

[767] According to the fiscal year 2018 budget, projected receipts from leasing represent less than 0.5% of the total budget deficit reductions proposed (Office of Management and Budget, 2017)

[768] Murphy, op. cit.

In addition, the EIS should consider the considerable time lag between potential approval of oil and gas development and production, and subsequent royalty payments to the U.S. Treasury. These payments may not reach the Treasury until 10-20 years after leasing is approved.

a. BLM Must Analyze How Arctic Refuge Drilling Would Affect Employment and the Subsistence Economy in the Short- and Long-Term.

The EIS must acknowledge that because oil is a non-renewable, finite resource, oil industry jobs resulting from drilling in the Arctic Refuge would be temporary, lasting no more than a few decades. After peak production, oil output and employment would decline until production ceased altogether, at which point the oil industry would abandon the area and related employment would cease. In addition, a distinction should clearly be made between new jobs created (thus reducing unemployment) and jobs filled by people previously employed elsewhere (a shift in jobs) which results in no net job creation.

In contrast to the transient, boom-and-bust nature of oil development, the Porcupine Caribou Herd and natural habitats of the Arctic Refuge have been the socio-economic backbone of the Gwich'in people and other Alaska Native and Canadian First Nations for millennia. Therefore, the relatively short-term employment benefits of drilling must be carefully weighed against the risk of sacrificing a sustainable economic asset of immense value.

From an economic sustainability perspective, the central question that the EIS must address is this: Looking 50-70 years into the future — after recoverable oil is exhausted and/or abandoned — would it better to have (a) no Arctic-based oil drilling jobs and no Arctic caribou-based subsistence economy and society, having been irreversibly destroyed by the oil drilling, or (b) no Arctic-based drilling jobs and a healthy Arctic caribou-based subsistence economy that may continue to thrive for many centuries into the future?

B. Trans-Alaska Pipeline Operation without Arctic Refuge Oil.

The EIS also must accurately describe the operation and longevity of the Trans-Alaska Pipeline System (TAPS) without Arctic Refuge oil. There are several ways to ensure that TAPS continues to operate over the long-term including technical upgrades to the pipeline such as adding heat. TAPS' operator, Alyeska, is employing those measures. Notably, although TAPS currently is operating at less than at its peak, pipelines are always designed and operated to carry less than peak flow and it is in no danger of shutting down due to low oil flow. Despite some in-state and DC-based rhetoric, Arctic Refuge oil and gas is not necessary to ensure that TAPS remains operational.[769]

2. Economic Considerations for Delaying Leasing.

In addition to the economic points raised in the above-referenced report, the EIS must consider if and when economic and other relevant considerations should dictate when leasing and development should actually occur.

As summarized in the Mineral Leasing Act, for example, the national policy underlying oil and gas leasing is "the orderly and *economic development of domestic mineral resources*, reserves, and reclamation of metals and minerals to help *assure satisfaction of industrial, security and environmental needs*."[770] Consequently, the BLM should not commit to moving forward with oil and gas leasing on the Coastal Plain of the Arctic Refuge when economic and other considerations indicate it is not the right time to do so.

In this context, the BLM can and should apply the principles of option value or informational values, which permit the agency to look at the benefits of delaying irreversible decisions. It is well-established that issuance of an oil and gas lease can be an irreversible commitment of resources.[771] In the context of the Coastal Plain, there are significant considerations that would support delaying leasing. As the U.S. Court of Appeals for the D.C. Circuit held in the context of considering the informational value of delaying leasing on the Outer Continental Shelf, "[t]here is therefore a tangible present economic benefit to delaying the decision to drill for fossil fuels to preserve the opportunity to see what new technologies develop and what new information comes to light."[772]

Similar reasoning also applies to delaying approvals to conduct activities connected with exploration and development of leases. Once a lease is issued, the BLM still has to evaluate and issue approvals for on-the-ground activities associated with exploration and development. After an approval is issued, activities may proceed that may harm the resources of the Coastal Plain. Delaying exploration and development will avoid immediate harm and provide an opportunity to consider new data and technology. As discussed above, the Tax Act leaves BLM with ample

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[769] See Epstein, L., Trans-Alaska Oil Pipeline Flow: Doing Just Fine After Forty Years, 11 pp. https://wilderness.org/sites/default/files/Alaska%20Pipeline%20Report.pdf (June 2017).

[770] 30 U.S.C. § 21a (emphasis added).

[771] *See Pennaco Energy, Inc. v. U.S. Dep't of the Interior*, 377 F.3d 1147 (10th Cir. 2004).

[772] *Ctr. for Sustainable Economy v. Jewell*, 779 F.2d 588, 610 (D.C. Cir. 2017).

discretion to condition exploration and development on specific circumstances and, by suspending leases, BLM can toll the terms of leases, as well as the obligations of leaseholders to make rental payments. BLM has used this authority to suspend leases in the interest of conservation of natural resources, which the agency defines as both preventing harm to the environment and preventing loss of mineral resources. This approach must be considered in the range of alternatives.

The EIS for leasing must evaluate the economic benefits that could arise from delaying leasing in terms of improvements in technology, additional information on risks to other resources in the Coastal Plain and ways to avoid those risks, and additional information on the impacts of climate change and ways to avoid or mitigate resulting changes to the affected environment. BLM has the ability and obligation to undertake an analysis of the benefits of delaying leasing, which can be both qualitative and quantitative. Further, the Mineral Leasing Act underscores the importance of looking at economic and environmental needs in making leasing decisions. Given the importance and vulnerability of the Coastal Plain of the Arctic Refuge, an option value analysis should be part of a comprehensive evaluation of the impacts of leasing and should inform alternatives to simply proceeding with leasing in the EIS.

VII. BLM MUST CONDUCT A COMPREHENSIVE ANILCA SECTION 810 ANALYSIS.

Title VIII of ANILCA recognizes that subsistence uses and the continuation of subsistence opportunities are in the public interest and provides a framework to consider and protect subsistence uses in agency decision making processes.[773] As the Supreme Court explained:

> [t]he purpose of ANILCA § 810 is to protect Alaskan subsistence resources from unnecessary destruction. Section 810 does not prohibit all federal land use actions which would adversely affect subsistence resources but sets forth a procedure through which such effects must be considered and provides that actions which would significantly restrict subsistence uses can only be undertaken if they are necessary and if the adverse effects are minimized.[774]

Thus, ANILCA section 810 imposes a two-tiered process to evaluate a project's impacts on subsistence uses. First, the federal agency:

> [i]n determining whether to withdraw, reserve, lease, or otherwise permit the use,

[773] 16 U.S.C. §§ 3111–3126.
[774] *Amoco Production Co. v. Village of Gambell, Alaska*, 480 U.S. 531, 544 (1987).

> occupancy, or disposition of public lands . . . shall evaluate the effect of such use, occupancy, or disposition on subsistence uses and needs, the availability of other lands for the purposes sought to be achieved, and other alternatives which would reduce or eliminate the use, occupancy, or disposition of public lands needed for subsistence purposes.[775]

This initial finding is referred to as the "tier-1" determination,[776] and requires the agency to consider the cumulative impacts in making the determination.[777]

If the agency, after conducting the tier-1 analysis, determines that the activity will not "significantly restrict subsistence uses,"[778] then the agency issues a Finding of No Significant Restriction (FONSI) and the requirements of ANILCA section 810 are satisfied. However, if the agency makes the initial determination that the action would "significantly restrict subsistence uses," the agency must then make conduct a "tier-2" analysis.[779] Under tier-2, the agency must determine that any restriction on subsistence is necessary considering sound public lands management principals, involves the minimal amount of public lands necessary to accomplish the purpose of the use, occupancy or disposition of public lands, and takes steps to minimize the adverse impacts to subsistence uses and resources from any use.[780] Thus, as the Ninth Circuit explained, ANILCA section 810 imposes procedural requirements as well as substantive restrictions on the agency's decisions.[781] The agency must also provide notice to local and regional councils and hold hearings.

The NOI indicates that BLM will consider the impacts to subsistence use and resources and how to minimize any impacts from any impacts that result from restrictions that BLM determines are necessary.[782] Oil and gas leasing and any associated activities on the Coastal Plain will adversely affect subsistence resources and will likely significantly restrict subsistence

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[775] ANILCA § 810(a), 16 U.S.C. § 3120(a).

[776] *Hanlon v. Barton*, 470 F. Supp. 1446, 1448 (D. Alaska 1988)

[777] *Sierra Club v. Penfold*, 664 F. Supp 1299, 1310 (D. Alaska 1897), *aff'd*, *Sierra Club v. Penfold*, 857 F.2d 1307 (9th Cir. 1988).

[778] 16 U.S.C. § 3120(a).

[779] *Kunaknana v. Clark*, 742 F.2d 1145, 1151 (9th Cit. 1984); *Hanlon*, 470 F. Supp. at 1448.

[780] 16 U.S.C. § 3120(a)(1)–(3).

[781] *Sierra Club v. Marsh*, 872 F.2d 497, 502–03 (9th Cir. 1989).

[782] 83 Fed. Reg. 17,563.

use. Those impacts will be felt by those using the subsistence resources within the Coastal Plain, but also those that depend on the subsistence resources that the Coastal Plain supports beyond its boundaries. BLM must consider the impacts to all subsistence users of Coastal Plain resources. BLM must consider the impacts to the Inupiat of the North Slope as well as the Gwich'in of Alaska and Canada, who are heavily dependent on the Porcupine Caribou Herd as it follows its historic migratory route through the Gwich'in homelands. BLM should provide a thorough discussion of whether the alternatives do, in fact, involve the minimal amount of public lands necessary to accomplish the purpose of the use and a thorough analysis of what steps it anticipates taking to minimize the adverse impacts to subsistence uses and resources.[783]

VIII. CONCLUSION

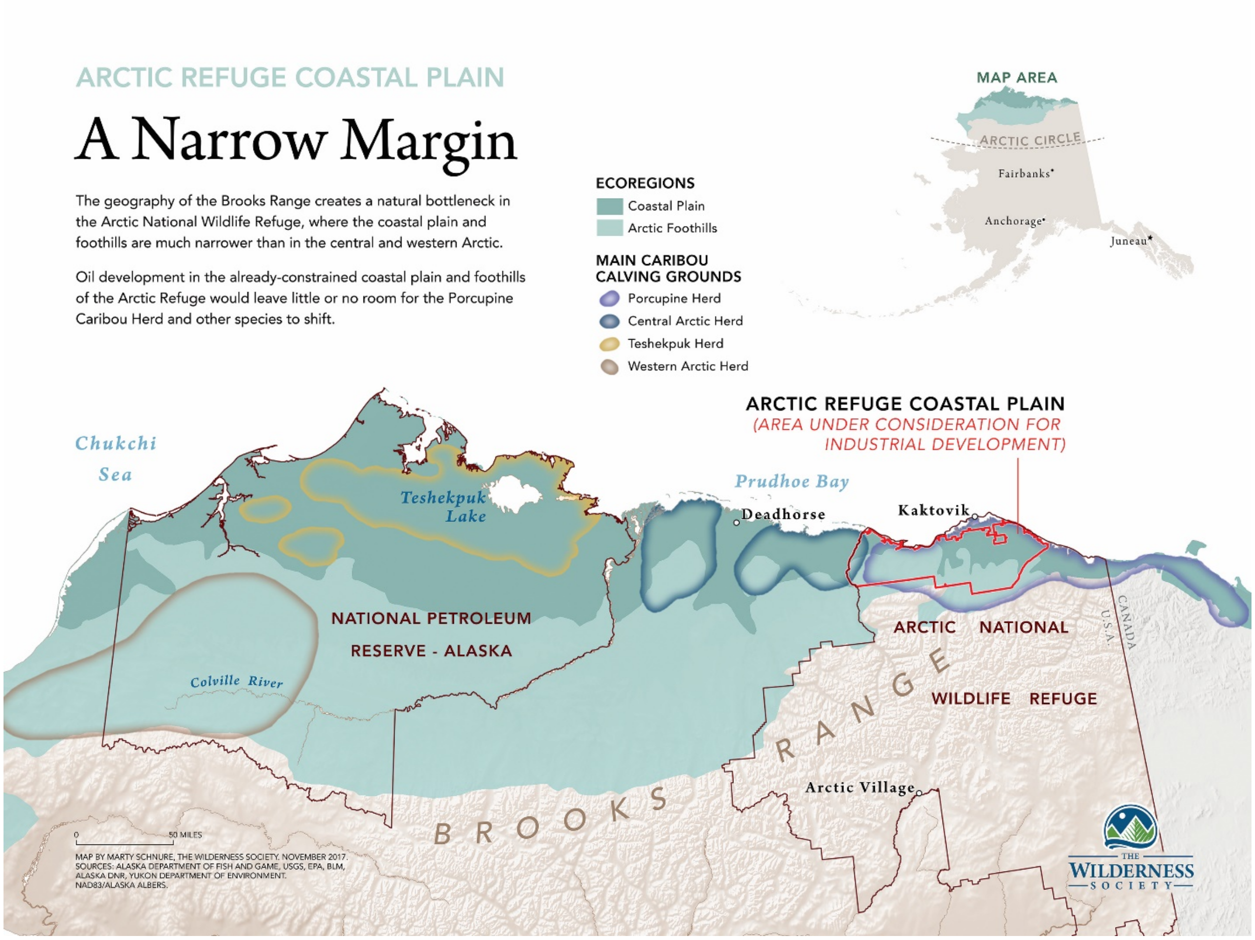
As outlined above, BLM must address numerous issues and conduct a robust analysis to comply with its legal duties before it can authorize any oil and gas activities on the Coastal Plain. We believe that any valid scientific review will show that oil and gas activities on the Coastal Plain will have unavoidable and un-mitigatable destructive impacts on Arctic Refuge wildlife and habitat.

Appendices:
Appendix 1-A Narrow Margin map
Appendix 2-Vulnerable Species charts 1a & 1b
Appendix 3-References Cited for Caribou Section
Appendix 4-References Cited for Soundscapes and Acoustics Section
Appendix 5-References Cited for Hydrology and Fish Sections
Appendix 6-Relevant Blowout and Spill Data

Attachments:
Defenders of Wildlife, No Refuge from Warming
Defenders of Wildlife, No Refuge from Warming Supplementary Materials
The Wilderness Society, Arctic National Wildlife Refuge: Economics of Potential Oil Development
National Wildlife Refuge Association Ltr. re: Timeline for Arctic Refuge Leasing EIS

[783] *See also supra* Part V.F., VI.C.1.

Appendix 1


ARCTIC REFUGE COASTAL PLAIN
A Narrow Margin
The geography of the Brooks Range creates a natural bottleneck in the Arctic National Wildlife Refuge, where the coastal plain and foothills are much narrower than in the central and western Arctic.
Oil development in the already-constrained coastal plain and foothills of the Arctic Refuge would leave little or no room for the Porcupine Caribou Herd and other species to shift.
ECOREGIONS
Coastal Plain
Arctic Foothills
MAIN CARIBOU CALVING GROUNDS
Porcupine Herd
Central Arctic Herd
Teshekpuk Herd
Western Arctic Herd
MAP AREA
ARCTIC CIRCLE
Fairbanks
Anchorage
Juneau
ARCTIC REFUGE COASTAL PLAIN
(AREA UNDER CONSIDERATION FOR INDUSTRIAL DEVELOPMENT)
Chukchi Sea
Teshekpuk Lake
Prudhoe Bay
Deadhorse
Kaktovik
NATIONAL PETROLEUM RESERVE - ALASKA
ARCTIC NATIONAL WILDLIFE REFUGE
Colville River
BROOKS RANGE
Arctic Village
CANADA
U.S.A.
0
50 MILES
MAP BY MARTY SCHNURE, THE WILDERNESS SOCIETY, NOVEMBER 2017.
SOURCES: ALASKA DEPARTMENT OF FISH AND GAME, USGS, EPA, BLM, ALASKA DNR, YUKON DEPARTMENT OF ENVIRONMENT.
NAD83/ALASKA ALBERS.
THE WILDERNESS SOCIETY

Appendix 2

EXTREMELY VULNERABLE SPECIES

● (red) Greatly increases vulnerability
● (orange) Increases vulnerability
● (yellow) Somewhat increases vulnerability

CONTRIBUTING FACTORS

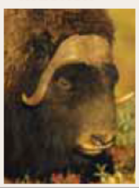
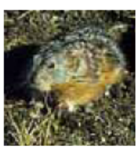
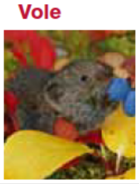
Species	Description	Sea level rise	Natural barriers to range shift	Sensitivity to rising temperature	Sensitivity to moisture change	Sensitivity to changes in fires and floods	Dependence on ice and snow	Habitat versatility	Dietary versatility	Genetic factors
Polar Bear 	Adapted to life on Arctic sea ice and classified as marine mammal. Hunts preferred prey, seals, from ice. Dens and gives birth along coast of refuge, where sea-ice loss is already accelerating. Population predicted to decline by two-thirds over next 50 years as sea ice continues to disappear.	Red	Red	Red			Red		Yellow	Yellow
Arctic Fox 	Turns white in winter. Acute hearing helps locate small rodents under snow. Habitat in refuge confined to narrow strip of tundra bordered by the ocean. Faces competition from larger red fox as boreal forest expands northward with climate change.	Orange	Orange	Red			Red		Yellow	Yellow
Muskox 	Grazes on tundra vegetation that freezing rains can encase in ice. Also vulnerable to parasites that thrive in warmer temperatures. With fewer than 300 in refuge, lacks genetic variation that facilitates adaptability.	Yellow	Red	Red	Orange	Orange			Yellow	Orange
Collared Lemming 	Feeds on plants and twigs in upland areas of tundra. Only rodent that turns white in winter. Depends on snow cover for insulation and to avoid predators. Ocean limits ability to shift northward.		Orange	Red			Orange			
Brown Lemming 	Found in moister areas of tundra, not as far north as collared lemming. Relies on snow cover for winter insulation and predator avoidance. Habitat sensitive to drying out as snowpack and other variables change.		Orange	Red	Yellow		Yellow	Yellow		
Tundra Vole 	Lives in dense vegetation at edges of streams and marshes. Eats grasses and sedges in summer and stores roots and seeds for later. Lower survival documented in warmer winters due to freeze-thaw cycle icing over feeding areas. Encroachment of forest on tundra also a threat.		Yellow	Red	Yellow	Yellow	Yellow			

Table 1a. Arctic National Wildlife Refuge mammal species that are “Extremely Vulnerable” to climate change

HIGHLY VULNERABLE SPECIES

● Greatly increases vulnerability
● Increases vulnerability
● Somewhat increases vulnerability

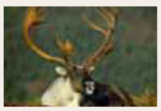
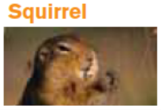
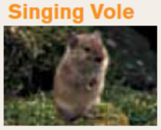
Species	Description	Sea level rise	Natural barriers to range shift	Sensitivity to rising temperature	Sensitivity to moisture change	Sensitivity to changes in fires and floods	Dependence on ice and snow	Habitat versatility	Dietary versatility	Genetic factors
Lynx 	Solitary boreal forest cat. Snowshoe hares preferred prey, but also hunts rodents, aided by big feet and light build that offer advantage over other predators in snow. Changes in snowpack bring coyotes and other competitors to lynx habitat.		Somewhat			Increases	Greatly	Somewhat		
Wolverine 	Largest terrestrial member of weasel family. Hunts small mammals and scavenges carrion in forested mountains. Young born in den dug by female in snow for insulation and protection. Requires persistent spring snow for denning and cannot tolerate hot summers.		Increases	Greatly			Greatly			Somewhat
Caribou 	Migratory grazer already declining due to ice storms glazing over tundra vegetation; more frequent fires that kill lichens it eats; peaking of best spring forage before herd arrives in refuge to breed; and increase in mosquitoes significant enough to interfere with feeding.		Increases	Greatly	Increases	Increases			Somewhat	
Dall Sheep 	High mountain slopes of Brooks Range in refuge northernmost extent of population. Forages in alpine meadows and avoids deep snow. Vulnerable due to narrow habitat requirements and potential increase in parasites.		Greatly	Greatly	Increases					Somewhat
Alaska Marmot 	Larger rodent found only on slopes of Brooks Range. Spends most of year in hibernation, emerging in late spring to feed on vegetation until first snow sends back underground. Small window for feeding and breeding and dependence on sensitive alpine tundra pose risk.		Somewhat	Greatly		Increases	Somewhat			
Arctic Ground Squirrel 	Lives on upland ridges and tundra. Needs well-drained soils for burrowing. In hibernation has lowest body temperature of any mammal. Sensitive to changes in temperature, moisture and snow cover and limited by narrow habitat range.		Somewhat	Greatly	Somewhat		Somewhat			
Singing Vole 	Named for characteristic vocalization. Active year-round in moist areas of tundra. Feeds on plants it gathers and dries on rocks. Threats include encroachment of shrubs on tundra, increased flooding, and icing of food stores.		Somewhat	Increases	Somewhat		Somewhat			
Northern Bog Lemming 	Lives near bogs and in damp meadows. Eats mostly grasses and sedges. Nests in underground burrows or under logs, hummocks or snow. Already rare, specific habitat requirements and reliance on snow cover for insulation leave highly susceptible to climate change.		Somewhat	Increases	Increases		Somewhat	Somewhat		
Tundra Shrew 	Tiny insect-eater found in shrubby areas, especially on hillsides. Consumes up to three times weight in food per day. Vulnerable due to narrow range of potential habitats and limited dispersal ability.		Somewhat	Greatly			Somewhat			
Barren Ground Shrew 	Wet area counterpart to tundra shrew. Poorly studied insectivore, but likely vulnerable due to narrow habitat range on coastal plain of refuge.		Somewhat	Greatly			Somewhat			

Table 1b. Arctic National Wildlife Refuge mammal species that are "Highly Vulnerable" to climate change.

Appendix 3—References Cited for Impacts to Caribou Section

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Appendix 6—Relevant Blowout and Spill Data

In 2016, British Petroleum (BP) had a production well blowout near its Prudhoe Bay infrastructure on the North Slope. This unexpected event could have been much more serious had the gas ignited. International well kill specialists Boots & Coots came to Alaska to shut down this well. Later in 2016, the Alaska Oil and Gas Conservation Commission (which oversees all oil and gas wells in the state) ordered a review of every North Slope well to determine if they have similar designs with the potential for dangerous and environmentally damaging blowouts.[784] BP determined the cause of the blowout was thawed permafrost.[785]

During the winter of 2012, Repsol had an exploratory well blowout on the North Slope that spewed an estimated 42,000 gallons of drilling muds. It took a month to plug that well because frigid temperatures slowed down or prevented work during that period.

BP's March 2006 pipeline spill of over 200,000 gallons was the largest crude oil spill to occur in the North Slope oil fields. It brought national attention to the chronic nature of such spills. Another pipeline spill in August 2006 resulted in shutdown of BP production in Prudhoe Bay and brought to light major concerns about systemic neglect of key infrastructure. Lack of adequate preventive maintenance is not a new issue, however, as corrosion problems in Prudhoe Bay and other oil field pipelines have been raised previously by regulators and others, including as early as 1999 by the Alaska Department of Environmental Conservation.[786]

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[784] DEMARBAN, A., STATE REGULATORS LAUNCH WIDE REVIEW OF NORTH SLOPE OIL FIELDS FOLLOWING BP LEAK, *ALASKA DISPATCH NEWS*, RETRIEVED NOVEMBER 1, 2017 FROM HTTPS://WWW.ADN.COM/BUSINESS-ECONOMY/ENERGY/2017/10/30/STATE-REGULATORS-LAUNCH-WIDE-REVIEW-OF-NORTH-SLOPE-OIL-FIELDS-FOLLOWING-BP-LEAK/ (OCTOBER 30, 2017).

[785] BP Exploration., October 2017 Update to the DS02-)3 Accidental Oil and Gas Release.

[786] Charter for the Development of the Alaskan North Slope, December 2, 1999, (BP ARCO Merger Agreement), http://www.dec.state.ak.us/spar/ipp/docs/Charter%20Agreement.pdf.

The State of Alaska completed a report in November 2010[787] which reviewed over 6,000 North Slope spills from 1995-2009. This report showed that there were 44 loss-of-integrity spills each year[788] with 4.8 of those each year on average greater than 1,000 gallons,[789] meaning that there is a spill of 1,000 gallons or more nearly every two months.

In 2009, The Wilderness Society issued a report on North Slope spills entitled *Broken Promises*[790] which should be used in conjunction with the state's North Slope spill report. This Wilderness Society report shows a spill frequency on the North Slope of 450 spills each year from 1996-2008, with the difference being that the state included only "production-related" spills in its analysis and excluded North Slope toxic chemical (e.g., antifreeze) and refined product (e.g., diesel) spills - many of which are related to oil development - as well as spills indirectly related to oil production infrastructure, such as those from drilling or workover operations and from vehicles.

Looking at the raw data reported to the Alaska Department of Environmental Conservation,[791] there were 121 reported crude oil spills on the North Slope during the five years from October 30, 2012 until October 30, 2017, or approximately two crude oil spills per month. Additionally, there have been 1,647 reported spills of all types on the North Slope during this period, which is nearly one spill per day.

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787 Nuka Research & Planning Group, LLC, North Slope Spills Analysis: Final Report on North Slope Spills Analysis and Expert Panel Recommendations on Mitigation Measures, for the Alaska Department of Environmental Conservation, 244 pp., retrieved November 1, 2017 from http://dec.alaska.gov/spar/PPR/ara/documents/101123NSSAReportvSCREENwMAPS.pdf (November 2010).

788 *Id.* at 21.

789 *Id.* at 23.

790 The Wilderness Society, Broken Promises: The Reality of Oil Development in America's Arctic (2nd Edition) (2009).

791 See the Alaska Department of Environmental Conservation Spills Database Search website: http://dec.alaska.gov/Applications/SPAR/PublicMVC/PERP/SpillSearch.

NO REFUGE FROM WARMING

Climate Change Vulnerability of the Mammals of the arctic national wildlife refuge

By Aimee Delach & Noah Matson

Save something wild.

Table of Contents

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DEFENDERS OF WILDLIFE

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Defenders of Wildlife is a national, nonprofit membership organizations dedicated to the protection of all native wild animals and plants in their natural communities.

INTRODUCTION: MAMMALS OF THE ARCTIC NATIONAL WILDLIFE REFUGE

THE ARCTIC NATIONAL WILDLIFE REFUGE, ENCOMPASSING 19 MILLION ACRES OF FORESTS, MOUNTAINS, TUNDRA, RIVERS AND COASTLINES OF NORTHERN ALASKA, IS THE CROWN JEWEL OF OUR NATIONAL WILDLIFE REFUGE SYSTEM. THE REFUGE VIES WITH YELLOWSTONE NATIONAL PARK FOR THE TITLE OF "AMERICA'S SERENGETI" ON ACCOUNT OF THE STUNNING ARRAY OF ANIMALS THAT MAKE A LIFE IN THIS HARSH AND BEAUTIFUL LAND. AMONG ITS 38 SPECIES OF TERRESTRIAL MAMMALS, THE REFUGE IS HOME TO ONE OF THE LARGEST CARNIVORES ON EARTH, THE POLAR BEAR (WHICH CAN REACH 1600 POUNDS), AS WELL AS THE SMALLEST MAMMAL IN NORTH AMERICA, THE PYGMY SHREW, WHICH BARELY OUTWEIGHS A PENNY. AND THESE ANIMALS' ADAPTATIONS TO LIFE AT HIGH LATITUDE ARE AS VARIED AS THEIR BODY SIZE: SOME ANIMALS SPEND THE WINTERS HIBERNATING, LIKE THE ARCTIC GROUND SQUIRREL, WHICH IS CAPABLE OF "SUPERCOOLING" ITS BODY TO 27°F, THE LOWEST TEMPERATURE OF ANY MAMMAL. OTHERS STAY ACTIVE ALL WINTER, INCLUDING THE CARIBOU, WHOSE CONTINUAL SEARCH FOR FEEDING AND CALVING GROUNDS TAKE IT ON A 2,500-MILE ODYSSEY EVERY YEAR, THE LONGEST MIGRATION OF ANY LAND ANIMAL.

Despite their variety, the mammals of the Arctic Refuge all have a few things in common. They are all adapted to life in one of the coldest places in North America, and they are all already experiencing the effects of climate changes that will inevitably accelerate in coming decades. According to the U.S. Global Change Research Program, much of Alaska has warmed over 4°F over the past 50 years, and the northern part of the state where the Refuge is located is projected to warm faster than any part of the continent (USGCRP 2009). The area is experiencing more freezing rain events that encase vital food plants in a tough coating of ice. Coastal erosion is on the rise as protective sea ice retreats from the coast earlier, laying the region bare to damaging storm surges. And this is just the beginning. Climate models project that the average annual temperature will increase by 3.5 to more than 7 degrees Fahrenheit by mid-century (USGCRP 2009).

What will these changes mean for the animals of the Arctic National Wildlife Refuge, some of which are highly specialized to the current climate conditions? Will they all be equally imperiled by the changes ahead? If not, then which of the 38 mammal species in the Arctic Refuge are likely to be most susceptible to climate change, and which are likely to be less so? A clearer understanding of which animals are most vulnerable to climate change and why will help refuge managers, scientists, and the public act to prevent the loss of these species. In this report, we present the results of a systematic comparison of climate change vulnerability for mammals in the Arctic National Wildlife Refuge over the next 50 years.

Climate Change Vulnerability

Vulnerability refers to the degree to which a species (or habitat, or community) is likely to experience harm due to exposure to perturbations or stresses. Vulnerability assessments can provide information about which species are most vulnerable to climate change, and identify the factors that make species vulnerable. This information allows wildlife managers, scientists and other conservation practitioners to design effective adaptation strategies and prioritize limited conservation resources (Williams et al. 2008; Fussel et al. 2006). Vulnerability assessments can also help to identify important gaps in knowledge and areas of uncertainty where more research is needed.

A species' vulnerability to climate change is a function of three variables: **exposure**, or the degree to which it is exposed to climate change and variability (e.g., the amount of warming temperatures), its **sensitivity** to these changes, and its **adaptive capacity** to respond to these changes, as well as the management response to help the species or system adapt. Exposure is a result of regional climate changes, but may be modified by local microhabitat conditions. A species' sensitivity will be determined by factors including its ecological, genetic and physiological traits such as dependence on sensitive habitats, dietary flexibility, population growth rates and interactions with other species. The combination of exposure and sensitivity determines the potential impact of climate change on the species, which is then modified by its ability to adapt to climate changes, and the capacity of humans to manage, adapt and minimize the impacts to it (Williams et al. 2008). Assessing adaptive capacity includes considerations such as the species' dispersal ability, lack of barriers to its movement, evolutionary potential (e.g., genetic variation and reproductive rate), and plasticity, or the ability of the species to modify its physiology or behavior to match changes in its environment. Species with a high degree of adaptive capacity to climate changes will be less impacted than those with relatively low adaptive capacity.

To conduct this vulnerability assessment, we researched the known scientific information for each species, analyzed projected future climate change for the Refuge using ClimateWizard, and inputted our data into the NatureServe Climate Change Vulnerability Index (Index), a Microsoft Excel-based tool designed to provide scores of the relative vulnerability of animal and plant species to climate change in a given assessment area (www.natureserve.org/prodServices/climatechange/ccvi.jsp and Glick et al. 2011).

Vulnerability of Arctic Refuge Mammals to Climate Change

The results of our analysis indicate that almost half of the mammals of the Arctic Refuge are highly or extremely vulnerable to the impacts of climate change over the next four decades. Table 1 summarizes the results for all 38 species, including both the score for each sensitivity factor and its overall vulnerability score. Each species is profiled, with a more detailed explanation of the sensitivity factors, in the section below.

Table 1: Summary of climate change vulnerability scores for 38 mammal species of the Arctic National Wildlife Refuge

Species	Sea Level Rise	Natural Barriers to Range Shift	Dispersal and Movement Ability	Sensitivity to Temperature Change	Sensitivity to Moisture Change	Changes in Disturbance	Dependence on Ice and Snow	Restriction to Uncommon Geologic Features	Habitat Versatility	Dietary Versatility	Genetic Factors	Phenology	Modeled/Documented Response to Climate Change	Overall Vulnerability
Polar Bear														
Arctic Fox														
Musk Ox														
Collared Lemming					*						*	*	*	
Brown Lemming														
Tundra Vole					*									
Caribou														
Wolverine											*			
Dall Sheep														
Lynx							*							*
Northern Bog Lemming														
Tundra Shrew						*								
Barren Ground Shrew							*							*
Arctic Ground Squirrel						*								*
Alaska Marmot														
Singing Vole					*	*								
Brown Bear														*
Marten														
Taiga Vole					*	*								

Table 1, continued

Species	Sea Level Rise	Natural Barriers to Range Shift	Dispersal and Movement Ability	Sensitivity to Temperature Change	Sensitivity to Moisture Change	Changes in Disturbance	Dependence on Ice and Snow	Restriction to Uncommon Geologic Features	Habitat Versatility	Dietary Versatility	Genetic Factors	Phenology	Modeled/Documented Response to Climate Change	Overall Vulnerability
Snowshoe Hare														
Moose							*							
Northern Red-backed Vole														
Meadow Vole							*							
River Otter														
Mink														
Dusky Shrew							*							
Masked Shrew			*								*			
Red Squirrel									*					
Porcupine						*								
Pygmy Shrew														
Least Weasel														
Muskrat														
Ermine						*								
Gray Wolf							*							
Coyote														
Beaver														
Black Bear														
Red Fox													*	

Key to Table 1:

Box Color	Factor Key	Species Key
(red)	This factor **greatly increases** the species' vulnerability to climate change	Extremely Vulnerable to climate change: Abundance and/or range extent within the Refuge extremely likely to substantially decrease or disappear by 2050
(orange)	This factor **increases** the species' vulnerability to climate change	Highly Vulnerable to climate change: Abundance and/or range extent within the Refuge likely to decrease significantly by 2050
(yellow)	This factor **somewhat increases** the species' vulnerability to climate change	Moderately Vulnerable to climate change: Abundance and/or range extent within the Refuge likely to decrease by 2050
(white)	This factor is **neutral**, neither increasing nor decreasing the species' vulnerability to climate change	*Not used*
(light green)	This factor **somewhat decreases** the species' vulnerability to climate change	Not vulnerable/presumed stable to climate change: Available evidence does not suggest that abundance and/or range extent within the Refuge will change substantially by 2050. Actual range boundaries may change.
(dark green)	This factor **greatly decreases** the species' vulnerability to climate change	Likely to increase population with climate change: Available evidence suggests that abundance and/or range extent within the Refuge is likely to increase by 2050
(gray)	Insufficient information for assessment	*Not used*
*	Two or more factors selected, see text for details	Confidence in score is LOW, see text

ARCTIC REFUGE MAMMAL VULNERABILITY PROFILES

Polar Bear — Extremely Vulnerable

Ursus maritimus — Certainty: Very High

Current Global Conservation Status: Vulnerable

Polar bears (*Ursus maritimus*) are among the largest carnivores in the world, and are unmistakable for their numerous adaptations to life in the polar sea and ice: dense white fur which covers even their feet, a long neck and narrow skull that aid in streamlining them in the water, and a thick layer of insulating blubber. Polar bears feed almost exclusively on ringed seals and, to a lesser extent, bearded and harp seals. They are also known to eat walrus, beluga whale and bowhead whale carcasses, birds, small mammals and sometimes vegetation and kelp especially in summer when other food is unavailable.

Polar bears are only found in the Arctic region and are highly dependent on the pack ice there, since they spend much of their time hundreds of miles from land. The most important habitats for polar bears are the edges of pack ice, where currents and wind interact with the ice, forming a continually melting and refreezing matrix of ice patches. These are the areas of greatest seal abundance and accessibility. Individual polar bears can travel thousands of miles per year following the seasonal advance and retreat of sea ice. Polar bears are distributed throughout the Arctic region in 19 subpopulations. At the most recent meeting of the IUCN Polar Bear Specialist Group, scientists reported that eight of these populations are in decline, three are stable, and one is increasing (data was insufficient to determine the status of the remaining seven).

Scientists from the U.S. Geological Survey recently modeled polar bear response to climate change in four "ecoregions" (divisions of the polar bear's current range). Three of the four ecoregions as they classified had a >75% chance of "extinction" within 100 years. Overall, their modeling suggested that if loss of Arctic sea ice proceeds at currently projected rates, it would result in the loss of about 2/3 of the world's polar bears within the next 40 years.

Ursus maritimus scores as **extremely vulnerable** to climate change in the Arctic National Wildlife Refuge. Multiple aspects of its biology increase its vulnerability, and very few have a mitigating effect.

Critical Factors Affecting Polar Bear Vulnerability to Climate Change

Natural barriers	Polar bears face larger natural barriers than most other species assessed, since melting of sea ice will result in them facing larger expanses of open ocean.
Sea level rise	More than 90% of the bear's range within the Refuge is coastal, so their terrestrial habitat, such as for denning, could be lost to rising sea levels and increased erosion.
Dispersal and movements	One factor possibly mitigating their vulnerability is the fact that the polar bear is capable of long-distance movements.
Sensitivity to temperature change	Polar bears are found exclusively in cold habitats and are dependent on Arctic ice. Their habitat is extremely sensitive to changes in air and ocean temperature.
Dependence on ice or snow	Polar bears are among the world's most ice-dependent species. In its listing decision for the polar bear, the U.S. Fish and Wildlife Service stated: "Moore and Huntington (in press) classify the polar bear as an 'ice obligate' species because of its reliance on sea ice as a platform for resting, breeding, and hunting, while Laidre et al. (in press) similarly describe the polar bear as a species that principally relies on annual sea ice over the continental shelf and areas toward the southern edge of sea ice for foraging."
Dietary versatility	Polar bears are rely on a fairly limited set of species for food; namely, ice-dependent seals, especially ringed seals (*Phoca hispida*), and bearded seals (*Erignathus barbatus)*, which may themselves face serious threats from climate change.
Genetic variability	Genetic studies indicate that variability is relatively low; in particular, inter-population genetic variation among populations of polar bears is less than that of black bears and brown bears, but that intra-population variation is similar (Paetkau et al. 1995, 1999).
Documented response to recent change	The IUCN Polar Bear Specialist Group reports that eight of the world's 19 subpopulations of polar bears are in decline (IUCN PBSG 2009), and climate change is widely regarded as an important factor in this decline.
Modeled future change in range or population size	One population model for polar bears found that if sea ice continues to be lost at the rates currently projected, that "would mean loss of ~2/3 of the world's current polar bear population by mid-century" (Amstrup et al. 2007).

Arctic Fox

Vulpes lagopus

Extremely Vulnerable

Certainty: Very High

Arctic fox (*Vulpes lagopus*), like the polar bear, is highly specialized to the most northerly regions of the world. Their thick, dense fur turns white in the winter, and they have better hearing than other foxes, which helps them find prey even under the snow. Lemmings and voles are the staple foods for arctic foxes. However, they will eat whatever is available out on the frozen tundra such as birds, marine invertebrates, fish and carcasses of sea mammals and even reindeer calves as scavenging leftover from polar bears and wolves. The arctic fox is found throughout the entire Arctic tundra, through Alaska, Canada, Greenland, Russia, Norway, Scandinavia, and even Iceland, where it is the only native land mammal.

Our analysis found the arctic fox in the Refuge to be **extremely vulnerable** to climate change, due to habitat loss, competition with red foxes and changes in prey abundance. The species' sensitivity to climate change results from its physiological thermal regime, occurrence in conditions of historically stable temperature and moisture regimes in the past, dietary versatility, dependence on ice, ice-edge, or snow habitats, and low genetic diversity. The arctic fox is severely restricted (>90% of occurrences or range) to relatively cool or cold environments that may be lost or reduced in the assessment area as a result of climate change.

Its vulnerability is in large part due to the fact that its tundra habitat is located in a narrow strip of the Refuge, with ocean directly to the North and boreal forest (uninhabitable by arctic fox) to the south. Large expenses of tundra habitat could be replaced by forest (Feng et al. 2011), which is unsuitable to the arctic fox. There is also evidence that the arctic fox may not have been able to track habitat shifts during the last interglacial as cold habitats moved northward (Dalen et al. 2007). Results from a DNA analysis suggest that the arctic fox became extinct in mid-latitude Europe at the end of the Pleistocene and did not track the habitat when it shifted north during the interglacial (Dalen et al. 2007) suggesting it may be particularly vulnerable to future increases in global temperatures.

In addition to habitat loss, boreal forest encroachment will allow for expansion of populations of the red fox. Red foxes are larger and more effective hunters than arctic foxes, and also directly kill the latter. Red fox expansion may have been responsible for the decline of the arctic fox during the last interglacial (Dalen et al. 2005).

Finally, prey for the arctic fox may decline. Three species that figure prominently in arctic fox diets, the brown and collared lemming and the tundra vole, are themselves among the most vulnerable species in the Refuge according to our analysis (see profiles for those species).

Critical Factors Affecting Arctic Fox Vulnerability to Climate Change

Factor	Arctic fox
Natural barriers	Arctic fox range in Alaska runs along the northern coast in a narrow band and the northern range of the species is essentially limited by ocean. As the climate warms the boreal forest, which is habitat for its main competitor the red fox, will encroach on the tundra where the arctic fox makes it home. The arctic fox will effectively be trapped between rapidly encroaching unsuitable forest habitat to the south and open ocean to the north.
Sea level rise	Most of the fox's range in the Refuge occurs in coastal areas subject to sea level rise. The arctic fox migrates towards the sea in fall and early winter and often lives near the shore, roaming out onto the pack ice. Sea level rise and resulting loss of coastal habitat will interact with encroaching boreal forest development in the southern portion of the range to greatly shrink the current suitable habitat for the species.
Dispersal and movements	One factor possibly mitigating vulnerability is that the arctic fox is capable of long-distance movement or migration (Anthony 1997).
Sensitivity to temperature change	The arctic fox is completely or almost completely restricted to tundra and coastal habitats in the polar region. As temperatures warm, boreal forest will encroach on this habitat, providing more of a prey base to the red fox, and exposing the arctic fox to competition with and predation from the latter, which is larger and a better hunter.
Dependence on ice or snow	The arctic fox is highly dependent on ice- or snow-associated habitats. The arctic fox migrates towards the ice edge in the winter and fall, uses snow for denning and insulation in the winter, and changes color from brown/black to white in the winter to blend in with the snow. The species will likely be highly sensitive to changes in snow cover and pack ice extent.
Dietary versatility	Arctic foxes in Alaska and Canada feed mainly on collared lemmings and their population cycles follow lemming population cycles. They have decreased reproductive output in low lemming years and undergo an enormous reproductive output during lemming peaks (Dalen et al. 2005). Based on one study, climate change will increase the length of the collared lemming life cycle and decrease its maximum population densities which will be detrimental to predator species including the arctic fox (Glig et al. 2009).
Genetic factors	One comparative genetic study found that nucleotide diversity was considerably lower than that in other mammals including wolves, coyotes and moose (Dalen et al. 2005).

Musk Ox | **Extremely Vulnerable**
Ovibos moschatus | Certainty: Very High

Musk oxen (*Ovibos moschatus*), which are more closely related to sheep and goats than to oxen, are found exclusively in Arctic areas, mostly in Canada and Greenland. Fewer than 300 musk oxen live in the Refuge. During the summer, musk oxen live in wet areas, where they graze on grasses, sedges and willows. In winter, they seek out windblown places where there is less snow to cover their forage.

Our analysis found that muskoxen ranked as **extremely vulnerable** to climate change in the Refuge, due in part to its low genetic variation and obligate association with cold climates, but also due to the possibility of changes to composition or availability of tundra vegetation. Past studies have also shown that changes in Arctic plant distributions lead to changes in muskoxen distributions (Forchhammer et al. 2005). According to one study, the historic range of musk ox, based on DNA analysis, was much larger than the current range and a warming trend over the last several thousand years is likely the result for this reduction in range (Campos et. al. 2010).

Warming winters may also be detrimental to the species if they result in more freezing rain and icing events, resulting in thicker, crustier snow that impedes grazing. Warming temperatures may also lead to higher parasite loads in muskoxen that are susceptible to lung infections from parasitic worms. These worms are now developing faster and surviving longer as the climate warms, so the muskoxen are facing higher levels of infection.

Critical Factors Affecting Musk Oxen Vulnerability to Climate Change

Natural barriers	Musk oxen are essentially at their northernmost limit in the Arctic Refuge and may be trapped from moving in response to rising temperatures by the ocean (Kerr and Packer 1998).
Sea level rise	Part of musk ox range in the Refuge exists in coastal areas, thus the species may be somewhat impacted by sea level rise along its northern edge.
Dispersal and movements	One factor possibly mitigating vulnerability is that the musk ox is capable of long-distance (>10km) movement or migration.
Sensitivity to temperature change	Musk ox range is restricted to extreme northern locations globally. There is also evidence to suggest that musk ox abundance decreased in the past due to climatic warming. Climate change has been implicated as the probable cause of decline in musk ox population numbers and restriction of the existing population to cooler habitats.
Sensitivity to moisture change	The musk ox, especially in winter, is highly dependent on shallow, windblown snow that allows the animal to forage on vegetation under the shallow snow. Climate change could melt these shallow snows from warming temperatures events, which would be beneficial to the species if cold temperatures didn't return after the initial thaw. But if freezing temperatures returned, those areas could produce a layer of ice that would prevent the musk oxen, particularly, calves, from being able to feed on the foliage.
Sensitivity to disturbance change	Warming temperatures in the Arctic have been linked to increased survival and faster development of a nematode that infects the lungs, reducing the animals' ability to run and making them more vulnerable to predation, potentially altering population structure.
Dietary versatility	Musk oxen eat a fairly narrow range of tundra vegetation species, and may therefore be sensitive to changes in tundra vegetation.
Genetic variability	Studies of both nuclear DNA and mitochondrial DNA show low levels of genetic diversity, and it has been hypothesized that the musk ox underwent a genetic bottleneck in the late Pleistocene (Campos et al. 2010).

Collared Lemming
Dicrostonyx groenlandicus

Extremely Vulnerable
Certainty: Very High

Collared lemmings (*Dicrostonyx groenlandicus*) are small rodents that live on the Arctic tundra, in Alaska, Canada, and Greenland, ranging to the northernmost reaches of the islands of the Canadian high Arctic. The lemming lives in the higher elevation areas of the tundra, feeding on a wide array of broad-leaved and grass-like plants in the summer, and the twigs of willow, aspen and birches in winter. It occupies runways beneath the snow and tunnel systems down to permafrost level. The collared lemming is the only rodent in Alaska that turns white in winter.

The collared lemming is **extremely vulnerable** to climate change in the Arctic Refuge due to climate change exposure, indirect climate factors such as natural barriers to species range shifts, and species-specific factors, including physiological thermal regime, occurrence in conditions of historically stable temperature and moisture regimes in the past, its dependence on snow cover, and its potentially low genetic variability (although there is disagreement in the peer reviewed literature about this). The lemming is restricted (>90% of occurrences or range) to tundra habitat that may be lost or reduced in the assessment area as a result of climate change. The species range is mainly limited to northern Canada and Alaska an area which has experienced only small shifts in temperature and precipitation in the past, which may predispose the lemming to higher sensitivity to future changes in these variables.

Collared lemmings may benefit from the insulating cover of snow in the winter months, use snow for tunneling, and turn white in the winter. The timing of molt is controlled by photoperiod, not the length of winter, which may make the species more vulnerable in the future as the timing of snowfall becomes more variable. Because their range in the Arctic Refuge is bordered by a large stretch of ocean, it is limited in its ability to shift northward. Kerr & Packer (1998) projected that a 3.6ºF temperature increase would shrink the collared lemming's habitat by 38% and a 7.2ºF change would cause 60% loss of habitat. Other research suggests that the population cycles for which the lemmings are famous are being "dampened" by climate change, and that the species is having fewer years where the population reaches high levels. This may be further bad news for the arctic fox and other predators that rely on lemmings (Gilg et al. 2009).

Critical Factors Affecting Collared Lemming Vulnerability to Climate Change

Factor	Notes
Natural barriers	Collared lemmings may be limited in keeping pace with habitat shifts due to climate change because of the ocean and sea ice very close to most of their range.
Dispersal and movements	Collared lemmings' vulnerability may somewhat mitigated by the fact that the species is capable of medium-distance (1 to 10 km) dispersal or movements (Brooks & Banks 1970).
Sensitivity to temperature change	Collared lemmings are found exclusively in Arctic tundra and are limited in distribution to northern Canada and Alaska. They tolerate very low temperatures, their fur turns white in winter, and they are active under and on the snow and ice (Hart 1962, Ferguson and Folk 1970).
Sensitivity to moisture change	(*)Collared lemmings prefer dryer ground in summer. If flooding or precipitation events increase this could be negative for the species, while drying may have an overall positive affect. However, the magnitude and direction of moisture change over the next 50 years is unclear. While the projections used in the index indicate little change in moisture in 50 years, other studies and projections in the region suggest that drying is likely to occur.
Dependence on ice or snow	The species may be dependent on snow in the winter for insulation of its tunnels and also some degree of protection from predators. The species turns white in winter, so snow provides camouflage. Results from a modeling study (Gilg et al. 2009) also suggest that a decrease in snow cover may lead to longer population cycles and decreased densities: increasing the length of the snow-free period increases the length of the population cycle and reduces peak density.
Genetic variability	(*)We found conflicting evidence regarding the level genetic variability in the species (Ehrich & Jorde 2005, Boonstra 1997, Prost et al. 2010), so this factor was weighted as neutral but with the caveat that it was difficult to score.
Phenology	Molt timing is controlled by photoperiod (Gower et al. 1992), and for this reason there is the potential for a phenologic mismatch to occur with the species turning white without snow cover. This would likely make the species highly visible and therefore vulnerable to predation. However, we did not find documentation of observed discontinuities have arisen to date between molt timing and snow cover.
Modeled future change in range or population size	The index only accepts population modeling information within the Arctic Refuge, and we did not find any studies that qualified. However, population models in other regions do project lemming declines (Kausrud et al. 2008, Gilg et al. 2009).

Brown Lemming | Extremely Vulnerable

Lemmus trimucronatus | Certainty: Very High

Brown lemmings (*Lemmus trimucronatus*) are another small tundra rodent, but they are not found as far north as the collared lemming and do not turn white in winter. Brown lemmings live in moister areas of the tundra than collared lemmings. They use well-drained tundra uplands in the spring, when the lowest areas are flooded with snowmelt, but move downslope as the wet meadows dry out over the course of the summer (Batzli et al. 1980). They mainly eat grasses and sedges, with mosses also forming an important part of the diet in summer and twigs of willow and birch in winter. Active all year, they make their nests underground in the summer, and above ground under insulating snow cover in winter.

Brown lemmings score as **extremely vulnerable** to climate change in the Arctic Refuge. The species' sensitivity to climate change results from its physiological thermal and hydrological regime, occurrence in conditions of historically stable temperature and moisture regimes, dependence on ice, ice-edge, or snow habitats, and reliance on one or a few species for its habitat. The lemming is highly dependent (>90% of occurrences or range) to relatively cool or cold environments that may be lost or reduced in the assessment area as a result of climate change (tundra and taiga). The species is found in northern Canada and Alaska, though not as far north the collared lemming, which reaches the High Arctic islands. Brown lemming habitat has experienced only small variations in temperature and precipitation in the past, which may predispose it to higher sensitivity to future changes in these variables. Brown lemmings may benefit from the insulating cover of snow in the winter months, as well as from decreased predation risk resulting from snow cover. Finally, the species is most often found in sphagnum bogs and sedge habitats, suggesting it may be dependent on one or a several species for habitat generation and these species (in this case sphagnum moss in particular) may be vulnerable to changes in climate.

Critical Factors Affecting Brown Lemming Vulnerability to Climate Change

Natural barriers	Brown lemmings may be limited from keeping pace with habitat shifts due to climate change because of the ocean and sea ice.
Sensitivity to temperature change	The brown lemming is almost completely restricted to relatively cool or cold environments that may be lost or reduced in the assessment area as a result of climate change.
Sensitivity to moisture change	While brown lemmings preferentially utilize moist areas, they are not completely dependent on them. Furthermore, it is unclear from the climate data if there is going to be a loss of moisture in the next 50 years across the Arctic Refuge assessment area.
Dependence on ice or snow	The brown lemming may be somewhat dependent on snow in the winter for insulation of its tunnels and also for protection from predators
Habitat versatility	The brown lemming appears to use a limited number of species, particularly sphagnum moss and sedge, for much of its habitat.

Tundra Vole

Microtus oeconomus

Extremely Vulnerable

Certainty: Very High

Another small rodent confined to the northernmost reaches of North America, Europe and Asia, the tundra vole (*Microtus oeconomus*) typically inhabits damp, densely-vegetated areas along the edges of lakes, streams and marshes. It may be found in tundra, taiga, forest-steppe, and even semi-desert. Wet meadows, bogs, fens, riverbanks and flooded shores are all important habitats. It eats mainly green grasses and sedges in summer and stores rhizomes (especially knotweed and licorice root) and grass seeds for later use. Nests are in shallow burrows or under debris.

The tundra vole is **extremely vulnerable** to climate change in the Arctic Refuge. The species is limited in distribution mainly to moist tundra, which may shrink in extent over the next century. The species may also suffer from increasing fire or flooding disturbances and changes in hydrology or temperature. It is less clear how moisture conditions will change across the area assessed however. The species may also be squeezed out of its habitat as shrubs and trees encroach along the southern areas of the Refuge and the Beaufort Sea and coastal ice areas prevent northward expansion of the tundra.

The tundra vole's high vulnerability to climate change is due in part to the fact that winter survivorship is inversely correlated with temperature. One study tracking vole survival through a series of winters found that the survival rate was highest during the coldest winter, which had only 1 day above freezing, and plummeted in the warmest winter, which had 20 days above freezing (Aars and Ims 2002). Survival is lowest during warmer winters, specifically those with a higher proportion of days above freezing, because that sets up a freeze/thaw cycle that covers vole habitat with ice. The authors noted, "In particular, mild weather that led to the formation of ice on the ground seemed to be detrimental for winter survival. We predict that if increased frequency of such events arose, due to climate change, normal cyclic dynamics of northern small rodent populations would be disrupted." Tundra habitat is also likely to see increasing forest encroachment as temperatures rise which would be detrimental to the species. Temperature increases could lead to encroachment by shrubs, displacing sedges and other plants used as food.

Critical Factors Affecting Tundra Vole Vulnerability to Climate Change

Natural barriers	The Beaufort Sea and ice to the north may form a significant natural barrier to species movement; however, since the vole's range extends through most of Alaska, this factor adds less to vulnerability as for species (like the arctic fox) whose range is entirely near the coast.
Sensitivity to temperature change	Tundra voles have lower rates of survival in warmer winters, due to the increased likelihood of freezing rain events (Aars and Ims 2002). Tundra habitat is also likely to experience increasing shrub and forest encroachment as temperatures rise which would be detrimental to the species, as these would displace sedges and other plants used as food.
Sensitivity to moisture change	(*)The species is particularly associated with wet tundra, due to their dependence on grasses and sedges for food. Roughly 70-80% of summer diet is sedges, and tundra vole density is highest in low, wet habitats dominated by these types of plants (Batzli and Henttonen 1990). The moisture balance the species prefers could shift under climate change, though it is not clear this will happen in the next 50 years under the climate projections; hence the species scored both under "somewhat increase" and "neutral" for this factor.
Sensitivity to disturbance change	Due to its small size and limited ability to move quickly in the event of disturbances like fire, the vole is somewhat sensitive to changes in disturbance regime from climate change.
Dependence on ice or snow	While not strictly a snow-dependent species, tundra voles' winter survival is enhanced by insulating snow cover (Aars & Ims 2002).

Caribou
Rangifer tarandus

Highly Vulnerable
Certainty: Very High

Caribou (*Rangifer tarandus)* are one of the most iconic species of the Arctic National Wildlife Refuge, and, like the polar bear, are already considered a sentinel of climate change. Circumpolar in distribution (referred to as "reindeer" in Europe), caribou live in scattered populations, or herds. The Refuge's Porcupine holds the world record for longest overland migration, averaging 2,700 miles (Berger 2004). The Porcupine herd arrives on the tundra in early summer to give birth to their calves and feed on the new growth of nutritious sedges. As summer progresses, they switch their diet to low-growing tundra shrubs, including dwarf birch, bog blueberry, arctic heather and arctic willow. In autumn, they move south into the boreal forest, where they feed on lichens throughout the fall and winter.

Caribou are **highly vulnerable** to climate change in the Arctic Refuge. The species is sensitive to climate change due to the following factors: Historical thermal and precipitation niche, its physiological thermal and hydrological niche, its reliance on a specific disturbance regime, its phenological response to climate change and documented results showing declines in abundance across its range. The species may also be restricted from moving in response to climate changes by the ocean and Arctic sea ice to the north and loss of tundra vegetation to the south.

Worldwide, caribou populations have declined 57 percent in recent decades, including in the Arctic Refuge. Climate changes in the Arctic are among the most important drivers of this decline: 1) increased frequency of ice storms are covering their winter food sources in a coating of ice that is difficult to paw through; 2) increases in fire frequency kill off the slow-growing lichens they prefer to eat; 3) changes in spring timing mean the best forage now peaks before the caribou herd arrive at their calving ground; and 4) warmer summer temperatures mean an increase in mosquitoes, which can get so bad that the caribou spend more time shaking off mosquitoes than they do eating.

Critical Factors Affecting Caribou Vulnerability to Climate Change

Natural barriers	The ocean and sea ice may represent barriers to caribou along its northern range in the Arctic Refuge, while encroachment of boreal forest could limit habitat for the species in the southern portion of the Refuge.
Dispersal and movements	The Porcupine Caribou herd undertakes the longest overland migration of any terrestrial mammal, averaging over 2,700 miles per year (Berger 2004). Their excellent dispersal ability may help to mitigate their vulnerability.
Sensitivity to temperature change	Caribou are restricted to tundra and boreal forest and adapted to cold temperatures. A notable example of the direct effect of warming temperatures is an increase in the level of insect harassment faced by caribou during the summer grazing season. Cold temperatures have historically limited the abundance and timing of emergence of mosquitoes and other insects. An increase in these pests in response to temperature increases has already had demonstrable negative effects on caribou (Vors and Boyce 2009).
Sensitivity to moisture change	Caribou may be particularly sensitive to changes in winter precipitation from dry snow to freezing rain and ice. One already documented impact of observed climate change on caribou is the increase in winter ice storms that form hard crust over lichens. Pawing through this crust substantially increases foraging effort (Vors & Boyce 2009).
Sensitivity to disturbance change	Because of the slow growth of lichen, caribou avoid boreal forests that have burned within the past 50 to 60 years. An increase in the frequency, severity or extent of fires, particularly if they create an overall shift to younger forests, would negatively impact winter habitat availability and quality (Rupp et al. 2006). Projections suggest that fires are likely to increase in Alaska under climate change.
Dietary versatility	The caribou diet is limited to certain species at various times of the year: fruticose and foliose lichens dominating in winter, sedges in early summer, and shrubs in later summer (Thomas & Hervieux 2010, White & Trudell 1980).
Phenology	Phenologic mismatches have been detected for caribou in Greenland, where spring plants are achieving maximum nutritional value earlier, but the timing of caribou arrival and birth of calves has not changed (Vors and Boyce 200, Post & Forchhammer, 2008).
Documented response to recent change	"Thirty-four of the 43 major herds that scientists have studied worldwide in the last decade are in decline, with caribou numbers plunging 57 percent from their historical peaks" (Struzik 2010). Climate change has been implicated as one major factor (along with mining, drilling and other disturbances) in the decline.

Wolverine
Gulo gulo

Highly Vulnerable
Certainty: Very High

The wolverine (*Gulo gulo*) is the largest terrestrial member of the mustelid family, and ranges mainly in mountain forests, where it hunts and feeds on carrion. Individuals have been known to disperse up to 500 miles.

The wolverine is **highly vulnerable** in the Arctic Refuge, due to a combination of climate change exposure, natural barriers to species range shifts, and species-specific factors including dependence on snow covered habitats. The species will not face significant anthropogenic barriers in its range around the Arctic Refuge, should it need to shift in response to climate change. However its northward expansion is limited by ocean directly to the North of the Refuge which will likely increase the vulnerability of the species in this area. Other portions of the species range that can move directly northward will likely be less vulnerable.

The species' sensitivity results from its physiological thermal regime, occurrence in conditions of more stable temperature and moisture regimes in the past across this range, dependence on snow, and low to average genetic variation. The wolverine is completely or almost completely restricted (>90% of occurrences or range) to relatively cool or cold environments that may be lost or reduced in the assessment area as a result of climate change. This is documented in literature results that suggest that the wolverine is limited in its range by summer temperatures. Whether this limitation is due to temperature itself of is a result of elevation, prey base, of other factors is not clear. Wolverines require persistent spring snowpack for denning and studies suggest that the distribution of spring-snow covered areas can be used to predict year round habitat use, dispersal pathways and historical and current distributions (reviewed in McKelvey et al. 2010). These factors significantly increase the wolverine's vulnerability to changes in climate and resulting changes in snow cover.

Finally, there have been several studies on the impacts of climate change on current and future distributions of wolverines. A study from 2010 (Brodie and Post 2010) examined snow cover in 6 Canadian Provinces and also looked at wolverine harvest numbers and found correlating declines over the period from 1970 to 2004. Declines ranged from about 50 to 70% -- though questions have been raised about whether harvest data is a good proxy for abundance (De Vink et al. 2011).

Critical Factors Affecting Wolverine Vulnerability to Climate Change

Natural barriers	If wolverines need to move to locations to the north to keep pace with warming temperatures populations in the Arctic Refuge, they will face a natural barrier in the form of the ocean to the north. Other locations in the range of the species will have unrestricted access further north, and Alaskan populations may be able to shift east and then north in response to changing temperatures.
Dispersal and movements	Wolverines are known for their large home ranges and excellent dispersal capabilities (Inman et al. 2004), and in one individual is known to have traveled from Grand Teton National Park to Rocky Mountain National Park.
Sensitivity to temperature change	The wolverine is completely or almost completely restricted to relatively cool or cold environments that may be lost or reduced in the assessment area as a result of climate change. This is documented in literature results that suggest that the wolverine is limited in its range by summer temperatures. Whether this limitation is due to temperature itself of is a result of elevation of other factors is not clear.
Dependence on ice or snow	Wolverines depend on persistent spring snow cover for denning. A study of den locations in North America and Scandinavia found that 98% were in locations that were covered with snow until mid-May, and 90% of spring locations of wolverines were in snow-covered areas (Copeland et al. 2010, McKelvey et al. 2010).
Genetic factors	(*) Habitat fragmentation at the southern end of the wolverine's range has decreased genetic diversity there (Kyle and Strobeck 2001), which would warrant a "somewhat increase" scoring, but this appears to be less problematic in the area of the Refuge.
Documented response to recent change	One study in six Canadian Provinces compared snow cover and wolverine harvest numbers and found correlating declines over the period from 1970 to 2004. Declines ranged from about 50 to 70% (Brodie and Post 2010). However, by way of caveat, *harvest* may not necessarily be a good proxy for abundance, (DeVink et al. 2011).

Dall Sheep
Ovis dalli

Highly Vulnerable
Certainty: Very High

Dall sheep (*Ovis dalli)* live in the high mountains of the Brooks Range. In summer, they graze in alpine meadows on grasses, sedges, forbs and shrubs, and they winter on alpine ridges where strong winds keep the ground clear of snow. Nearly half of their winter foraging is in areas with no snow, and they spend very little time in places where the snow is more than a few inches deep. Dall sheep is **highly vulnerable** to climate change in the Arctic Refuge. The species is sensitive to climate change due to the following factors: Historical thermal and precipitation niche, physiological thermal and hydrological niche, and low genetic variation. For instance, an increase in temperature could increase the parasite load on Dall sheep, as these conditions lengthen the growing season and enhance winter survivorship of parasites. Climate-mediated range expansion of a parasitic muscleworm to Brooks Range Dall sheep populations has been predicted (Jenkins et al. 2005). Warming temperatures are also altering patterns of precipitation, and given the sheep's strong avoidance of deep snow, any changes that bring deeper or icier snows to its winter range could impede foraging.

Natural barriers to species movement will also be important for *Ovis dalli.* Because the species is restricted to the rain/snow-shadowed sides of mountain ranges and because the species uses these areas to escape from predators, the species faces natural barriers in the form of intervening valleys. Moving through this unsuitable habitat in response to climate change could pose a significant risk both in terms of snow-cover and predator avoidance. Additionally, the ocean provides a barrier to further northward migration.

The USGS is currently studying the effects of climate change on Dall sheep habitat and populations in Alaska; results should be available in coming years to inform future management of this species (Pfiefer et al. 2010).

Critical Factors Affecting Dall Sheep Vulnerability to Climate Change

Natural barriers	Dall sheep is limited to mountainous environments. Females with lambs rely on steep slopes utilize steep mountain slopes for protection from predators. Summer foraging occurs in high alpine meadows, and winter foraging on wind-swept ridges. Areas of lower elevation may represent barriers to species movement.
Dispersal and movements	One factor possibly mitigating vulnerability is the fact that the species is characterized by excellent dispersal and movement abilities, with migration distances averaging 5 to 30 miles (Bowyer & Leslie 1992).
Sensitivity to temperature change	Dall sheep is restricted to cool and cold environments, namely, mountain ranges in Alaska, Northwest Territories Another important factor for this species is the potential for warming temperatures to enhance survivorship and expand the range of parasites, including a muscleworm that could lead to disease outbreaks (Jenkins et al. 2005).
Sensitivity to moisture change	Dall sheep may be particularly sensitive to changes in winter precipitation from dry snow to ice or heavy wet snow. Winter foraging occurs almost exclusively in areas of little or no winter snow, so precipitation patterns that bring deeper snow or thick icy ground cover could be detrimental to the species. Biologists with the Alaska Fish and are studying the impact of icing on Dall sheep mortality elsewhere in the state, but it could be a vulnerability factor in the Arctic Refuge as well.
Genetic variability	Reported genetic variation in Dall sheep is "low" compared to related taxa (Sage and Wolff 1986).

Lynx
Lynx canadensis

Highly Vulnerable
Certainty: Low

The Canada lynx (*Lynx canadensis*) is a highly specialized cat of the boreal forest, adapted to travel and hunt in areas of deep snow that deter their competitors, particularly coyotes and mountain lions. Lynx are known for the close coupling of their populations to those of the snowshoe hare, their most important prey item. They need a mix of young and old forests in close proximity to each other. Young forests with lots of underbrush are where snowshoe hares live, but lynx need older forests with a lot of downed trees to den in.

Due to these sensitivities, scientists and conservationists have already raised concern regarding the possible effects of climate change on the species, particularly at the southern edge of its range. For instance a Spatially Explicit Population Model was conducted for eastern Canada out to 2055. It predicted lynx decline of 59% because of climate change, 36% because of trapping, and 20% in scenarios evaluating the effects of population cycles (Carroll 2007). While results of this particular model are not translatable to future conditions and lynx vulnerability in the Arctic Refuge, our own exercise found similar results. Lynx scores as **highly vulnerable** to climate change in the Arctic Refuge.

The species' sensitivity to climate change results from its occurrence in conditions of historically stable temperature and moisture regimes in the past, sensitivity to changes in disturbance regime, dependence on snow, and limited dietary diversity. Because the lynx needs a matrix of older growth and younger growth forests, changes in disturbance frequency that would reduce the availability of this matrix, particularly an alteration in fire regime, will be problematic. A reduction in the depth or increase in the density of snow will allow predators with higher foot load, like coyotes, to access areas where the lynx currently holds a competitive advantage due to its small weight to foot area ratio (Krohn et al. 1995; Mowat et al. 2000). Finally, snowshoe hare can account for over 90% of the lynx diet during winter, making the species more sensitive to climate changes that affect their prey base than more flexible carnivores.
However, because of uncertainties in the effect of changes to snow cover and forest response, the model simulations in our analysis split between "highly" and "moderately" vulnerable, resulting in "low" confidence for the lynx's vulnerability score.

Critical Factors Affecting Lynx Vulnerability to Climate Change

Natural barriers	The species is unlikely to need to shift further north in its range in Alaska in the next 50 years; however, if it does, significant natural barriers in the form of the ocean exist near the current northern range of the species in the Arctic Refuge.
Dispersal and movements	Excellent dispersal ability may help mitigate the lynx's vulnerability. Average dispersal distance for young animals is nearly 10 miles, and individual animals have been known to travel hundreds of miles (Schwartz et al. 2002).
Sensitivity to temperature change	While the lynx is primarily found in cold areas and is likely to be vulnerable at the southern end of its range, the climate changes in the Arctic Refuge are not likely to exceed the physiological tolerances for this species or to pose problems like expansion of parasite load.
Sensitivity to disturbance change	The lynx depends on a matrix of older growth and younger growth forests, so changes in disturbance frequency that reduce the availability of this matrix will be problematic. Changes in disturbance regime in the form of increased fire activity through the end of this century are very likely in response to projected temperature increased and lower available moisture. Increase in fire activity is projected to be greatest in the next 20-30 years (Rupp 2008). It is likely that large regions of mature spruce will be replaced by a more patchy distribution of deciduous forest and younger stages of spruce without the older growth; the loss of older growth trees could be detrimental to the lynx.
Dependence on ice or snow	(*)In Maine and Quebec, lynx populations are unlikely to occur in areas with less than 106 inches of snow per year. Lynx have large feet and relatively light body mass, allowing them to be more effective predators in deep, fluffy snow, compared to larger coyotes and mountain lions (Krohn et al. 1995; Mowat et al. 2000). Reduced snowfall or wetter, denser snow, could erase the lynx's competitive advantage against other predators.
Habitat versatility	Lynx have a fairly specific set of habitat needs, and are found preferentially in spruce-fir forests (RMRS, undated).
Dietary versatility	Lynx depend almost exclusively (up to 96%) on snowshoe hares as prey in winter (RMRS, undated).

Northern Bog Lemming

Synaptomys borealis

Highly Vulnerable

Certainty: Very High

The northern bog lemming *(Synaptomys borealis)* is a small, short-tailed lemming that lives primarily in and near sphagnum bogs. It is found in Labrador, Canada, west to central Alaska in the United States, and south to Washington, Montana, southeastern Manitoba and northern New England. Records from the southern end of its range indicate that it also inhabits alpine sedge meadows, krummholz spruce-fir forest with dense herbaceous and mossy understory, mossy streamsides. Northern bog lemmings make runways and tunnels within sphagnum mats, and eat mainly mosses, grasses and sedges.

Despite being one of the lesser-studied animals we analyzed, is **highly vulnerable** to climate change in the Arctic Refuge due to climate change exposure, indirect climate factors such as natural barriers to species range shifts, and species-specific factors. The species is at its northern range limit in the southern portion of the Arctic Refuge, and thus does have room to expand northward if its habitat moves in this direction. However, due to the patchiness of its habitat, it may encounter natural barriers in the form of unsuitable habitat areas.

The species' sensitivity to climate change results from its physiological thermal regime, occurrence in conditions of historically stable temperature and moisture regimes in the past, possible dependence on ice, ice-edge, or snow habitats, and reliance on one or a few species for its habitat. The lemming is moderately restricted (>50% of occurrences or range) to relatively cool or cold environments that may be lost or reduced in the assessment area as a result of climate change. The species is considered critically vulnerable in the southern extent of its range, though it is unclear if climate plays a role in this. The species has experienced only small shifts in temperature and precipitation in the past, which may predispose it to higher sensitivity to future changes in these variables. Northern bog lemmings may benefit from the insulating cover of snow in the winter months, as well as from decreased predation risk resulting from snow cover. Finally, the species is most often found in sphagnum bogs, though it also is found in sedge and moist upland habitats suggesting it may be dependent on one or a several species for habitat generation and these species (in this case sphagnum moss in particular) may be vulnerable to changes in climate.

Critical Factors Affecting Northern Bog Lemming Vulnerability to Climate Change

Natural barriers		The northern bog lemming may be limited by keeping pace with habitat shifts due to climate change because the patchy nature of its habitat.
Dispersal and movements		Dispersal and movements are not well known in the northern bog lemming, but they seem to be able to move between bog patches up to a mile apart (Reichel and Beckstrom 1992).
Sensitivity to temperature change		The northern bog lemming is moderately restricted (>50% of occurrences or range) to relatively cool or cold environments that may be lost or reduced in the assessment area as a result of climate change.
Sensitivity to moisture change		Because the species is found most often in or near sphagnum mats or wet sedge meadows, it may be particularly sensitive to changes in moisture.
Dependence on ice or snow		The lemming may be somewhat dependent on snow in the winter for insulation of its tunnels and also some degree of protection from predators.
Habitat versatility		A single group of species, sphagnum mosses, is the primary component of the lemming's habitat; however, it is also found in sedge areas and other upland sites with moist soil.

Tundra Shrew

Sorex tundrensis

Highly Vulnerable

Certainty: Very High

Tundra shrews (*Sorex tundrensis*) live in tundra and boreal forests, particularly thinned forests with dense understory cover, from Russia and Mongolia to Alaska, Yukon, and the Northwest Territories. They feed on insects, small invertebrates and grasses in grassy and shrubby tundra on hillsides and other well-drained sites.

Although the species has high genetic variability and is able to tolerate and utilize a range of habitats, the tundra shrew may be **highly vulnerable** to climate change in the Arctic Refuge. Vulnerability in the tundra shrew is caused by a combination of climate change exposure, indirect climate factors such as natural barriers to species range shifts, and species-specific factors including dependence on snow covered habitats and physiological thermal regime. While the species will not face significant anthropogenic barriers should it need to shift in response to climate change, its location in the Arctic Refuge with ocean directly to the north of the Refuge will likely increase the vulnerability of the species in this area. Other portions of the species range that can move directly northward will likely be less vulnerable.

The species' sensitivity to climate change results from: its physiological thermal regime, occurrence in conditions of historically stable temperature and moisture regimes in the past, and its possible dependence on snow for insulating cover in the winter months. The shrew is completely or almost completely restricted (>90% of occurrences or range) to relatively cool or cold environments that may be lost or reduced in the assessment area as a result of climate change (e.g., the tundra). The species distribution is in boreal forest and tundra habitat in Alaska and Northwest Canada. It reaches its southern extent in British Columbia where it is considered critically imperiled. It is not clear if the species' distribution is limited by temperature or by competition with more southern species. The range of the tundra shrew in the Arctic Refuge has historically experienced by low temperature and moisture shifts which increase the sensitivity of the species to future climatic changes. Finally, the species may rely on snow cover to provide insulation in the cold winter months. These factors significantly increase the shrews' vulnerability to changes in climate.

Critical Factors Affecting Tundra Shrew Vulnerability to Climate Change

Natural barriers		If the shrew needs to move to locations to the north to keep pace with warming temperatures populations in the Arctic Refuge, it will face a natural barrier in the form of the ocean to the north. Other locations in the range of the species will have unrestricted access further north, and Alaskan populations may be able to shift east and then north in response to changing temperatures.
Sensitivity to temperature change		The shrew is completely or almost completely restricted (>90% of occurrences or range) to relatively cool or cold environments that may be lost or reduced in the assessment area as a result of climate change.
Sensitivity to moisture change		The species has some association with damp habitats but is found in drier areas as well (Vinogradov 2008), so moisture changes may have less impact on this species than others.
Sensitivity to disturbance change		(*)One study found relatively high numbers in recently logged or cleared areas (Vinogradov 2008), so a moderate increase in disturbance might create additional habitat for the species.
Dependence on ice or snow		The shrew may be somewhat dependent on snow in the winter for insulation of its tunnels and also some degree of protection from predators.

Barren Ground Shrew
Sorex ugyunak

Highly Vulnerable
Certainty: Low

The barren ground shrew (*Sorex ugynak*) uses wetter areas of the tundra than the tundra shrew, and eats a similar diet of insects, small invertebrates and seeds. It is distributed across a narrow band of Alaska north of the Brooks range, stretching east across most of Nunavut Territory to the northwest Hudson Bay. It was once considered to be a subspecies of *S. cinereus*.

Confidence in information was low on this species due to paucity of species-specific information; however, *Sorex ugyunak* may be **highly vulnerable** to climate change in the Arctic Refuge due to climate change exposure, natural barriers to species range shifts, and species-specific factors including its physiological thermal regime. While the species will not face significant anthropogenic barriers should it need to shift in response to climate change, its location in the Arctic Refuge with ocean directly to the north of the Refuge will likely increase the vulnerability of the species in this area. Other portions of the species range that can move directly northward in response to changing temperatures will likely be less vulnerable.

The species' sensitivity to climate change results from its physiological thermal regime, occurrence in conditions of historically stable temperature and moisture regimes in the past, possible dependence on snow and ice habitat, and moderate dependence on disturbance regimes. The shrew is significantly restricted (>90% of occurrences or range) to relatively cool or cold environments that may be lost or reduced in the assessment area as a result of climate change (montane areas and boreal forests). The species distribution follows a very narrow range across northern Alaska and Canada bounded to the east by Hudson Bay. While the shrew does prefer moist habitats of the wet tundra, but there is no indication that these areas will be lost in the Arctic Refuge based on the ClimateWizard moisture analysis. Therefore this factor is neutral for the species. For snow cover dependence we scored the species as slightly increase/neutral because while the species does forage under snow in winter there is no data to suggest that snow is important for insulation.

Critical Factors Affecting Barren Ground Shrew Vulnerability to Climate Change

Natural barriers	If the shrew needs to move to locations to the north to keep pace with warming temperatures populations in the Arctic Refuge, it will face a natural barrier in the form of the ocean to the north. Other locations in the range of the species will have unrestricted access further north, and Alaskan populations may be able to shift east and then north in response to changing temperatures.
Sensitivity to temperature change	The barren ground shrew is completely or almost completely restricted (>90% of occurrences or range) to relatively cool or cold environments that may be lost or reduced in the assessment area as a result of climate change.
Sensitivity to moisture change	The barren ground shrew is moderately dependent on wet areas but the predicted moisture changes do not indicate that these will be drastically reduced.
Dependence on ice or snow	(*)The shrew does forage under snow cover in winter and may depend on snow cover for insulation; however, species information was unclear on the level of dependence.

Arctic Ground Squirrel — Highly Vulnerable

Spermophilus parryii — Certainty: Low

The arctic ground squirrel (*Spermophilus parryii*) inhabits well-drained soils on open tundra, in areas where permafrost is not close to the surface. They preferentially utilize upland ridges and dunes with well-drained soils appropriate for burrowing and with views of the surrounding landscape. Arctic ground squirrels hibernate at the lowest body temperature of any mammal; they can "supercool" their body temp to 27 degrees F. Of the species analyzed here, they have the most distinctive associations certain geological feature, rather than hydrology or plant composition.

The arctic ground squirrel is **highly vulnerable** to climate change in the Arctic Refuge. The species is limited in distribution and is likely sensitive to changes in temperature, hydrologic regimes and vegetation. The species is also dependent on more rare geologic features and snow for winter hibernacula. Changes that bring more freezing rain and ice events could also decrease winter survivorship. The species may be limited in range expansion in the future by the ocean on its northern boundary.

Simulations of the vulnerability models split between "highly" and "extremely" vulnerable, resulting in "low confidence for this species.

Critical Factors Affecting Arctic Ground Squirrel Vulnerability to Climate Change

Natural barriers	If the ground squirrel needs to move to locations to the north to keep pace with warming temperatures populations in the Arctic Refuge, it will face a natural barrier in the form of the ocean to the north. Other locations in the range of the species will have unrestricted access further north, and Alaskan populations may be able to shift east and then north in response to changing temperatures.
Dispersal and movements	Arctic ground squirrels have moderate dispersal ability. In the Yukon, females dispersed a mean 400 feet and males a mean 1700 feet (Byrom & Krebs 1999).
Sensitivity to temperature change	Arctic ground squirrels are limited in distribution to a small swath of northwest Canada and Alaska and preferentially utilize tundra habitat. They are found less frequently in boreal forest. Increased extent of boreal forest in the Arctic Refuge as a result of climate warming could be detrimental to the species that prefers open ground. Also, they appear to preferentially avoid eating shrubs (Batzli & Sobasky 1980), so a change in conditions or disturbance regime that allowed encroachment of trees or shrubs could be detrimental to the species.
Sensitivity to moisture change	Increased precipitation could increase the vulnerability of the species, particularly if rain increases during hibernation. Winter rain events may affect hibernating ground squirrels in two important ways; reducing snowpack and by directly flooding burrows (Donker 2010). Flooding is a major problem for the species, so in the short-term melting of permafrost and pooling of meltwater would represent a challenge as would increases in winter precipitation falling as rain.
Sensitivity to disturbance change	Increasing fire activity projected during this century (Rupp 2008) will likely benefit the species by increasing forest openings which provide preferable habitat to the species (Donker 2010). Because it is somewhat uncertain, the species was scored in two categories.
Dependence on ice or snow	The species burrows under snow in the winter during hibernation. Snow thus provides both important insulation and predator protection.
Restriction to uncommon geologic features	The arctic ground squirrel has one of the clearest geological associations of any of the Refuge mammals analyzed. They preferentially utilize upland ridges and dunes with well-drained soils appropriate for burrowing and with views of the surrounding landscape.

The Alaska marmot (*Marmota broweri*) is endemic to northern Alaska, found mainly in the Brooks Range and environs. They inhabit talus slopes and feed on a variety of alpine tundra vegetation: leaves, seeds, grains, and also eat insects. They are active for a short period, hibernating from early September through April or May. Hibernacula tend to be on exposed ridges where the snow melts earlier (Rausch & Rausch 1971); however, from the limited hibernation data available (Lee et al. 2009), they need to maintain an above freezing body temp, and overwinter is a significant source of mortality, so insulating cover is probably important in deep winter.

The marmot is **highly vulnerable** to climate change in the Arctic Refuge in the next 50 years primarily because of its limited range in the tundra environment of Alaska. The species may face a natural barrier (in the form of the ocean) to northward movement in the future which may increase its future vulnerability. The species is endemic to the northern mountains in Alaska and depends on tundra vegetation for its food supply. The species has also existed under conditions of stable temperature and precipitation across its range in the Arctic Refuge, which may make it slightly more sensitive to climatic changes.

Critical Factors Affecting Alaska Marmot Vulnerability to Climate Change

Natural barriers		If the marmot needs to move to locations to the north to keep pace with warming temperatures populations in the Arctic Refuge, it will face a natural barrier due to the absence of mountainous habitat north of the Brooks Range.
Dispersal and movements		Marmots exhibit good dispersal and movement ability, generally in the range of 2 to 9 miles.
Sensitivity to temperature change		The Alaska marmot is endemic to the northern mountains of Alaska and makes its home in talus fields above productive tundra vegetation which is the coldest climate in our assessment area. It is dependent on tundra vegetation for its food supply and encroachment from woody vegetation and boreal forest as warming occurs is likely to be detrimental to the species.
Dependence on ice or snow		Alaska marmots hibernate from early September through April or May. There is some indication that their hibernacula tend to be on exposed ridges where the snow melts earlier (Rausch & Rausch 1971). However, from the limited hibernation data available (Lee et al. 2009), they need to maintain an above freezing body temp, and overwinter is a significant source of mortality, so insulating cover may be an important factor in deep winter.

Singing Vole
Microtus miurus

Highly Vulnerable
Certainty: Very High

The singing vole (*Microtus miurus)* lives in arctic and alpine tundra in mountainous areas of Alaska and northwestern Canada. It is found most often in mesic microhabitats: low, moist slopes with mosses, sedges, and broad-leaved plants, better drained slopes covered with shrubs, and rocky flats near streams. They feed on horsetails, shoots of grasses and sedges, and leaves of broadleaved plants and shrubs. Singing voles are active year round, and store food in aboveground haypiles and underground caches.

The singing vole is **highly vulnerable** to climate change in the Arctic Refuge. The species is limited in distribution mainly to tundra and mountainous habitats and has specific hydrological requirements. The species may suffer from increasing flooding disturbances and changes in hydrology or temperature. It is less clear how moisture conditions will change across the area assessed however and therefore difficult to predict the impact on the species. The species may also be squeezed out of a habitat as shrubs and trees encroach along the southern areas of the Refuge and the Beaufort Sea and coastal ice areas prevent northward expansion of the tundra.

Critical Factors Affecting Singing Vole Vulnerability to Climate Change

Natural barriers	Encroachment by shrubs (which the species does not live in) and the Beaufort Sea and ice to the north may form a natural barrier to species movement.
Sensitivity to temperature change	The singing vole is found entirely in cold areas; namely arctic and alpine tundra.
Sensitivity to moisture change	(*)The species has a preference for areas that are of mesic, or intermediate, moisture. The delicate balance the species prefers could shift under climate change, though it is not clear this will happen in the next 50 years under the climate projections used in this analysis.
Sensitivity to disturbance change	(*)Increases in flood frequency or severity could cause mortality for riparian-dwelling animals. Increases in drought or fire frequency could impact food availability, though the likelihood of these is unclear.
Dependence on ice or snow	Much singing vole habitat is snow-covered up to eight months of the year. The link between survivorship and snow cover has not been illustrated as clearly as with tundra vole, but is probably in line with other small mammals that use snow for insulation and protection for predators.

Brown Bear — Moderately Vulnerable

Ursus arctos — Certainty: Low

Ursus arctos, the brown bear, scores as moderately vulnerable to climate change in the Arctic Refuge. Once widespread, the species has been extirpated from much of its original range, and Alaska is the only place where North American brown bear populations are considered likely to be secure, making the Refuge a critical sanctuary for the species. The species is omnivorous, adaptable and uses a wide variety of unforested habitats, though it is highly sensitive to human disturbances. It does not have specific thermal and hydrological requirements, though it does utilize areas of stable snowcover for denning.

The species has excellent dispersal abilities. The bear is mostly threatened in more southern portions of its range by human encroachment on its habitat; it requires undisturbed habitat and interactions with humans and roads decrease its fitness. Because its range in the Refuge is on the coastal tundra, the brown bear scores more vulnerable on the sea level rise and range shift categories than many other species.

Simulations of brown bear vulnerability in our model split between “moderately” vulnerable and “presumed stable,” resulting in low overall confidence in vulnerability score.

Important Factors Affecting Brown Bear Vulnerability to Climate Change

Natural barriers

Brown bears may not to need to shift further north in its range in Alaska in the next 50 years, but if they do they will encounter the Beaufort Sea.

Sea level rise

Brown bears use coastal areas of the Refuge, so they may be somewhat impacted by sea level rise along its northern edge.

Dispersal and movements

Brown bears have excellent dispersal and movement abilities and can range hundreds of miles (Pasitschniak-Arts 1993, LeFranc et al, 1987).

Sensitivity to temperature change

The brown bear’s current distribution is mostly northern, but it once ranged as far as south as Mexico. Available information suggests that human development and habitat loss, rather than climate factors, drove distribution changes.

Dependence on ice or snow

Grizzly bears select den sites with stable snow conditions for the duration of time required. Stable snow conditions are most often present at middle elevations where slope and aspect offer protection from prevailing wind and sun exposure (Linnell at al. 2000).

Phenology

The bear has a dormant period in winter following a period of gluttony in the fall. No information was found regarding possible impacts of climate change effects on the hibernation cycle in the Refuge, but this may be a topic requiring further investigation.

Marten

Martes americana

Moderately Vulnerable

Certainty: Very High

The American marten (*Martes americana*), is a small forest carnivore that is strongly associated with mature stands of conifers, generally spruce-fir, fir-white birch, or black spruce- jack pine forests. They feed on a wide variety of small rodents, birds and bird eggs, amphibians, and will eat berries and seeds seasonally. The marten scores as moderately vulnerable to climate change in the Arctic Refuge. The species has been extirpated from portions of the southern part of its range, but this more likely due to logging and other forms of habitat destruction than to climate changes. Marten habitat is sensitive to habitat disturbance, but they have a much broader dietary versatility, compared to lynx. Like lynx, martens are positively associated with snow cover, due to a light foot-load and thus a competitive advantage against larger predators in snowy conditions. However, unlike the lynx, the marten's closest competitor, the fisher, is not found in the Refuge, or near enough to be likely to move in within the next 50 years. This, with their broader dietary versatility, reduces their overall vulnerability to "moderate" in this analysis.

Important Factors Affecting Marten Vulnerability to Climate Change

Sensitivity to disturbance change

Martens are strongly associated with older coniferous forests, and negatively associated with disturbances like fire and logging (Drew 1995). Changes in disturbance regime in the form of increased fire activity through the end of this century are very likely in response to projected temperature increased and lower available moisture. Increase in fire activity is projected to be greatest in the next 20-30 years. (Rupp 2008). It is likely that large regions of mature spruce will be replaced by a more patchy distribution of deciduous forest and younger stages of spruce without the older growth which could be detrimental to the marten.

Dependence on ice or snow

Like lynx, martens are positively associated with snow cover and appear to gain an advantage over larger competitors, in the snow Krohn et al. 1995, Carroll 2007). However, their most important competitor is unlikely to expand its range into the Refuge over the near term.

Habitat versatility

The marten is fairly restricted by forest type associations and prefers spruce-fir, fir-white birch, black spruce-jack pine. However, age structure is likely important, which is reflected in the "disturbance" score.

Taiga Vole (Yellow-cheeked Vole)
Microtus xanthognathus

Moderately Vulnerable
Certainty: Very High

Microtus xanthognathus, the taiga vole, is also known as the yellow-cheeked vole. This vole is found primarily in early successional bottomland forests (Swanson 1996, Wolff 1980) or recently burned stands regenerating with densely growing black spruce forest. They feed primarily on sedges and rhizomes of horsetail and fireweed, which they also cache for overwintering. During winter, they huddle in groups in underground burrows, but do not enter a true hibernation. The taiga vole is moderately vulnerable to climate change in the Arctic Refuge. The species is limited in distribution to boreal forests and has specific hydrological requirements. While these factors may make it more sensitive to climate change across some parts of its range, within this particular assessment area, the vole is unlikely to be significantly affected by changes in these variables in the next 50 years. For example, the boreal forest is expected to increase northward into tundra area, so the taiga vole habitat may actually expand initially. The species may also benefit from increasing disturbances (e.g., increasing fire activity projected under climate change) that open up clearings and edge habitats in forests. However, at some point the boreal forest may not be able to maintain the level of increased fire activity and may instead convert to a different species mix (Rupp 2008) which may be detrimental to the taiga vole. The species may also be sensitive to any loss of snow cover, due to the insulating benefit it provides for wintering voles. The species will not be affected by barriers to movement since it is not located near the Beaufort Sea.

Important Factors Affecting Taiga Vole Vulnerability to Climate Change

Sensitivity to moisture change

(*)The species has a preference for wet, early successional boreal forest habitats. It is unclear from the climate data whether there will be any major change in moisture in the next 50 years. An increase in moisture would likely benefit the species, while a decrease in moisture would have a negative impact on the species.

Sensitivity to disturbance change

(*)Taiga voles may actually benefit from projected increases in fire disturbance over the next several decades, because that they are found most frequently in areas that have burned recently and have a dense stand of young trees. On the other hand, it is unclear whether taiga forest can sustain the increased fire regime over the long term.

Dependence on ice or snow

Taiga voles benefit from snow cover for overwintering insulation.

Dietary versatility

Taiga voles' seasonal diet is relies heavily on a limited number of species, particularly sedges in summer and caches of horsetail and fireweed in winter "(Conway and Cook 1999).

Snowshoe Hare — Not Vulnerable/Presumed Stable

Lepus americanus — Certainty: Very High

The snowshoe hare *(Lepus americanus)* lives in coniferous and mixed forests with large amounts of understory cover. It has a fairly flexible diet, eating a wide variety of plant species. The snowshoe hare is **not vulnerable/ presumed stable** to climate change in the Arctic Refuge. The species is likely to be less vulnerable than some of the other species assessed because it is not at its northern range limit and is not dependent on shrinking tundra habitat.

While the hare is dependent on cold habitats and is considered vulnerable in the southern edge of its range, it is not clear that climate changes in the Arctic Refuge over the next 50 years would alter the boreal forest habitat the species depends on; in fact, the species may be able to expand its range further north from its current limit in the southern portion of the Arctic Refuge as boreal forest moves into the tundra habitat further north in the Refuge.

Compared to the other species that ranked "Not vulnerable/ presumed stable," snowshoe hare exhibits stronger associations with snow and ice, and a greater degree of vulnerability associated with changes to snowpack. For instance, the species changes color in the winter to blend in with the snow and better avoid predators. Given the snowshoe hare's unique adaptations to snow (light build and huge back feet), loss of snowpack in winter or increased density of the snow would reduce the hare's ability to outrun predators. Additionally, the hare molts to white in winter, and this change is cued by photoperiod not temperature or snowfall itself. Over the last few years researchers in Montana have detected mismatches between hare seasonal coloration and their environment (white hares on brown ground). This could potentially be a problem for the species in the future across a wider portion of its range.

Moose **Not Vulnerable/Presumed Stable**

Alces alces Certainty: Very high

Moose *(Alces alces)*, which are the largest members of the deer family, live in northern areas. They eat willow, birch and aquatic plants, foraging in wet shrub thickets in summer and at forest edges in winter. The moose scores **not vulnerable/ presumed stable** to climate change in the Arctic Refuge, though it is likely to be vulnerable to climate change in more southern portions of its range. The moose does have some characteristics that may make it more sensitive to climate change, especially in areas further south of the Refuge including a reliance on lower temperatures, possible preference for snow-covered areas, and low genetic variability. Moose do not live in places where the temperature exceeds80°F for long periods of time, or where shade and access to water are lacking. In the summer it uses shaded areas or stands in water to prevent overheating, a practice which can limit foraging (Post et al. 1999). At the southern end of their range, there is also evidence that spring warming is associated with higher parasite loads, particularly ticks (DelGiudice et al. 1997). However, within the assessment period over the next 50 years, the species is not likely to encounter widespread loss of its thermal niche, so this factor was scored as "somewhat increase." Furthermore, while there is a barrier of ocean and Arctic sea ice to the north, it is unlikely that the temperature will change enough in the next 50 years to require the moose to need to move northwards to keep pace with climate change. Sensitivity to changes in snow cover reflected uncertainty as to the effect of snow cover changes on the species. Due to their long legs, moose have no trouble moving in snow depths up to 50 cm, and may use areas with this snow depth preferentially, for avoidance of wolves, but progressively impeded at depths greater than 60 cm. Harder, crustier snow supports them better, but also supports wolves better (Mech et al. 1987). The species' potential vulnerability is also moderated by their extensive use of early successional habitats, which may increase in the Refuge over the course of the assessment period.

Northern Red-backed Vole — Not Vulnerable/Presumed Stable

Myodes rutilus — Certainty: Very High

The northern red-backed vole *(Myodes rutilus)* is **not vulnerable/ presumed stable** to climate change in the Arctic Refuge. The species is limited in distribution mainly to tundra and boreal forest but appears to be flexible among these habitats, so its score for temperature sensitivity was "moderate increase in vulnerability." They utilize virtually every major forest type in Alaska, and will return to burned areas as soon as berry-producing shrubs, fungi and ground cover plants recolonize. The taiga and northern forest are unlikely to be altered significantly in our assessment area and may expand, while the tundra may shrink. The vole does not have specific hydrological requirements, has an extremely varied diet, and does not rely on a few species for habitat creation. Projected increases in fire activity over the next century may benefit the species, due to their extensive use of early successional habitats. While there is a barrier of ocean to the north, it is unlikely that the temperature will change enough in the next 50 years to require the vole to move northwards to keep pace with climate change. The only other factors that rated "yellow" for the northern red-backed vole were its use of snow for insulation, and low genetic variation, but these factors were not big enough problems to affect its overall score.

Meadow Vole — Not Vulnerable/Presumed Stable

Microtus pennsylvanicus — Certainty: Very High

Meadow voles (*Microtus pennsylvanicus)* are found in early successional habitats, such as old fields, pastures and forest clearings as far south as Georgia. They are strictly herbivorous but eat roots, shoots and seeds of a wide array of species. The meadow vole is **not vulnerable/ presumed stable** to climate change in the Arctic Refuge. The species is widely distributed and has broad temperature and hydrological requirements. The species may also benefit from increasing disturbances (e.g., increasing fire activity projected under climate change) that open up clearings in forests. The species will not be affected by barriers to movement since its current range is not located near the Beaufort Sea. Like the red-backed vole, the meadow may be somewhat sensitive to changes in snow cover and has low genetic variation, these factors were not sufficiently problematic to affect its overall score.

River Otter — Not Vulnerable/Presumed Stable

Lontra canadensis — Certainty: Very High

The river otter (*Lontra candensis)* is **not vulnerable/ presumed stable** to climate change in the Arctic Refuge, and may even expand its range further north into the Refuge. The species is wide ranging from Alaska in the North to Florida in the south and is not limited by a particular thermal regime or cold habitat. The species, though associated with rivers and streams, is not dependent on rare aquatic features such as ephemeral pools or seeps, and moisture is not likely to change enough in the Arctic Refuge in the next 50 years to affect flowing stream systems. The river otter does prefer certain geologic conditions, specifically steeply banked shorelines, and they avoid areas where the shoreline is more gradually sloped or has sand or gravel beds. However, these features are sufficiently dominant across the otter's range, that their availability is unlikely to be a climate change vulnerability factor. The only "yellow" factors that might make river otters slightly sensitive to climate change are potential changes in disturbance regimes and because it has low genetic variation. While there is a barrier of ocean to the north, it is unlikely that the temperature will change enough in the next 50 years to require the otter to move northwards to keep pace with climate change.

Mink — Not Vulnerable/Presumed Stable

Neovison vison — Certainty: Very High

The mink *(Neovison vision)* is found in a variety of wetland habitats throughout the U.S. except for southwestern deserts. They are strictly carnivorous but opportunistic, taking fish, bird eggs and nestlings, small mammals, frogs, and invertebrates. They do not dig burrows themselves, but will utilize abandoned burrows of muskrat, beaver, ground squirrel or rabbit. They will also use brush piles, cavities in trees, or rock piles. Given their dependence on proximity to water, they could be sensitive to extreme changes in hydrology, particularly flooding or severe drought. Nonetheless, our analysis found mink to be **not vulnerable/ presumed stable** to climate change in the Arctic Refuge. The species is wide ranging and does not have specific thermal or hydrological requirements that are likely to change in the Arctic Refuge over the assessment period. While there is a barrier of ocean to the north, it is unlikely that the temperature will change enough in the next 50 years to require the mink to need to move northwards to keep pace with climate change.

Dusky Shrew — Not Vulnerable/Presumed Stable

Sorex monticolus — Certainty: Very High

Sorex monticolus (dusky shrew), another small insectivore of the boreal forest, is most frequently found in riparian areas or within 100 meters of streams or wet areas. They prefer areas with a substantial amount of ground cover and woody debris, so are generally found in medium-aged forests, rather than deeply shaded mature forests or very young stands with little woody debris. The dusky shrew is **not vulnerable/ presumed stable** to climate change in the Arctic Refuge over the next 50 years. The shrew ranges from in Alaska through British Columbia and as far south as the Sierra Madres of Mexico. While it is restricted to relatively cool or cold environments that include montane areas and boreal forests, it is unlikely that these habitats will be lost in the assessment area, or that the species will need to move north to the point where it would encounter the ocean as a barrier. Similarly, the shrew does prefer moist habitats such as wet meadows and riparian zones, but there is no indication that these areas will be lost in the Arctic Refuge based on our moisture analysis. High genetic variation in the shrew also increases its resilience to climate change.

The only factors raising the dusky shrew's sensitivity to climate change were change in disturbance regime and reliance on ice and snow. The shrew requires a moderately open forest habitat (not deep forest, but not clear cuts either) and may be sensitive to increasing fire frequency, duration and extent in the future. For snow cover dependence, the species rated as slightly increase/neutral because while it does forage under snow in winter, we found no data to suggest that snow is important for insulation or that the species suffers in its absence.

Masked Shrew — Not Vulnerable/Presumed Stable

Sorex cinereus — Certainty: Moderate

Sorex cinereus, the masked shrew, is an insectivore that lives in damp leaf litter on the forest floor of many wooded areas of the northern U.S. and Canada, and extending further south in mountainous areas. The masked shrew is **not vulnerable/ presumed stable** to climate change in the Arctic Refuge over the next 50 years. The species rated "somewhat" vulnerable on the basis of sensitivity to moisture change, due to indications that environmental moisture is important for the species, and it is found more commonly on northern, mesic slopes, than on southern, xeric slopes (Brannon 2002). On the other hand, factors such habitat, disturbance, diet and genetic factors are not projected to be problematic for the shrew in the Arctic Refuge over the next 50 years. Nor is the species expected to need to move north to the point where it would encounter the ocean as a barrier.

Red Squirrel — Not Vulnerable/Presumed Stable

Tamiasciurus hudsonicus — Certainty: Very High

The red squirrel (*Tamiasciurus hudsonicus)* ranges as far south as New Mexico and Virginia, and reaches its northern extent in Alaska. It requires mature, seed-bearing conifers for its food supply, and large trees, with either cavities for nesting or branches that will support a leaf nest, and this requirement for mature forest makes it potentially sensitive to changes in fire frequency that could alter the age structure of forests. Overall, however, the red squirrel is **not vulnerable/ presumed stable** to climate change in the Arctic Refuge. The species is somewhat restricted to relatively cool or cold environments such as montane areas and boreal forests, but these are unlikely to be lost in the assessment area, or to shift sufficiently to the point where the squirrel encounters the ocean as a barrier. Other factors that reduce its vulnerability include high levels of genetic variation and phenologic plasticity. Interestingly the species is one of the first mammals that has shown phenotypic plasticity and micro-evolution in response to climate change, namely by altering its reproductive timing (Reale et al. 2003). This may decrease its sensitivity to climate change exposure and allow it to successfully adapt to certain changes.

Porcupine — Not Vulnerable/Presumed Stable

Erethizon dorsatum — Certainty: Very High

Porcupines *(Erethizon dorsatum)* are found as far south as Texas, although they are more prevalent in northerly areas. They primarily are found in forested areas, but will also utilize wooded riparian corridors in otherwise unforested landscapes. They den in large hollow trees or logs and eat a variety of plant species, with strongly seasonal variation: mainly evergreen needles and inner tree bark in winter, and virtually any plant material in summer.

Porcupines are not **vulnerable/ presumed stable** to climate change in the Arctic Refuge in the next 50 years. It does not have particular affinity with cold areas, specialized aquatic features, or dependence on snow and ice that make many other Refuge species vulnerable to climate change. Furthermore, while there is a barrier of ocean to the north, it is unlikely that the temperature will change enough in the next 50 years to require the porcupine to move northwards to keep pace with climate change. The factors that porcupine did rate somewhat sensitive to were changes in disturbance and dietary versatility. Changes in disturbance regime (such as an increase in fire) could be potentially detrimental to the species since it requires standing trees for perching and feeding. Finally, in winter porcupine's diet becomes somewhat more specialized than summer months, resulting in a "yellow" rank for this sensitivity factor.

Pygmy Shrew — Not Vulnerable/Presumed Stable

Sorex hoyi — Certainty: Very High

The pygmy shrew (*Sorex hoyi*) is the smallest mammal in North America. Its range extends through much of Canada and into the northern 48 States. Ants account for nearly half of its diet, but it also eats bees, beetles, moth larvae, and spiders. It is often found in association with rotting logs, and appears to select habitats where wet and upland areas occur in close proximity to each other. The pygmy shrew is **not vulnerable/ presumed stable** to climate change in the Arctic Refuge and may increase its range across the assessment area. The species may be sensitive to changes in snow cover, as an assessment of shrews in Nova Scotia found winter factors to be a larger component of vulnerability for *S. hoyi* than summer factors (Herman and Scott 1994). That study found the pygmy shrew to be one of the less vulnerable species, and our assessment reaches a similar conclusion, that changes temperature or precipitation will not adversely affect its habitat or diet in this portion of its range.

Least Weasel — Not Vulnerable/Presumed Stable

Mustela nivalis — Certainty: Very High

The least weasel (*Mustela nivalis)* ranges across much of the northern half of the continent and through the Appalachians to as far south as Georgia. They are found in fields, forests, hedgerows, shrub-steppe, and semi-deserts.The most important habitat factor for this species is the presence of sufficient prey, which is dominated by mice and voles, but can also include other small mammals, bird eggs and nestlings, frogs, lizards, fish and invertebrates. The least weasel is **not vulnerable/ presumed stable** to climate change in the Arctic Refuge and may instead expand its range in Alaska. The species is wide ranging and does not have specific thermal or hydrological requirements that are likely to change in the Arctic Refuge.

The least weasel does have some traits that may make it somewhat sensitive to climate changes, though these are more likely to be problematic in other portions of its range. The species may benefit from hunting in the subnivian zone during the winter so loss of snowpack or changes in snowpack (e.g., more ice instead of snow leading to crushed tunnels in the subnivian zone) could potentially be detrimental. On the other hand, the species seems to have significant phenological plasticity. Weasels in the northern portion of the range turn white in winter and weasels in the southern portion of the range don't. Breeding time and number of breeding cycles per year varies with prey density rather than with temperature or light variables. These characteristics indicate significant flexibility, which may help the species adapt to climate changes.

Muskrat — Not Vulnerable/Presumed Stable

Ondatra zibethicus — Certainty: Very High

Muskrats (*Ondatra zibethicus)* are found in a wide array of aquatic habitats. They eat aquatic vegetation and live either in constructed lodges or in burrows dug in banks. The muskrat is ranked as **not vulnerable/ presumed stable** to climate change in the Arctic Refuge. The species showed low sensitivity to climate change overall. Muskrats are found as far south as Texas and Alabama, and the species is at its northern border in Alaska; therefore, they are not restricted to relatively cool or cold environments that may be lost or reduced in the assessment area as a result of climate change, and they are unlikely over the next 50 years to need to move northward to the point they will encounter the ocean as a barrier. While the muskrat is dependent on specific wetland environments, the direction of change in moisture (no significant change in the next 50 years or slight increase) is unlikely to affect these habitats. The muskrat's only "yellow" sensitivity factor was to changes in disturbance regime, particularly increases in floods or extremes in water levels. Tidal surges are associated with juvenile mortality (Kinler et al. 1990) and spring ice jam flood cycles are correlated with muskrat population cycles (Timoney et al. 1997). Similarly, changes in water level that affect emergent vegetation could also be detrimental because they reduce the food supply (Clark and Kroeker 1993).

Gray Wolf — Not Vulnerable/Presumed Stable

Canus lupis — Certainty: Very High

The gray wolf (*Canis lupis)* is not **vulnerable/ presumed stable** to climate change in the Arctic Refuge in the next 50 years. The species is widespread, generalized in its habitat and dietary needs, tolerates a variety of disturbance regimes, has excellent dispersal characteristics (Adama et al. 2008), and high genetic variability (Leonard et al. 2005). Its lack of sensitivity makes it one of the species likely to continue to remain widespread under climate change. Within the assessment period, the species is not likely to require northward movement that would cause it to encounter the natural barrier of the ocean. The only factor potentially increasing vulnerability for this species is changes in snow cover, because snowy conditions confer wolves an advantage over many prey species.

Ermine

Not Vulnerable/Presumed Stable

Mustela erminea

Certainty: Moderate

The ermine (*Mustela ermine)* ranges into the Great Lakes and mid-Atlantic region, and as far south as California and New Mexico in the mountains. Its preferred habitats are riparian areas, forest edges and hedgerows, avoiding deep forests and desert areas. Ermines feed exclusively on small mammals, and their elongate shape helps them track prey into burrows and under snow, but hinders thermoregulation at extremely cold temperatures. The ermine is **not vulnerable/ presumed stable** to climate change in the Arctic Refuge. The species is widespread, generalized in its habitat and dietary needs, has high genetic variability, and excellent dispersal characteristics. While the species' distribution is mainly limited to boreal forest habitat, boreal forest is not likely to decrease in the Arctic Refuge in the next 50 years and instead may increase as temperatures warm enough for this habitat to shift northward. For this species, the disturbance factor was scored with some uncertainty because disturbance has both positive and negative effects: fires reduce ermine numbers, but the species does seem to prefer early successional habitats. So an increase in fire frequency might actually create habitat, while also temporarily suppressing numbers. However, they have a fairly high reproductive rate, so disturbance ultimately may be a positive factor as long as it is not so frequent or severe that it suppresses the prey base.

Ermines may also be sensitive to changes in snow cover because they track prey under the snow and may utilize it for insulation as well. It is not clear whether snow cover changes will pose issues for the ermine with respect to molt timing. Seasonal molt appears to be controlled by both photoperiod and temperature: according to one study, white ermines placed at 18 hour daylight period molted to brown, but onset was faster for individuals held at 70ºF than those at 20ºF (Rust 1962). Furthermore, individuals on south end of range don't necessarily molt, so the species may have sufficient plasticity to avoid phonologic mismatches.

Coyote

Not Vulnerable/Presumed Stable

Canis latrans

Certainty: Very High

The coyote *(Canis latrans)*, which is well known as a widespread and adaptable carnivore, is **not vulnerable/ presumed stable** to climate change in the Arctic Refuge in the next 50 years. The species is widespread, generalized in its habitat and dietary needs, tolerates a variety of disturbance regimes, and has excellent dispersal characteristics. The coyote's lack of sensitivity makes it one of the species likely to continue to remain widespread under climate change. While there is a barrier of ocean to the north, it is unlikely that the temperature will change enough in the next 50 years to require the coyote to need to move northwards to keep pace with climate change.

Beaver

Castor canadensis

Not Vulnerable/Presumed Stable

Certainty: Very High

The beaver *(Castor candensis)* is **not vulnerable/ presumed stable** to climate change in the Arctic Refuge. They live in a wide range of aquatic habitats, and these environments are neither rare, nor likely to diminish as a result of climate change in the next 50 years. While the species will be exposed to climate change across its range, it lacks many of the sensitivity factors that make other species vulnerable to climate change. It is likely the species may expand north, further into the Arctic Refuge under climate change. While there is a barrier of ocean to the north, it is unlikely that the temperature will change enough in the next 50 years to require the beaver to need to move northwards to keep pace with climate change.

Black Bear

Ursus americanus

Not Vulnerable/Presumed Stable

Certainty: Very High

The black bear (*Ursus americanus*) is **not vulnerable/ presumed stable** to climate change in the Arctic Refuge. The species is ranges across much of the continent and does not have specific thermal or hydrological requirements that are likely to change in the Arctic Refuge. Black bears have few traits that will make them sensitive to climate change: they have a flexible diet, excellent dispersal ability, do not rely on interspecific associations with other species, tolerate a wide range of temperatures and hydrologic regimes, and may benefit from disturbances that are likely to increase in the future. While there is a barrier of ocean to the north, it is unlikely that the temperature will change enough in the next 50 years to require the black bear to need to move northwards to keep pace with climate change.

Red Fox
Vulpes vulpes

Not Vulnerable/Increase Likely
Certainty: Very High

The red fox *(Vulpes vulpes)* is **not vulnerable** to climate change and is **likely to increase** in the Arctic Refuge in response to climate change over the next 50 years. The species is the most widespread carnivore in the world, generalized in its habitat and dietary needs, not dependent on snow or ice, and with excellent dispersal characteristics. The species may benefit from projected increases in fire in the region (Rupp 2008), as fire will likely result in an increase in forest edge and early successional habitat that red foxes use preferentially (USFS FEIS 2007). Red foxes historically did not occupy the tundra partly because it was too cold; with their longer ears and limbs, they lose heat faster than the related arctic fox. But the temperature in the Arctic has risen over 2 degrees F in the past 50 years, making the region more hospitable to the red fox. The species may also benefit from encroaching forest habitat into the tundra. Large expenses of tundra habitat are expected to be replaced by forest. The red fox in adjacent boreal forest will be able to expand into the tundra as the climate warms and the forest moves towards the poles. This may result in negative consequences for the arctic fox as red foxes are superior hunters and may have been responsible for the decline of the arctic fox during the last interglacial (Dalen et al. 2005; see arctic fox notes above for more).

CONCLUSIONS AND RECOMMENDATIONS

Relationship of This Assessment to Other Listing and Management Plans

Vulnerability to climate change is an important and dynamic factor in assessing overall threat to species, and to formulating and prioritizing conservation actions. We believe that this assessment for the mammals of the Arctic National Wildlife Refuge provides a valuable and timely addition to the science of wildlife conservation in the face of climate change. However, climate change vulnerability is only one part of any species' or ecosystem's overall conservation status, and should be considered within the context of other parameters, including population size, population trends, isolation, and other threats.

Federally Listed Species

Only one mammal species in the Arctic National Wildlife Refuge is federally listed under the Endangered Species Act (ESA): the **polar bear**. The polar bear was listed as threatened under the ESA on May 14, 2008. This move officially recognized climate change as a driver of polar bear imperilment, but was accompanied by an unprecedented exemption stipulating that greenhouse gas emitting activities were outside of the purview of the ESA. In fact, the polar bear's extensively documented response to climate change, and its dependence on habitat factors that are particularly at risk from warming, argue strongly for it to be considered the Refuge's top conservation priority.

Alaska Listed Species and State Wildlife Action Plan

The Alaska Department of Fish and Game also maintains lists of Endangered Species and Species of Special Concern, but neither list contains any of the Refuge mammals analyzed here. Alaska's Comprehensive Wildlife Conservation Strategy (ADFG 2006), a state wildlife action plan, lists the **polar bear** and **Alaska marmot** as conservation priorities.

State and Global Conservation Rank

NatureServe and the International Union for the Conservation of Nature (IUCN) have established rankings that provide a quick snapshot of species population status and vulnerability to extinction. These rankings provide a quantitative assessment of species rarity and further highlight the urgent plight of the **polar bear**: of Refuge species, it is the only species considered "Vulnerable."

Management Recommendations for the Arctic National Wildlife Refuge

Conservation planning and actions to preserve the Refuge's species should take several factors into account.

The species most vulnerable to climate change in the Arctic National Wildlife Refuge are the ones specially adapted to the cold, snow and ice. Arguably the most vulnerable species in the Refuge are the polar bear and the arctic fox, because their distribution within the Refuge is limited almost entirely to the narrow North Slope. Other species whose Refuge habitats are limited to this narrow strip of tundra bordered by the Beaufort Sea, also face serious challenges from climate change. Species with broader distributions will most likely be less vulnerable.

The Refuge's tundra-dependent animals are particularly at risk from changes that bring icier conditions to the tundra or that encourage the expansion of boreal forest into areas that are currently open tundra. Icy conditions are on the increase as winters warm: warmer air can hold more moisture, and as the number of days where the temperature reaches above freezing expands, the likelihood increases that some precipitation will fall as freezing rain or sleet, or as thicker, crusty snow. Species like caribou and musk oxen have already been documented to have a more difficult time feeding when the vegetation is encrusted in ice, and they have to expend more energy to do so. This is undoubtedly also the case for smaller, less studied animals, like the voles and lemmings that form the basis of the food chain for many larger predators.

Expansion of boreal forest into areas that are currently tundra vegetation is also a significant problem for species that are specialized to the tundra. While our assessment did not itself predict vegetation changes, other work, including the Arctic Climate Impact Assessment (2005) and Feng and colleagues (2011), clearly project tundra vegetation to be replaced by shrubs and boreal forest.

The particular geography of the Arctic National Wildlife Refuge may be a contributing factor to vulnerability. North of the Brooks Range, the strip of coastal plain tundra is narrower in the Refuge than it is elsewhere in the North Slope of Alaska and adjacent areas of Canada. Therefore, changes in the region may more quickly push those habitats northward to the sea. To the west of the Refuge lies Prudhoe Bay, which has already experienced significant disturbance and modification due to oil exploration. To the east, just over the Canadian border, lies the Mackenzie River Delta, a large area of fairly low elevation, which is vulnerable to sea level rise (see Figure 4 in the web appendix). While there are large expanses of tundra to the west of the Refuge, and to the east in Canada, and islands to the north of Nunavut, it is unclear how easily species will be able to move around these barriers.

Considering these factors, land and wildlife managers should focus their efforts on four crucial objectives:

1. **Protect the North Slope from disturbance.**
   One way to help preserve the Refuge's most vulnerable species is to limit oil and gas exploration and development, and other activities that disturb wildlife and destroy habitat on the coastal plain tundra. Drilling in the 1002 area, as the Refuge's

coastal plain is known, with its attendant noise, spills, transportation and industrial development, should be permanently prohibited. The effects of shipping, visitation and other potentially disturbing activities should also be carefully monitored.

2. **Maintain linkages to areas of tundra adjacent to the Refuge.**
   While climate change projections indicate that the Arctic will warm more than much of the rest of the country, the region does have the advantage that its habitats are relatively pristine and more connected than in many other areas. Some of the more threatened species in the Refuge may need to move to broader expanses of tundra to the east and west that may persist longer into the future. It is important to maintain connectivity between the Refuge and these other areas, particularly on the Canadian side where islands stretch the northern extent of terrestrial habitats.

3. **Invest in research and monitoring of vulnerable species and habitats.**
   While our climate change vulnerability assessment has value in helping tease out factors and focus attention on potentially vulnerable species, real on-the-ground data and better modeling are needed to understand exactly how these and other species are being affected. Research and monitoring efforts focused on the suite of extremely and highly vulnerable species we have identified will be invaluable in helping conserve these animals. The Refuge should use research and monitoring information to educate the nation about the impacts of climate change on the Refuge's wildlife. Data needed may include:
   - Baseline data sets of variables including vegetation cover, soil type, permafrost extent, species distributions, snow and ice cover, and hydrology.
   - Modeling of climate change impacts to sensitive systems, particularly tundra vegetation.
   - Monitoring of climate and weather conditions, vegetation changes, hydrologic changes, fire frequency and extent, invasive species and forest pest outbreaks, and population trends of vulnerable species.

4. **Adopt as a fundamental management goal enhancing the adaptive capacity of vulnerable species and habitats.**
   This vulnerability assessment focused on Refuge mammals' exposure and sensitivity to climate changes over the next 50 years. The species' overall vulnerability may be reduced by actions to enhance their adaptive capacity. We recommend that the Service develop scenario planning and adaptive management as tools to identify and implement adaptation responses.

For references and an extended description of the methodologies and bibliography please see the Supplementary Material document:

http://www.defenders.org/resources/publications/programs_and_policy/gw/no_refuge_from_warming_supplementary_materials.pdf

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NO REFUGE FROM WARMING

SUPPLEMENTARY MATERIALS

by Katie Theoharides

Contents

Save something wild.

Methods: Using the Climate Change Vulnerability Index

The Climate Change Vulnerability Index (Natureserve, undated) requires inputs that measure Direct Exposure to climate change and Sensitivity to climate change, which includes both Indirect Exposure and Species Sensitivity. The Index combines data on exposure to climate change (in this case changes in moisture and temperature) with information about species sensitivity to climate change resulting from extrinsic factors caused by indirect exposure to changes related to climate change (e.g. sea level rise) and species specific factors such as flexibility of habitat and dietary requirements (Figure 1). The index also allows users to include limited information on a species' documented response to recent or ongoing climate change as well as the results of modeling studies. The output of the Index is a score ranging from extremely vulnerable to not vulnerable/ presumed stable/expansion likely. The index identifies the "critical factors" or the elements that make the species assessed vulnerable. The scores and identification of critical factors can be used to develop targeted conservation efforts and further research projects to help manage the species in a climate change future.

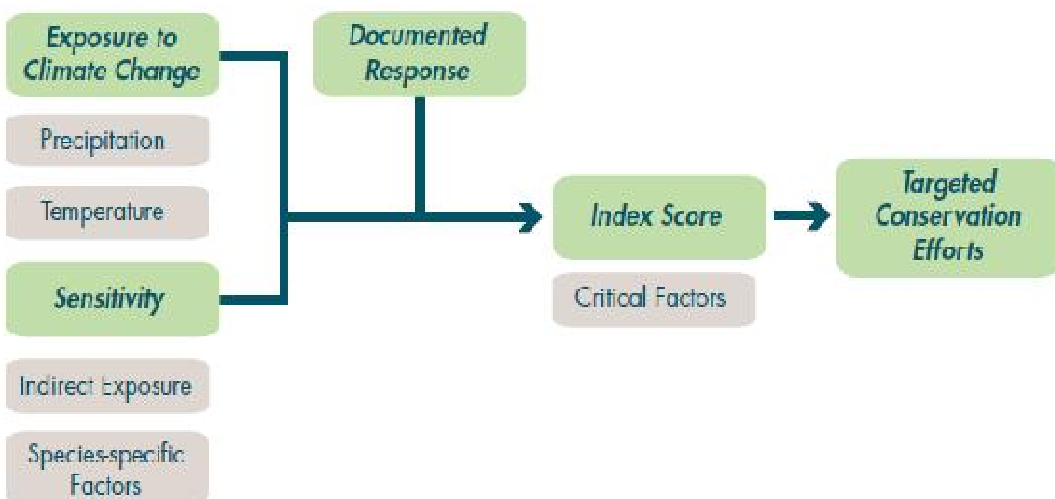

Figure 1: Framework for the NatureServe Climate Change Vulnerability Index. Figure from Glick et al. 2011

The Index divides vulnerability into two components, the exposure to climate change across the range of the species within the assessment area, and the sensitivity of the species to climate change (Figure 1). These two components are mathematically combined to produce the final vulnerability score. In this way exposure is treated as a modifier of sensitivity. A species with traits that make it highly sensitive to climate change will not have a high vulnerability score if the climate across the region it occurs in remains stable (CCVI Guidelines 2010), while a species with broad tolerances and low sensitivity is unlikely to be vulnerable even if the climate changes drastically across its region.

Adaptive capacity of the species is not explicitly addressed in the index, though several sensitivity factors and indirect climate change factors overlap with factors that might contribute to or detract from the adaptive capacity of the species. For example, one factor assesses whether or not the species has been able to respond to ongoing climate change by changing any aspect of its phenology in a beneficial way. This trait could arguably be considered part of adaptive capacity rather than species sensitivity. Similarly dispersal ability, genetic variation, and distribution as related to natural barriers could all be considered as contributing to the adaptive capacity of the species.

Direct Exposure: Climate Change in the Arctic National Wildlife Refuge

The first factor addressed in the Index is **exposure to climate change.** Exposure information captured in the index includes the magnitude of projected changes in average annual **temperature** and **moisture** across the species' range in the assessment area. To incorporate exposure information the Index guidance suggests using ClimateWizard for developing future climate projections. ClimateWizard, a project of the Nature Conservancy, University of Washington and the University of Southern Mississippi provides a source of downscaled temperature and precipitation predictions from 17 Global Circulation Models (GCMS) that can be downloaded and incorporated into GIS for analysis (Girvetz et al. 2009). See below for a more detailed discussion of the General Circulation Models used and the downscaling process.

Change in Temperature

Across the Arctic National Wildlife Refuge temperatures are projected to increase over the next 50 years. These changes range from an increase of 4 degrees F in the most southern portion of the refuge to greater than 6 degrees F in the north of the refuge (Figure 2). Temperature changes will lead to a variety of impacts including changes in snowfall and snowcover, changes in vegetation, alteration of the fire regime, and changes in species phenology and species interactions. These more specific changes are not part of the outputs from the ClimateWizard tool and therefore cannot be modeled specifically for our assessment.

Table 1 shows the percent of the assessment area in each of the temperature ranges defined in the index. The rankings in the severity of change column of the table are assigned scores from NatureServe based on the relative range of expected changes in temperature by Mid-Century. Each individual species profile describes the changes projected for that species' range within the Refuge.

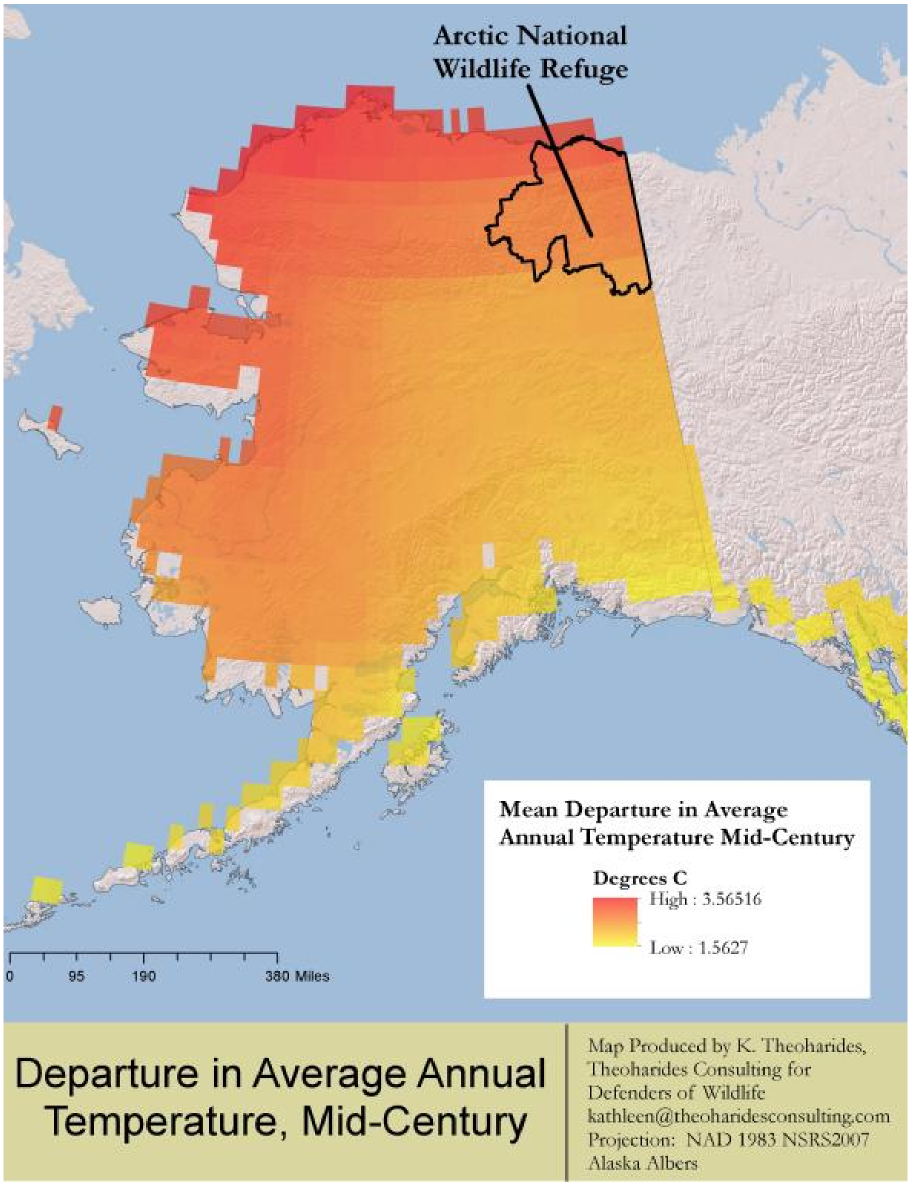

Figure 2: Departure in average annual temperature across the Alaska by Mid-Century.

Table 1: Percent of each category of temperature change in the Arctic Refuge based on ClimateWizard projections. Scope must sum to 100 percent.

Severity of Change	**Temperature Range**	**Scope** (percent of range)
High	>5.5° F (3.1° C) warmer	**7.79%**
Medium High	5.1-5.5° F (2.8-3.1° C) warmer	**57.14%**
Medium Low	4.5-5.0° F (2.5-2.7° C) warmer	**27.27%**
Low	3.9-4.4° F (2.2-2.4° C) warmer	**7.8%**
Insignificant	< 3.9° F (2.2° C) warmer	**0%**
	Total:	**100%**

Change in Moisture

In the lower 48 states the Index version 2.0 includes a Hamon AET:PET moisture metric, rather than changes in precipitation. The Index made this change from the use of precipitation data in the original Index version 1.0 to a more biologically relevant climate variable as species are impacted by available moisture and not precipitation levels directly. The Hamon AET:PET moisture metric used in the Index integrates temperature and precipitation through a ratio of actual evapotranspiration (AET) to potential evapotranspiration (PET), with consideration of total daylight hours and saturated vapor pressure. However, the Hamon AET-PET index employed in the CCVI for the lower 48 states is not available in Alaska so we instead used the percent departure in the historical ratio of Actual Evapotranspiration (AET) to Potential Evapotranspiration to the mid-century projected ratio to indicate how moisture is changing in Alaska. This ratio is available through the ClimateWizard Custom Analysis Tool. Potential Evapotranspiration is defined as the amount of evaporation that would occur if a sufficient water source were available. The actual evapotranspiration (AET) is considered the net result of atmospheric demand for moisture from a surface and the ability of the surface to supply moisture, and PET is a measure of the demand side for moisture. Surface and air temperatures, insolation, and wind all affect this ratio. A loss of moisture over time is indicated by a negative percent departure in the ratio, while a moisture gain is indicated by a positive change (See Table 2). Across the Arctic Refuge moisture change will not be significant as indicated by the AET:PET ratio and may in fact be slightly positive (Figure 3). Changes in the ratio ranged from an increase of .08827 to an increase of .02040. For some caveats about the projected moisture change in the Arctic National Wildlife Refuge, see below.

Table 2: Difference in the ratio of annual AET:PET by mid-century.

Severity	**Moisture range**	**Scope** (percent of range)
Very High	< -0.119	0%
High	-0.097 - -0.119	0%
Medium High	-0.074 - -0.096	0%
Medium Low	-0.051 - -0.073	0%
Low	-0.028 - -0.050	0%
Insignificant	>-0.028	100%
	Total:	100%

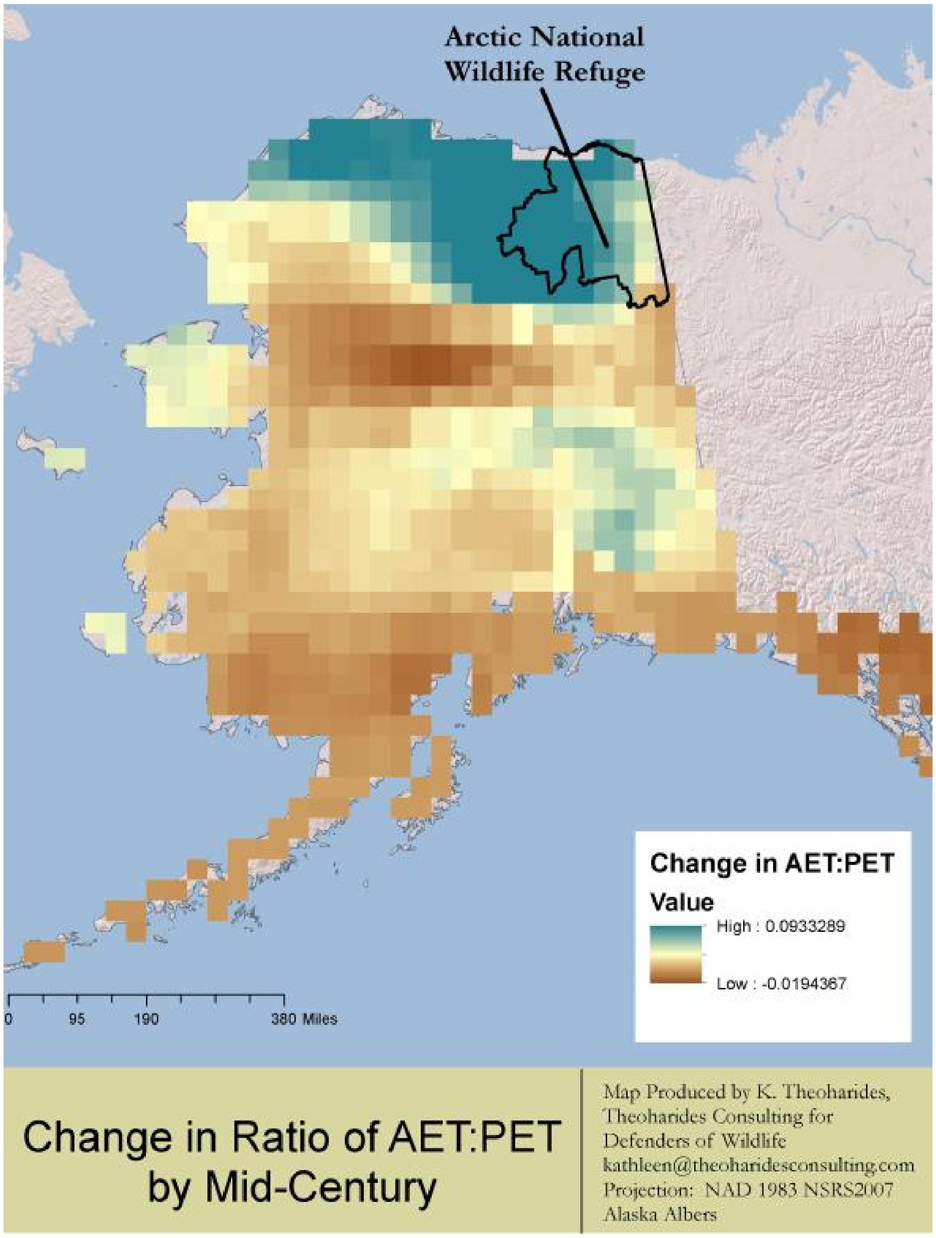

Figure 3: Change in the ratio of AET:PET by mid-century. Change across the refuge was slightly positive, but considered insignificant based on the NatureServe scoring.

Sensitivity to Climate Change

The Index assesses sensitivity by scoring species against 20 factors divided into two categories: **indirect exposure to climate change** (extrinsic sensitivity) **and species-specific sensitivity** (intrinsic sensitivity). Extrinsic sensitivity is sometimes considered adaptive capacity, but in this case the Index treats it as a component of sensitivity.

Species receive a score for each factor ranging from greatly increasing to having no effect on, to decreasing the species' vulnerability. If information is not available the factor can be skipped; the Index can calculate an overall score with as few as 13 of 20 factors. The creators of the Index recommend estimating scores for as many factors as possible and capturing uncertainty and a lack of data by selecting multiple scores for each factor. For detailed descriptions of each factor, please reference the NatureServe Climate Change Vulnerability Index guidance document. Explanations of how each sensitivity factor was treated in our analysis, including any assumptions made, are provided below. We also include details on the background materials used to score each species.

Indirect Exposure to Climate Change

Many species will be affected not only by direct changes in temperature and precipitation, but also by more indirect effects of climate change, such as exposure to sea level rise, and barriers to dispersal and movement. Below are a list of the factors considered in the "Indirect Exposure to Climate Change" category and a brief description of how I treated these.

Sea Level Rise

NatureServe suggests using the scenario of 0.5 to 1m of sea level rise for the assessment. Sea level rise is only an issue for species with ranges that are all or partially within a region that may be subject to the effects of 0.5 to 1m sea level rise and the influences of storm surges in the next 50 years. For example, species whose range within the assessment area occurs 90% of the time in areas subject to sea level rise (e.g. low-lying islands or the coastal zone) will have greatly increased vulnerability due to sea level rise. For our analysis we used imagery available from the Center for Remote Sensing of Ice Sheets (www.cresis.ku.edu/data/sea-level-rise-maps), which provides imagery of the impacts of sea level rise in Alaska and other regions of the world based on different sea level rise scenarios (Figure 4). Most species in our assessment range were not affected by sea level rise because their ranges were not coastal. However, a few species, including the polar bear and the arctic fox, do range in coastal areas and thus they were scored accordingly. Of note: the index does not access whether or not sea level rise will pose a problem for the species, it simply addresses whether the species' current range will be impacted by sea level rise. A species like the polar bear that may be able to move further inland to den and then hunt on top of ice may not in fact be impacted by sea level rise, so scoring here is questionable.

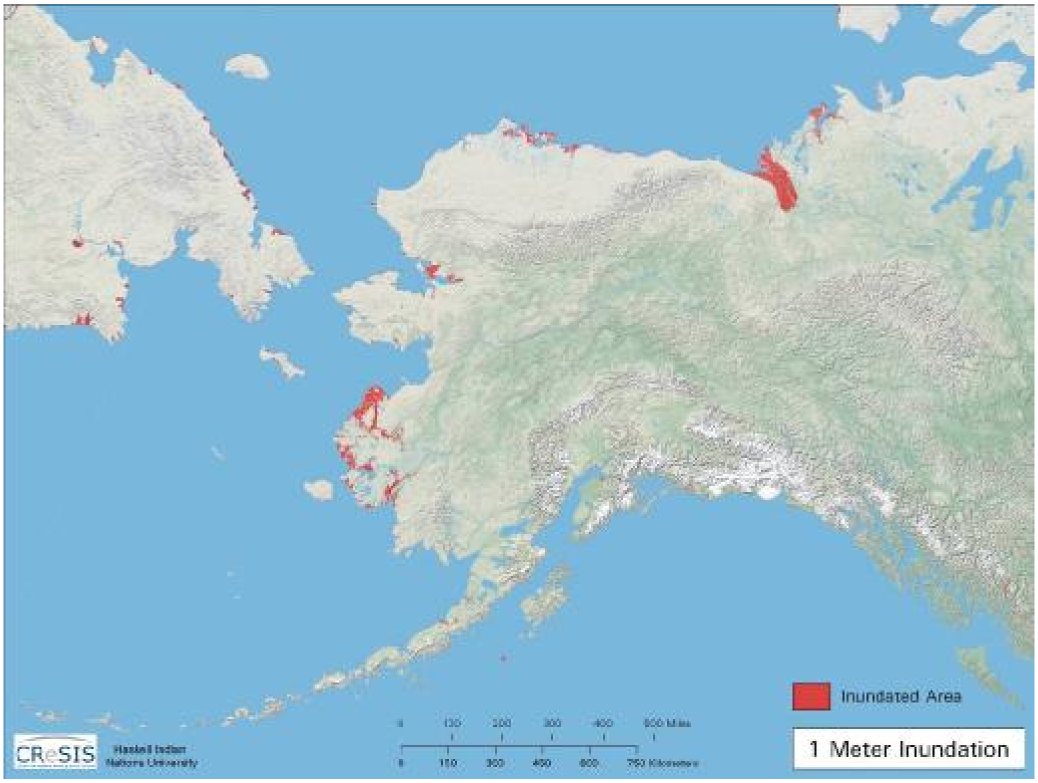

Figure 4: Inundated area of land under a scenario of 1 meter of inundation from sea level rise.

Natural Barriers

The index considers natural barriers to be topographic, geographic or ecological barriers that limit a species' ability to move in response to climate change. The index defines barriers as "features or areas that completely or almost completely prevent movement or dispersal of species" (Young et al. 2010). The inherent assumption is that species will be more vulnerable if they are prevented from moving in response to climate change. Species in the Arctic National Wildlife Refuge are keenly impacted by barriers to northward movement in the form of the Beaufort Sea and arctic sea ice. Most of the species assessed are at the northern edge of their range in our assessment area due to the simple fact that they run out of land and suitable habitat to the north. While some species may be able to move east into Canada in order to go further north and respond to shifting tundra habitat and warming temperatures, the ocean coupled with the mountainous terrain presents many natural barriers to the species assessed. Species that make their home in the tundra may be particularly vulnerable because of projected shrub and boreal vegetation encroachment to the south, coupled with meeting a hard barrier of ice and ocean as well as rising sea levels to the north. For species not expected to see significant habitat shift in next 50 years (e.g. species who live in boreal habitat), or species whose range does not extend to the northern edge of the refuge the impact of barrier was usually scored as neutral.

Anthropogenic Barriers

Anthropogenic barriers are treated the same as natural barriers except that they result from human land use such as areas of intensive urban or agricultural development, waters subject to chemical pollution, or dams that block fish movement. NatureServe suggests assessing the intensity of land use in the assessment area and in the direction of expected species movements using the Wildland-Urban Interface of the Silvis Lab (University of Wisconsin-Madison and the USDA Forest Service). This dataset is not available in Alaska, so we used the National Land Cover Dataset (NLCD) for 2001 from the Multi-Resolution Land Characteristics Consortium (http://www.mrlc.gov/). NLCD 2001 data maps standardized land cover components in the following categories:

- Open water
- Perennial snow/ice
- Developed, open space
- Developed, low intensity
- Developed, medium intensity
- Developed, high intensity
- Barren land
- Deciduous forest
- Evergreen forest
- Mixed forest
- Dwarf scrub
- Shrub/scrub
- Grassland/Herbaceous
- Sedge/Herbaceous
- Moss
- Pasture Hay
- Cultivated crops
- Woody wetlands
- Emergent herbaceous wetlands

We downloaded the NLCD data and brought it into a GIS environment to analyze landcover across the assessment area and in a 60-mile buffer on the east and west of the refuge, which represents the expected direction of species movement. Significant developed and agricultural lands were not located within the refuge or in the buffer around it so this factor was scored as NEUTRAL for all species. If significant oil and gas development were to be allowed in the refuge or to take place in the buffer area in the future, anthropogenic barriers could become a problem for some species.

Land Use Changes Designed to Mitigate Climate Change Impacts

The index also addresses the effects of actions that are taken by human communities to mitigate or adapt to climate change on species in the assessment area. For example, a high future wind or solar power development in an assessment area may negatively impact certain species like bats or desert tortoises. The Index suggests that areas with a high likelihood of wind or solar power development based on maps of resource potential or other knowledge should be scored to reflect this risk to species that could be impacted The National Renewable Energy Laboratory (NREL.gov) provides maps of energy potential for different types of renewable energy including wind and solar. Similarly, actions taken to adapt to rising seas by building fortifications such as sea walls and dykes may be detrimental to species that use wetlands and beaches. This factor is not intended to capture habitat loss from on-going human activities, such as oil and gas development, deforestation or high intensity agriculture. Because we are assessing a National Wildlife Refuge we made the assumption that activities related to mitigation or adaptation are unlikely to occur on a large enough scale within the Refuge to impact the species we assessed. Shoreline fortifications in response to sea level rise may occur in the area of Kaktovik in the 92,000 acres of land owned by the Kaktovik Inupiat Corporation which falls within refuge boundaries. However, the species assessed are not likely to be adversely impacted by shoreline fortifications and it is unlikely that these fortifications would occur across a large enough area to have a significant impact. Another threat in some areas is aforestation as a mitigation strategy. While aforestation may take place in some southern refuges, we made the assumption that a large-scale tree planting program in the High Arctic would not be a high priority, especially given concerns over the loss of tundra habitat.

Species-Specific Sensitivity

To assess species intrinsic sensitivity to climate change the Index asks the user to enter information about the species dispersal and movement ability, its temperature and moisture regime, dependence on disturbance events, relationship with ice or snow-cover habitats, physical specificity to geological features, interactions with other species, and phonological responses to changes in climate. In order to characterize species sensitivity to climate change based on life history data and species ecology we completed a literature review for each species. This review involved extensive searching of scientific databases for peer-reviewed studies as well as the use of species databases such as the NatureServe Explorer which provides access to summarized species information based on already compiled data and literature review. Because many of these factors may be unknown for certain species the index allows the user to only enter data on 13 of the 20 sensitivity factors. The more information provided, the better the accuracy of the score.

The factors below are described in further detail in the Index guidelines provided by NatureServe.
C1. Dispersal and Movements: This factor assesses the species ability to disperse and move across the landscape, based on the assumption that species that have high dispersal capacity may be less vulnerable because they have the capacity to move in response to habitat shifts caused by climate change. Species were scored here according to the Index guidelines. No assumptions were made beyond the directed scoring procedure described in the index guidelines (see p. 21 of guidelines document). Information on dispersal distances was collected from literature review and use of online databases.

C2: Predicted Sensitivity to Temperature and Moisture Changes: This factor scores each species based on the conditions of temperature and moisture that the species can exist under successfully. Species with more narrow abiotic tolerances or requirements, such as species who live in vernal pools or cold alpine environments may be more vulnerable to habitat loss from climate change than species with more widespread distributions" (Young et al. 2010).

a. Temperature: This factor has two components, historical thermal niche and physiological thermal niche.

Historical thermal niche (exposure to past variations in temperature): The index quantifies large-scale variation in temperature that a species has experienced in the last 50 years "as approximated by mean seasonal temperature variation (difference between highest mean monthly maximum temperature and lowest mean monthly minimum temperature) for occupied cells within the assessment area. It is a proxy for species' temperature tolerance at a broad scale" (Young et al. 2010). To assess this factor we used past climate data from the ClimateWizard (available at the 4km2 scale) to make a map in GIS of the difference between the highest mean monthly temperature (July) and the lowest mean monthly temperature (January). We extracted this map of differences using the boundaries of the Arctic Refuge and completed a calculation using raster calculator that provided the difference in temperature across every $4km^2$ grid cell in the park between the average annual high and low. We compared this range to the range of temperature variation given in the NatureServe guidelines to score the factor.

It should be noted that scoring for the factor is based on comparisons in temperature variation to the lower 48 states and may not be relevant in Alaska. Also of concern is the fact that this variable is only considered across the range of the species within the assessment area, rather than across the species' entire distribution. Because the assessment area in this study was small and is an area of relatively stable seasonal temperature variability, historical thermal niche was scored as a factor increasing vulnerability for every species considered in this analysis. For species like the coyote or shrew that have a large range extending into the southern U.S. looking only at temperature variation within the assessment area would seem to falsely amplify the importance of this factor in determining the species vulnerability. However, we believe that inclusion of physiological thermal niche (see below) in the analysis helps to mitigate this potential problem by allowing separate consideration of the species' thermal tolerances across the breadth of its range.

Physiological thermal niche: The physiological thermal niche factor is scored based on how restricted a species is to relatively cool or cold habitats *within the assessment area* that are likely to be vulnerable to loss in extent as a result of climate change. This could include species that occur in the assessment area's northernmost areas, highest elevation zones, or coldest waters" (Young et al. 2010). The Index is not asking about the species distribution relative to other species anywhere in the world, but rather to other species *within the assessment area.* So it is really a question of the relative thermal habitat requirements of the species. If it is distributed widely across the assessment area and does not appear to require a certain cool, or colder than average habitat type within the assessment area than it may be less vulnerable than a species who is limited to alpine pockets with very cold temperatures. For our assessment species that were limited to arctic tundra, alpine areas, or the northern-most portions of the refuge were considered the most sensitive to changes in temperature (that is this factor would Greatly Increase their vulnerability to climate change). Species with wide ranges throughout Canada and the lower 48 states and species that make their primary habitat in boreal forests or other forest types were considered less vulnerable or not at all vulnerable under this factor (Neutral). Species that rely on snow and ice are scored later in the assessment. The Index guidance notes that temperature and hydrologic regime are often difficult to separate and suggest that if temperature is the overriding factor it should be scored here. This is the assumption we worked with.

<u>b. Precipitation:</u> As with temperature, this factor has two components, historical hydrological niche and physiological hydrological niche.

<u>Historical hydrological niche:</u> The index quantifies large-scale variation in temperature that a species has experienced in the last 50 years using mean annual variation in precipitation the species has experienced across the assessment area. The guidance instructs the user to overlay the species range on the Climate Wizard mean annual precipitation map and subtract the lowest pixel value from the highest pixel value to assess this factor, using the extremes *within the assessment area.* Again, it should be noted that scoring for the factor is based on comparisons in temperature variation to the lower 48 states and may not be as relevant in Alaska. Also of concern is the fact that this variable is only considered across the range of the species within the assessment area, rather than across the species' entire distribution. For species like the coyote with large ranges covering a variety of moisture regimes, examining variation within the assessment area seems to falsely amplify the importance of this factor in determining the species vulnerability.

<u>Physiological hydrological niche:</u> Scores for this factor are based on species requirements for a very specific precipitation or hydrologic regime, such as strongly seasonal patterns of precipitation or specific wetland or aquatic habitats such as seeps or vernal pools that may be highly vulnerable to loss across the assessment area. The dependence on these habitats can be permanent or seasonal (Young et al. 2010). In order for this factor to greatly increase or increase a species' sensitivity to climate change the species must be dependent on a very narrowly defined regime. Species that live near wetlands, riparian areas or other "moist areas" were not considered to be strongly tied to a specific hydrologic regime. Examples of species that may be quite sensitive to this factor are species dependent on ephemeral pools.

This factor also asks the assessor to consider the direction of expected climate change in their ranking. Since the Arctic Refuge assessment area is not expected to see significant changes in moisture based on our ClimateWizard projections this factor was often less important. One item of note: Species that are dependent on snow falling as dry snow rather than heavy wet snow or ice were given a score of increase under this factor. These include species like muskoxen that depend on snow that is light and dry to allow them access for grazing in the winter. This appears to be the best place to score a change in the characteristics of precipitation.

c. Dependence on a specific disturbance regime: This factor was scored using the following guidance (for specific scoring see guidance doc). "This factor pertains to a species' response to specific disturbance regimes such as fires, floods, severe winds, pathogen outbreaks, or similar events. It includes disturbances that impact species directly as well as those that impact species via abiotic aspects of habitat quality. For example, changes in flood and fire frequency/intensity may cause changes in water turbidity, silt levels, and chemistry, thus impacting aquatic species sensitive to these aspects of water quality. The potential impacts of altered disturbance regimes on species that require specific river features created by peak flows should also be considered here; for example, some fish require floodplain wetlands for larval/juvenile development or high peak flows to renew suitable spawning habitat. Use care when estimating the most likely effects of increased fires; in many ecosystems, while a small increase in fire frequency might be beneficial, a greatly increased fire frequency could result in complete habitat destruction. Finally, be sure to also consider species that benefit from a lack of disturbance and may suffer due to disturbance increases when scoring this factor" (Young et al. 2010).

Fires were one of the main disturbances we considered under this category as studies suggest fire activity will increase in Alaska often leading to changes in age structure and species dominance in boreal forest (Rupp 2008). Other disturbances affecting species in our assessment included increased parasite and pest outbreaks and increased flooding. Some changes in disturbance regime may actually benefit species and the index is constructed to reflect this.

d. Dependence on ice, ice-edge, or snow cover habitats: This factor assesses a species' dependence on habitats associated with ice or snow across its range in the assessment area. A score of "greatly increase" is for species that are highly dependent (more than 80% of occurrences in range) on snow or ice habitat, such as the polar bear. Many of our species use the snow for burrowing, hiding from predators or hunting. These species were scored as "increase" or "somewhat increase", depending on how strongly they were tied to snow use for these activities. Similarly, species that molt in the winter and take on a white coat were considered to fit into the "increase" category as lack of snow would make them highly visible to predators. Changes in snow condition (i.e. icing over, wetter snow, etc) were considered under the physiological hydrological niche category.

C3: Restriction to uncommon geological features or derivatives: This factor was scored exactly as according to the guidance document for the index. Information on restriction to uncommon geologic features was collected from literature review and use of online databases.

C4: Reliance on interspecific interactions

a. Dependence on other species to generate habitat: Scored as described in guidance document.

b. Dietary versatility: Scored as described in guidance. If species that make up the diet of the species being assessed were considered vulnerable to climate change we used this information as well (e.g. lemmings are an important prey item for arctic fox and are considered extremely vulnerable to climate change).

c. Pollinator versatility: plants only, not considered in our assessment.

d. Dependence on other species for propagule dispersal: mainly for plants, insects and species with immobile progeny; not a factor in our assessment

e. Forms part of an interspecific interaction not covered by 4a-d: Scored as described in guidance. Not a major factor for most of our species. It is important to note that competitive relationships (or other negative interactions) are not considered under this heading. All species interactions described are positive and changes in competitive interactions are not considered anywhere in the index.

C5: Genetic factors

a. Measured genetic variation: Scored as described in guidance document.

b. Occurrence of bottlenecks in recent evolutionary history: Scored as described in guidance document.

C6: Phenological response to changing seasonal temperature and precipitation dynamics: Scored as described in guidance document. This factor assesses the degree to which a species has been able to respond to ongoing climate change through phenological changes (such as the timing of breeding or end of hibernation). This factor was of limited use for our assessment because much of the available data on phenology was not from studies in the assessment area as required by the index. It also does not make sense that this factor was considered in this section rather than section D on observed or modeled responses to climate change. It might be more useful if the index included a sensitivity trait to account for species with life histories that make them particularly susceptible from a phenology standpoint (i.e. species that hibernate, species that time their breeding cycles with emergence of other species, species that molt).

Overall Scoring

The following excerpt from the creators of the index describes how the scoring for the tool works.

Excerpt from:

Young, B. E., K. R. Hall, E. Byers, K. Gravuer, G. Hammerson, A. Redder, and K. Szabo. 2010. A natural history approach to rapid assessment of plant and animal vulnerability to climate change. In *Conserving Wildlife Populations in a Changing Climate*, edited by J. Brodie, E. Post, and D. Doak. University of Chicago Press, Chicago, IL.

To calculate an overall score, the index first combines information on exposure and sensitivity to produce a numerical sum, calculated by adding subscores for each of the extrinsic and intrinsic species sensitivity factors. Factors scored to “somewhat increase,” “increase,” and “greatly increase” sensitivity to climate change receive a values of 1.0, 2.0, and 3.0, respectively. Those scored to “somewhat decrease” and “decrease” sensitivity receive values of -1.0 and -2.0, respectively. Factors for which there are no data or that are scored as “neutral” to vulnerability receive a value of zero. If a factor is scored in multiple levels (e.g., both “somewhat increase” and “increase”), the index uses an average of the values for these levels.

The value for each factor is weighted by exposure to calculate a subscore for the factor. Climate influences vulnerability factors in different ways. For most factors, the exposure weighting is a climate stress value that combines data on projected change in both temperature and precipitation. In these cases, the weighting factor is the product of weightings for temperature (0.5, 1.0, 1.5, or 2.0 depending on whether the temperature across the range of the species is predicted to increase by less than zero, one, two, or greater than two standard deviations of the average temperature increase for the conterminous United States) and precipitation (0.5, 1.0, 1.5, or 2.0 depending on whether the precipitation across the range of the species is predicted to increase or decrease by less than zero, one, two, or greater than two standard deviations of the average precipitation change for the conterminous United States). Other weightings are either fixed at 1.0 in the case of sea level rise (which occurs independent of local climate), tied solely to temperature for historical and physiological thermal niche (thus ranging from 0.5-2.0 as described above), or the average of four times the precipitation and one time the temperature weighting (roughly accounting for how temperature interacts with precipitation) for historical and physiological hydrological niche.

General Circulation Models and Downscaling

To build a downscaled climate model the ClimateWizard requires the user to select a General Circulation Model or ensemble models (Table 3) and a future emissions scenario. General Circulation Models (GCMs) simulate the complex interactions of the atmosphere, oceans, land surface and ice. The models work by balancing (or nearly balancing) incoming energy in the form of short wave electromagnetic radiation with outgoing energy in the form of long wave electromagnetic radiation; any imbalance will result in a change in the average temperature of the earth (www.climatewizard.org).

Table 3: Global Circulation Models available for downscaling through ClimateWizard. Table from www.climatewizard.org

BCCR-BCM2.0	Norway	Bjerknes Centre for Climate Research
CGCM3.1(T47)	Canada	Canadian Centre for Climate Modelling & Analysis
CNRM-CM3	France	Météo-France / Centre National de Recherches Météorologiques
CSIRO-Mk3.0	Australia	CSIRO Atmospheric Research
GFDL-CM2.0	USA	US Dept. of Commerce / NOAA / Geophysical Fluid Dynamics Laboratory
GFDL-CM2.1	USA	US Dept. of Commerce / NOAA / Geophysical Fluid Dynamics Laboratory
GISS-ER	USA	NASA / Goddard Institute for Space Studies
INM-CM3.0	Russia	Institute for Numerical Mathematics
IPSL-CM4	France	Institut Pierre Simon Laplace
MIROC3.2(medres)	Japan	Center for Climate System Research (The University of Tokyo), National Institute for Environmental Studies, and Frontier Research Center for Global Change (JAMSTEC)
ECHO-G	Germany / Korea	Meteorological Institute of the University of Bonn, Meteorological Research Institute of KMA, and Model and Data group.
ECHAM5/MPI-OM	Germany	Max Planck Institute for Meteorology
MRI-CGCM2.3.2	Japan	Meteorological Research Institute
CCSM3	USA	National Center for Atmospheric Research
PCM	USA	National Center for Atmospheric Research
UKMO-HadCM3	UK	Hadley Centre for Climate Prediction and Research / Met Office

GCMs are driven by emission scenarios or assumptions about how population, energy use and technology are likely to change and develop in the future and the resulting emissions of greenhouse gases. Emission scenarios are essentially storylines that describe what the future *might* look like taking different social, economic, cultural, technological, and other human-based factors into account. Emission scenarios are used as inputs into these models to simulate changes in temperature, precipitation and other climate variables.

In order to make meaningful predictions about how temperature and moisture will change across a particular region, these global models need to be downscaled. ClimateWizard allows the user to downscale any or all of its GCMs using the method described below:

> The following was taken from *Maurer, E. P., L. Brekke, T. Pruitt, and P. B. Duffy (2007), Fine-resolution climate projections enhance regional climate change impact studies, Eos Trans. AGU, 88(47), 504* and describes the data presented in the ClimateWizard:
>
> A statistical technique was used to generate gridded fields of precipitation and surface air temperature over the conterminous United States and portions of Canada and Mexico. The method involves (1) a quantile mapping approach that corrects for GCM biases, based on observations of 1950–1999; and (2) interpolation of monthly bias-corrected GCM anomalies onto a fine-scale grid of historical climate data, producing a monthly time series at each 1/8-degree grid cell. The method has been used extensively for hydrologic impact studies (including many with ensembles of GCMs) and in a variety of climate change impact studies on systems as diverse as wine grape cultivation, habitat migration, and air quality.
>
> The downscaled data are freely available for download at the Green Data Oasis, a large data store at LLNL for sharing scientific data (http://gdo-dcp.ucllnl.org/downscaled_cmip3_projections/).
>
> Users can specify particular models, emissions scenarios, time periods, geographical areas, and raw data or summary statistics. All data are archived in a standard netCDF format, a self-describing machine-independent format for sharing gridded scientific data. The full text of this article can be found in the electronic supplement to this EOS issue (http://www.agu.org/eos_elec/).

DEVELOPING A FUTURE CLIMATE CHANGE SCENARIO USING CLIMATEWIZARD

The user interface on ClimateWizard is shown in Figure 5 below. In order to build a scenario of future climate change the user must select key inputs into the climate model and then download the data in a GIS compatible format. The user is asked to select an analysis area or spatial extent of the data, the time period (mid-century, end of century or past 50 years), type of map, measurement (precipitation or temperature) and the key inputs into the future climate model (emission scenario and general circulation model).

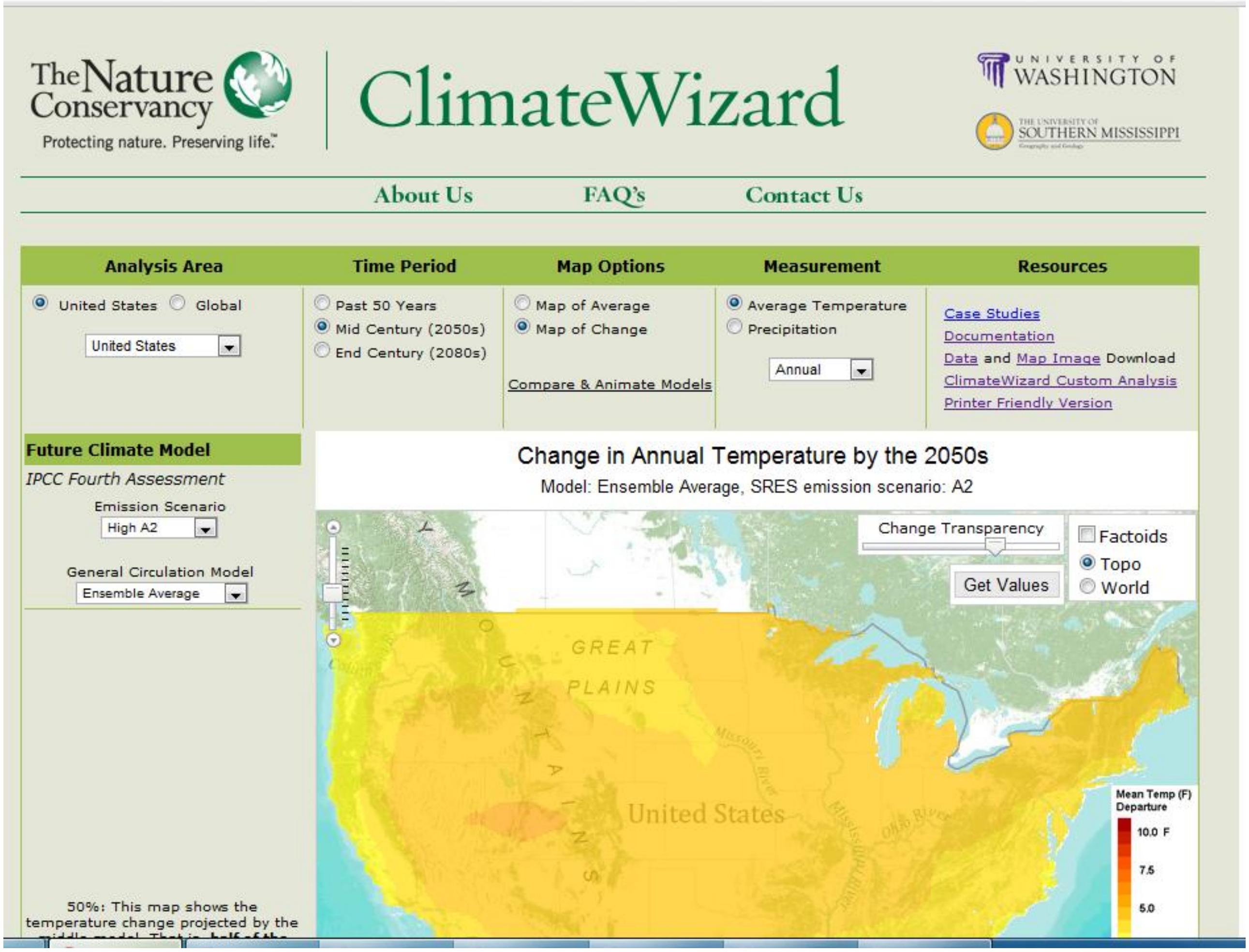

Figure 5: ClimateWizard user interface. The tool asks the user to select the analysis area, the time period, the type of map, measurement and the future climate model inputs (www.climatewizard.org).

For our analysis in Alaska we used a global climate model that combined an average ensemble model of all 17 available GCMs and a "High" A2 emissions scenario to produce both temperature and moisture data (Table 4). Because we used moisture data and not just standard precipitation data we needed to use the ClimateWizard Custom Analysis Tool (www.climatewizard.org/custom) which provides access to more types of data analysis and projections. All projections were made for the middle of the century as directed by the NatureServe CCVI guidance document.

Table 4: Data inputs used for climate projections in the Arctic Refuge

	Temperature	**Moisture**
General Circulation Model	Ensemble Average	Ensemble Average
Emission Scenario	High A2	High A2
Time period	Mid-Century	Mid-Century
Data produced	Average annual change in temperature as ASCII file for input in ArcGIS environment	Percent departure from historical ratio of AET: PET downloaded as ASCII map for input into ArcGIS
Spatial resolution	50km2	50km2

Data Processing

All data was processed in an ESRI ArcGIS 10.0 environment and a full list of steps is provided in Table 6 below along with a brief narrative. This information will not be particularly relevant to non-GIS users.

In order to use the climate exposure data produced with the ClimateWizard tool, we downloaded both temperature and moisture data for the state of Alaska based on the Climate Model described above. The data is downloaded in ASCII (American Standard Code for Information Exchange) format. ASCII is a character encoding scheme based on an ordering of the English alphabet. ASCII files can be imported into a GIS environment and converted into grids or raster data. We brought both the temperature and moisture ASCII files into a GIS environment by using the ArcGIS toolbox to convert the ASCII files to grid files. Grid files display the data as pixels containing different values. We also imported a shapefile of the Alaska National Wildlife Refuge boundaries into the GIS and standardized the projections of all files to NAD_1983_NSRS2007_Alaska_Albers.

Once we created grids of temperature and moisture change I had to change these grids from grids with floating point pixels to integer pixels so that their attribute information could be viewed. In order to preserve the accuracy of the data (integer grids cannot store decimals) we first multiplied the temperature and moisture data by 100 and then converted each grid to an integer file using the raster calculator. We used the Extract by Mask tool with the boundaries of the Arctic Refuge set as the mask to produce maps of change across our assessment area, the Alaska National Wildlife Refuge. This process extracts only data from areas inside the assessment area so that calculations can be made only in the area in question.

The Index requires that the user enter the portion of the species range over the assessment area that falls into the following temperature exposure categories: <3.9 degrees F, 3.9 – 4.4 degrees F, 4.5 – 5.0 degrees F, 5.1 – 5.5. degrees F and > 5.5 degrees F. To calculate the portion of each species range that falls into the above temperature exposure categories, we needed to assess the change of temperature across the species range in the Arctic Refuge. This required an additional extraction of temperature and moisture data using species range data as an additional mask. Species ranges were downloaded in GIS format (as vector files) from the NatureServe Explorer's Digital Distribution Maps of Mammals of the Western Hemisphere (http://www.natureserve.org/getData/animalData.jsp). Once downloaded, we standardized the projections of these files to NAD_1983_NSRS2007_Alaska_Albers. These maps are used as a mask to extract the temperature and moisture data in order to obtain information about the degree of climate change a species will be exposed to in the assessment area.

We extracted temperature and moisture data for each species and exported the attribute tables as dbf files. We then opened the exported dbf files in Excel and calculated the percentage of each species' range that fell into the exposure categories for temperature and moisture, described above. The calculation is done by using the Counts field in the attribute data to sum the number of pixels that fall within a certain category. Each sum is divided by the total of all pixels covering the assessment area and multiplied by 100 to give a percent of assessment area in each category. Results were entered into the CCVI Section A.

Table 6: GIS processing steps and output files created during analysis.

Data Inputs into GIS	**Processing Steps and Output Files**
Average Annual Temperature Departure, Mid-Century	1. Download ASCII file for average annual temperature change in Alaska from ClimateWizard 2. Convert ASCII file to faster grid using ArcToolbox à Conversion Tools à ASCII to Raster (chose float for output data type) = GRID1 (Floating Point) Temperature Change in Alaska 3. Define projection of file to WGS 1983 as specified in ClimateWizard 4. Re-project file to NAD_1983_NSRS2007_Alaska_Albers 5. In ArcToolbox à Map Algebra à Raster Calculator multiply the grid by 100 and convert from a float to an integer using the INT function. = GRID2 (Integer) Temperature change in Alaska 6. Use the following to extract the grid cell information across the assessment area: In ArcToolbox à Spatial Analyst à Extraction à Extract by Mask. Enter the boundary file for Alaska National Wildlife Refuge as the "input raster or feature mask" and GRID2 as the input raster. = GRID3 (Integer) Temperature change in the Arctic Refuge 7. Add species range data for species of interest and ensure file is correctly projected following procedure below. 8. Use the following to extract the grid cell information across the species range in assessment area: In ArcToolbox à Spatial Analyst à Extraction à Extract by Mask. Enter the species range file as the "input raster or feature mask," and GRID3 as the input raster. =GRID4(Integer) Temperature change across species range in the Arctic Refuge 9. Open the attribute table for the new grid created from extraction and export this attribute table as a .dbf file. 10. Open the .dbf file in Microsoft excel and calculate the sum and percentage of the area within each category given in Section A: Temperature Change of the CCVI using the Count field from the grid file.
Moisture Data	1. Download ASCII file for the average difference in AET:PET in Alaska from ClimateWizard 2. Convert ASCII file to faster grid using ArcToolbox à Conversion Tools à ASCII to Raster (chose float for output data type) = GRID1 (Floating Point) Moisture Change in Alaska 3. Define projection of file to WGS 1983 as specified in ClimateWizard 4. Re-project file to NAD_1983_NSRS2007_Alaska_Albers 5. In ArcToolbox à Map Algebra à Raster Calculator multiply the grid by 100 and convert from a float to an integer using the INT function.

	= GRID2 (Integer) Moisture change in Alaska 6. Use the following to extract the grid cell information across the assessment area: In ArcToolbox à Spatial Analyst à Extraction à Extract by Mask. Enter the boundary file for Alaska National Wildlife Refuge as the "input raster or feature mask" and GRID2 as the input raster. = GRID3 (Integer) Moisture change in the Arctic Refuge 7. Add species range data for species of interest and ensure file is correctly projected following procedure below. 8. Use the following to extract the grid cell information across the species range in assessment area: In ArcToolbox à Spatial Analyst à Extraction à Extract by Mask. Enter the species range file as the "input raster or feature mask," and GRID3 as the input raster. =GRID4(Integer) Moisture change across species range in the Arctic Refuge 9. Open the attribute table for the new grid created from extraction and export this attribute table as a .dbf file. 1. Open the .dbf file in Microsoft excel and calculate the sum and percentage of the area within each category given in Section A: Temperature Change of the CCVI using the Count field from the grid file.
Alaska National Wildlife Refuge Boundary	1. Add shapefile to map 2. Change projection to NAD_1983_NSRS2007_Alaska_Albers 3. Use as analysis mask as described above
Species Range Boundaries	1. Download species range maps from NatureServe 2. Add shapefiles to map 3. Define projection to GCS North American 1983 4. Convert projection to NAD_1983_NSRS2007_Alaska_Albers 5. Use as analysis mask as described above

Climate Change Vulnerability Index: Caveats Regarding Exposure, Sensitivity, and Certainty

The Index is limited in the data it uses to develop a scenario of future climate change the species will be exposed to. For example, it does not include biologically relevant climate changes such as changes in snow cover, monthly temperature changes, changes in degree days or changes in precipitation during certain critical periods. While recognizing that this weakness makes the index more accessible, it is also important to note that studies with more detailed climate change scenarios will likely lead to more thoroughly developed vulnerability assessments. In order to assess the sensitivity factors and include other information about how the climate might change and how these changes may impact the species we assessed, we relied on published study results and summary reports. We include a brief description of these results in the development of the climate change scenario below.

From the Arctic Climate Impacts Assessment (2005):

- The duration of the snow-free period at high northern latitudes increased by 5 to 6 days per decade and the week of the last observed snow cover in spring advanced by 3 to 5 days per decade between 1972 and 2000.
- The treeline is very likely to advance, perhaps rapidly, into tundra areas of northern Eurasia, Canada, and Alaska, as it did during the early Holocene, reducing the extent of tundra and contributing to the pressure upon species that makes their extinction possible.
- Forests are likely to replace a significant portion of the tundra and this will affect the composition of species and habitat availability for tundra species. Increasing forest cover will also lead to a decrease in albedo which will increase positive feedback in climate system. Forest development is likely to also alter local climate by increasing temperature.
- Species that today have more southerly distributions are very likely to extend their ranges north, displacing Arctic species.
- Permafrost is very likely to decay and thermokarst develop, leading to erosion and degradation of Arctic peatlands. Unlike the early Holocene, when lower relative sea level allowed a belt of tundra to persist around at least some parts of the Arctic Basin when treelines advanced to the present coast, sea level is very likely to rise in the future, further restricting the area of tundra and other treeless Arctic ecosystems.
- Taxa most likely to expand into tundra are boreal taxa that currently exist in river valleys and could spread into the uplands, or animal groups such as wood-boring beetles that are presently excluded due to a lack of food resources. Some animals are Arctic specialists and could possibly face extinction. Those plant and animal species that have their centers of distribution in the high or middle Arctic are most likely to show reduced abundance in their current locations should projected warming occur.

From the "Preliminary Report on Projected Vegetation and Fire Regime Response to Future Climate Change in Alaska" (Rupp 2008):

- Model simulations suggest an increase in cumulative area burned through 2099 and a general increase in fire activity in response to warming temperatures and less available moisture.
- Likely shift in boreal vegetation from a spruce dominated landscape to more deciduous vegetation in the next 50 years.
- Increased deciduous dominance on the landscape is likely to result in a change in patch dynamics and age structure in forests with large regions of mature, unburned spruce being replaced by a more patchy distribution of deciduous forests and younger spruce.

From "Evaluating observed and projected future climate changes for the Arctic using the Köppen-Trewartha climate classification" (Feng et al. 2011) (http://newsroom.unl.edu/announce/todayatunl/240/1862):

- By the end of the century, the annual average surface temperature in Arctic regions is projected to increase by 5.6 to 9.5 degrees Fahrenheit, depending on the greenhouse gas emission scenarios.
- The warming, however, is not evenly distributed across the Arctic. The strongest warming in the winter (by 13 degrees Fahrenheit) will occur along the Arctic coast regions, with moderate warming (by 4 to 6 degrees Fahrenheit) along the North Atlantic rim.

- The projected redistributions of climate types differ regionally; in northern Europe and Alaska, the warming may cause more rapid expansion of temperate climate types than in other places.

- Tundra in Alaska and northern Canada would be reduced and replaced by boreal forests and shrubs by 2059. Within another 40 years, the tundra would be restricted to the northern coast and islands of the Arctic Ocean.
- The melting of snow and ice in Greenland following the warming will reduce the permanent ice cover, giving its territory up to tundra.

"Certainty" within the context of the CCVI refers to whether or not the Monte Carlo simulations performed by the algorithm fall into the same category most or all of the time. In this analysis, most of the species ended up in the same vulnerability category in every run of the simulation, thus rating a "very high" certainty value. Where certainty was "low" due to splits in the model runs between different vulnerability categories, we have indicated such in the text and provided an assessment of which factors seemed to cause the variation between simulations.

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Arctic National Wildlife Refuge: Economics of Potential Oil Development

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Table of Contents

Executive Summary

Background

To some, drilling for oil and gas in the Coastal Plain of the Arctic National Wildlife Refuge (Coastal Plain) promises abundant, cheap energy that would displace oil imports, lower domestic gas prices, boost employment, and raise revenue to bring down the deficit. These promises, however, are based on outdated information and rosy assumptions about how much oil the Coastal Plain may hold, the price the oil may fetch, and the speed with which oil and gas could be found, extracted, and brought to market. Given the enormous risk to ecosystems and human welfare that such oil exploration and development would impose, it is essential that promised benefits be closely, carefully, and critically examined.

Estimates of Undiscovered Oil on the Coastal Plain

Oil under the Coastal Plain are unproven reserves, meaning there is no guarantee that oil is there and could one day be produced and sold. Ultimately, the only oil that matters is economically recoverable oil--that portion of technically recoverable oil which can be produced for less than the price of oil in the market—contingent on its discovery (Energy Information Administration, 2014). The U.S. Geological Survey (USGS) in 1998 estimated that there is a 50% chance that the Coastal Plain holds 10.4 billion barrels (BBO) of technically recoverable oil, a 95% chance that it holds up to 5.9 BBO, and a 5% chance that as much as 15.2 BBO are present (Attanasi & Freeman, 2009). Economically recoverable oil would be fraction of these volumes. Given the wide range of these estimates (not to mention the fact that they have not been updated in 20 years), Congress should be cautious about relying on oil from the Coastal plain to solve America's energy, budgetary, or broader economic problems.

Arctic Refuge Production Impact on U.S. and Global Oil Supply

Previous assessments suggest that during its peak year of production, the Coastal Plain could bring 700,000 barrels of oil a day to market (Energy Information Administration, 2008). Globally, any added supply from the Arctic Refuge could be offset by a small reduction from OPEC (Behar & Ritz, 2016). Domestically, the argument that Arctic Refuge oil would displace oil imports is not well substantiated: additional oil shipped from Port of Valdez would go primarily to west coast foreign markets. This would initially reduce the flow of tight oil from the Northern Midwest—but only to a limited extent (DeRosa & Flanagan, 2017). After that, additional Arctic Refuge oil would go into storage rather than further displacing imports. Even if each barrel pumped from the Coastal Plain meant one less barrel imported, imports, as a portion of all U.S. oil consumption would fall by only 4% to 48%, and that is at the projected peak of Coastal Plain production (Fineberg, 2011). Meanwhile, unconventional oil production and advances in energy efficiency are the big reasons for reductions in U.S. oil imports in the past decade. Energy conservation displaces 25 times more crude oil imports than oil taken from the Arctic National Wildlife Refuge ever could (Fineberg, 2011).

National and Global Price Impact

The effect on national oil prices would be brief and minimal at best, largely because prices are determined in the global market in which non-OPEC producers act as price-takers rather than price-makers. According to both the EIA (2008) and USGS (2009), the earliest commercial production could begin is 7 to 10 years after Congressional approval. Once production begins, any impact on prices at the pump would likely only be felt during a single peak production year approximately 10 years later (Energy Information Administration, 2008).At best, consumers could save 1% on gas 15 years after Congressional approval (Energy Information Administration, 2008; Hahn & Passell, 2008).

Potential Jobs Associated with Refuge Development

Changes in employment associated with potential oil production in the Arctic National Wildlife Refuge depend on factors including the phase of development, the number of wells and rigs, specific geographic location, and the type of project (Wood Mackenzie, 2011). Previous employment estimates of these changes vary widely and sit atop a house of cards, the foundation of which is out-of-date assessments of oil volume and oil prices nearly twice what they are today. While it is certain that extracting oil from the Coastal Plain would support some employment, the gains would be temporary and may simply represent a shift of jobs from other regions. Newer data and better models of net changes in economic well-being—that is, those that consider potential loss of traditional and current economic use of the Arctic Refuge—are needed.

Hypothetical Timeline for Oil Development on the Coastal Plain

Various U.S. government, industry, and other entities have estimated the time lag between Congressional approval of oil and gas development in the Arctic Refuge and actual production; estimates range from 7 to 20 years (Thomas et. al, 2009; Arctic Power, 2001; Attanasi and Freeman, 2009). If approval were to be granted in 2018, development and production could occur between 2025 and 2030 based on U.S. Department of Energy phasing (Thomas et. al, 2009). In this scenario, the first payments to the U.S. Treasury would begin in 2022 for leases, and in 2030 for royalties from production, assuming no delays. Under other plausible government and industry scenarios, production might not commence until 10 years later, or by 2040.

Opening the Refuge: Cost to the American Taxpayer

How much revenue the federal government receives will depend on the number of acres leased, the price per acre leased, and the distribution of revenue between the U.S. Treasury and the state of Alaska (Alaska Oil and Gas Competitive Review Board, 2015). Currently, the Trump Administration claims $1-1.8 billion could be raised by lease sales alone in the next ten years (Office of Management and Budget, 2017). The Center for American Progress, meanwhile, finds no more than $37.5 million in federal revenue could be raised from leases over the same period, or just 2% of the Administration's estimate (Lee-Ashley & Rowland, 2017). Because the White House and Congress are counting on high estimated revenues to fund expenditures, including proposed tax cuts, any shortfall relative to those expectations will increase the deficit.

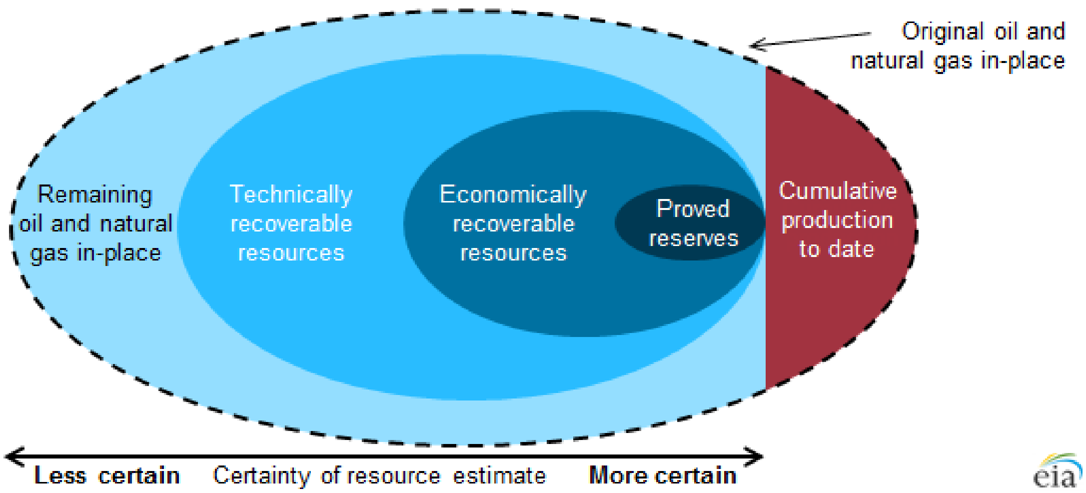
Challenges of Frontier Exploration

The climate, geography, and isolation of the Arctic present challenges to oil and gas exploration and development. The North Slope of Alaska is remote and sparsely populated with only one road connecting it with the rest of the state. These factors contribute to Arctic development being more expensive, riskier, and lengthier than comparable deposits found elsewhere in the world (Budzik, 2009). In addition to requiring larger investments than comparable projects elsewhere, the long lead-times required for Arctic projects add risk because economic conditions can change significantly between the time exploration leases are secured and when production begins.

Economically Recoverable Oil Potential in the Arctic Refuge

Estimates of technically recoverable oil on Alaska's Northern Slope continue to fuel the decades-long debate on oil drilling in the Coastal Plain (1002 Area) of the Arctic National Wildlife Refuge.[1] The more important consideration—and one often overlooked by those advocating for drilling—is how much of that oil will be economically recoverable, and to what extent should undiscovered economically recoverable oil inform market and policy decisions? While technically recoverable oil refers to oil that can be produced using current technology and geologic knowledge, economically recoverable oil is the portion of technically recoverable oil that can be produced for less than the price the oil would bring in the market—contingent on its discovery (Figure 1) (Energy Information Administration, 2014).

Figure 1. Visual representation of oil resource categorization (not to scale)
Source: U.S. Energy Information Administration, 2014



In the longer run, changes in technology (which presumably would be adopted only if they make recovery cheaper) would increase economically recoverable reserves. However, if cost-saving technology affects only other reserves elsewhere, the relative cost of North Slope oil will increase and its economically recoverable reserves will fall. Hydraulic fracturing, which has made production from shale and tight sands in the lower 48 states relatively less expensive, is a good example of this dynamic at work. The fracking boom has boosted

[1] The absolute limit to technically recoverable oil is not the total amount of oil available (as shown in Figure 1). Rather, it is the amount that can be extracted at a lower cost *in energy* than the energy content of the extracted oil. The ratio of energy out to energy in is the "energy return on investment" (EROI) and when that ratio falls below one, further effort to produce that energy become thermodynamically nonsensical (Daly & Farley, 2011; Hall, Lambert, & Balogh, 2014). One would not, for example, use 6 million BTUs of energy to pump a barrel of oil that may yield only 5.8 million BTUs (EROI=0.97). Even so, and due either to poor policy or a desire to have energy of a particular type or in a particular form (e.g., liquid fuel), it is possible to produce such oil at an energy loss, so long as other energy is available to make up that gap between energy out and energy in. Moreover, technically recoverable oil can increase over time as energy-saving technology, which increases EROI up, is developed and adopted in the energy industry.

energy supply and driven down prices, which further narrows the gap between the price of non-fracked oil and the cost of producing it (Nicks, 2014).

Clearly, estimates of the portion of oil reserves that is economically recoverable are fluid, and they are not nearly as easy to know at any moment as the volume of oil *in situ*, or even the volume that is technically recoverable. Economically recoverable reserves, however, is the more appropriate measure to use when assessing potential undiscovered resources in the Arctic. Otherwise, taxpayer dollars may be spent to facilitate production, incur environmental and social costs, and otherwise subsidize the production of oil that is not worth recovering.

Government Estimates of Recoverable Oil in the Coastal Plain Area of the Arctic Refuge

Government reports published in the last ten years provide estimates of the total undiscovered technically and economically recoverable oil in the Arctic Refuge. The latest U.S. Geological Survey (USGS) assessment, published in 1998 and updated in 2009, provides an average estimate, or 50% chance, that 10.4 billion barrels (BBO) of technically recoverable oil exist on the Coastal Plain (1002 Area) of the Arctic Refuge. Their estimates give a 5% probability that as much as 15.2 BBO exist on the Coastal Plain, and a 95% probability that at least 5.9 BBO are present (Attanasi & Freeman, 2009). Both the National Energy Technology Laboratory and USGS reported that, of the technically recoverable amount on the Coastal Plain, a mean estimate of 7.7 BBO, or 75% of the total estimate, is located on federal lands, while 25% lies under state and native lands within the Refuge. Considering that the economically recoverable volume is almost always a fraction of the technically recoverable volume, the 7.7 BBO represents an upper threshold mean estimate for how much oil could be produced from the Coastal Plain's federal lands (Thomas, et al., 2009).

The U.S. Energy Information Administration (EIA) (2008) based its estimates oil production potential in the Refuge on the USGS estimate of about 7.7 billion barrels of oil technically recoverable in the federal land portion of the Coastal Plain. The EIA created three scenarios that reflected the low, mean, and high estimate of *technically* recoverable oil provided by the USGS 1998 assessment. They compare these three scenarios to the 2008 Annual Energy Outlook "reference" case, which is a business-as-usual projection of resource supplies and prices contextualized by economic conditions.

In the reference case, with no additional oil from the Arctic Refuge, U.S. production increases from 5.1 MBD (million barrels per day) in 2006 to a peak of 6.3 MBD in 2018, then falls to an average of 5.6 MBD by 2030 (Energy Information Administration, 2008). In this case, Alaskan production increases post-2014 from the discovery and development of new offshore oil fields expected to be found off the North Slope (Energy Information Administration, 2008).

In all three Arctic Refuge oil resource cases, production starts in 2018 (now 2028, because, the analysis was published 10 years ago), and peaks at 510,000, 780,000, and 1,450,000 barrels per day around 2028 (now 2038) in the low, mean, and high-resource-case scenarios respectively. EIA estimates that Cumulative oil production in the twelve years following initial production would be 1.9 BBO, 2.6 BBO, and 4.3 BBO in the low, mean, and high-resource-case respectively (Energy Information Administration, 2008).

Limitations of Government Agency Analyses

There are a number of reasons to be cautious in using the 2008 EIA and 2009 USGS updated economic analyses as a resource for policy-making. The first and foremost concern with these government analyses is that they are based on outdated information. The last geological assessment was performed two decades ago using financial data and technological assumptions from that time, making it nearly irrelevant as a guide to current energy, budget, or economic policy. In May of 2017, Secretary of Interior Ryan Zinke ordered a plan for updating assessments of undiscovered, technically recoverable oil in the Coastal Plain, which would include consideration of new data as well as a reprocessing of existing data (U.S. Department of the Interior, 2017). Second, and while often noted at the end of these reports, there is a great deal of uncertainty surrounding resource estimates in the Arctic Refuge.

Another concern arises from the comparison of the three EIA *technical* estimates with a reference case embedded in the 2008 (then current) economy rather than economic estimates tied to long-term oil price projections. These factors suggest that the EIA's 2008 report, while one of the most recent analyses of oil production in the Arctic Refuge, is outdated in significant aspects ten years later, and should not be relied on as a source for economically recoverable estimates in the Arctic Refuge.

Price Projections

Price projections for crude oil are essential for determining the volume of undiscovered economically recoverable oil. Both the USGS 1998 assessment and 2009 economic update estimates are based on data from periods in which crude oil prices were fluctuating significantly. Since 2009, however, the global financial crisis as well as increases in supply erased much of the gain in prices (in real, or inflation-adjusted terms) since 2000, and prices are now more in line with historical norms (Figure 2).

Figure 2. Crude Oil Prices 1989-2016
Source: Macrotrends, L.L.C., 2017

A more relevant estimate of economically recoverable reserves available in the Coastal Plain is obtained by re-examining the 2009 USGS scenario in light of today's prices and the longer-term trends. First, we adjust the current price of crude oil, which was $50/BBL in September 2017, for inflation to get its 2007 equivalent of $42/BBL. Assuming all other parameters are unchanged, there would have been 14.9 BBO of economically recoverable oil at that $42/BBL price point in the entire North Slope study area in 2008. Of that total, 9.1 BBO would have been in the 1002 Area of the Arctic Refuge. Finally, since 75% of the technically recoverable oil in the Coastal Plain of the Arctic Refuge is estimated to occur on federal lands, some 6.8 BBO could be economically recoverable at current (September 2017) prices (Attanasi and Freeman, 2009). The purpose of this calculation is not to provide a new estimate for how much oil production to expect from the Coastal Plain, but rather to show how price changes alone can affect the implications of assessments from 10 to 20 years ago.

Economically Recoverable Oil vs. Break-even Prices

The most relevant oil prices are those that may prevail during the time at which Arctic Refuge resources would be extracted. If development were permitted today, it is unlikely that any oil would flow before 2028 (Energy Information Administration, 2008). Therefore, the relevant prices to use *today* to estimate economically recoverable oil would be the prices expected in 2028 and through a production period of up to 30 years. Naturally, predicting future price trends is difficult, and any resulting estimates of economically recoverable oil should be understood to come with a wide margin of error, and to be a measure of *undiscovered oil* (Behar & Ritz, 2017).

The price estimates for undiscovered oil cannot be contextualized with regional break-even prices often reported by market analysts; the economically recoverable price is used to inform industry of potential in a region under particular economic conditions, whereas the break-even prices often inform companies on specific producing regions or projects for which costs are more certain.

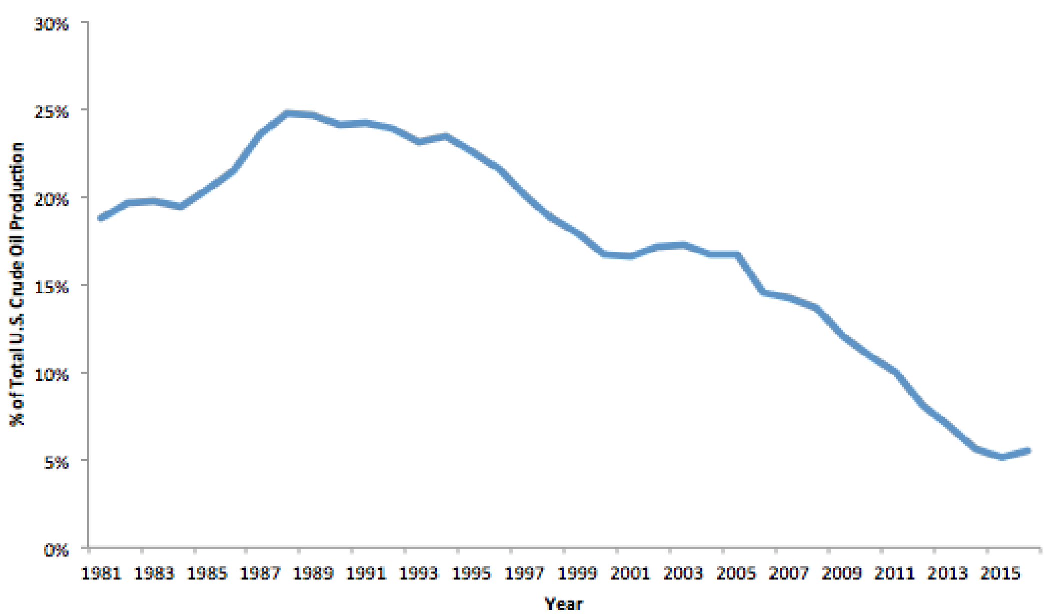
Other Factors Influencing the Cost of Coastal Plain Oil Production

The most important stipulation to projections of economically recoverable oil is that all of the projections described above are based on the estimated private or *internal* (to the oil companies) costs of bringing undiscovered oil to market. They do not consider the *external* costs of development, extraction, transportation, and ultimate consumption of energy derived from the Arctic Refuge crude oil. These costs include climate change, loss of habitat, human health effects of the release of toxins, disaster (spill) preparedness and response and a host of other costs that are largely shouldered by taxpayers. These costs are only imperfectly (at best) reflected in the market price of a barrel of oil, and call into question the notion that oil and gas development in the Arctic Refuge would actually generate revenues to balance the federal treasury. Because these costs could total 100% or more of the market value, the *net* price of oil could be zero or even negative. In that case, obviously, the amount of oil economically recoverable from the Arctic Refuge would be zero (Hall, 2004).

Impact of Arctic Coastal Plain Oil Production on U.S. and Global Supply

Since the debate on drilling in the Arctic National Wildlife Refuge began, proponents have insisted that the added domestic production will reduce U.S. dependence on foreign oil while lowering consumer prices and adding industry jobs in Alaska. Historically, Alaska has been one of the highest producing oil states in the U.S. with more than 738 million barrels of oil produced in its peak year in 1988 (Energy Information Administration, 2016a). In the 1980s and 1990s, Alaska accounted for 20% to 25% of total U.S. production annually, but as of 2016, Alaskan crude oil production made up only 5.5% of total U.S. supply (Figure 3). In the past ten years, mostly increases in tight oil production in the Northern Midwest and Gulf Region have contributed to decreased imports and greater U.S. reserves (Energy Information Administration, 2017b).

Figure 3. Alaska Crude Oil Production as a Portion of Total Annual U.S. Production
Source: Adapted from Energy Information Administration, 2016a



The smaller potential increases in U.S. supply—from even the most optimistic estimates of Refuge production—are projected to have little effect on U.S. imports or oil prices. Alaskan oil production will consistently be dwarfed by tight oil production in the lower 48 states in coming decades as companies continue to make oil discoveries around the Permian Basin in Texas and the Bakken Play in the northern Midwest. According to a new analysis by IHS Markit Ltd. the Permian Basin holds another 60 to 70 billion barrels of yet-to-be-pumped oil, which could supply, "every refinery in the U.S. for 12 years and have a market value of about $3.3 trillion at current prices" (Carroll, 2017). Even in Alaska's Prudhoe Bay, companies continue to discover economically recoverable oil within existing plays[2]. For example, Armstrong and Repsol announced a 1.2 billion barrel discovery on the North Slope of Alaska this past spring, noting the potential to bring 120,000 barrels of oil a day to the market beginning in 2022 (Harball, 2017). Not long after, the same companies announced promising results from an exploration drill in the Horseshoe play, meaning geologically connected discoveries by Caleus Energy, ConocoPhillips, and Armstrong-Repsol in the past year could bring over 400,000 barrels per day of new oil potential from the North Slope (Brehmer, 2017). Each discovery within plays that are already producing commercial oil weakens the commercial appeal of pursuing what oil may exist in the Arctic Refuge, where the lack of transportation infrastructure (roads, pipelines) means higher costs.

Misconceptions on U.S. Oil Import Displacement

Arctic drilling advocates, reinforced by the EIA's 2008 report on the Refuge, suggest that each barrel of oil produced in the Arctic Refuge would reduce U.S. imports by one barrel (Hahn & Passell, 2008). This assumption of a 1:1 ratio of Alaskan production to import reduction neglects existing infrastructure capacity and the flow of oil from Alaska's North Slope to its end-consumers on the West Coast. A recent analysis by DeRosa and Flanagan (2017) uses the National Transportation Fuels Model to simulate increased oil production from the North Slope into the Trans-Alaska Pipeline, which provides some insight into potential impacts of Coastal Plain oil development on pipeline infrastructure. The two primary markets that North Slope oil, including production in the Arctic Refuge, would reach from the Port of Valdez are: 1) delivery to export markets, and 2) shipment to ports on the West Coast of the U.S. (DeRosa & Flanagan, 2017). Should all economically recoverable oil be developed on the Coastal Plain, a nonlinear decline in imports would occur on the West Coast in ports connected to Valdez, with a modest impact on the flow of tight oil from Bakken to Washington and California. After a certain volume threshold, additional production from Alaska would go into storage rather than substitute for imported oil (Fineberg, 2011). Even if oil imports were displaced 1:1, U.S. production would increase domestically by a matter of one to two percent while imports would remain a significant portion of total oil consumption, dropping by, at most, 4 percentage points from 52% to 48% (Fineberg, 2011).

After a forty year ban on exporting oil, the United States began exporting American oil in 2016, and is expected to become one of the top ten exporters globally by 2020 (Slav, 2017). For Arctic Refuge drilling advocates to suggest that the U.S. would benefit from Arctic Refuge drilling because it would reduce America's dependence on foreign oil imports is disingenuous, runs counter to Congress's decision to break the U.S. ban to allow exports and is simply not compelling.

Global Supply

In 2016 world crude oil production averaged 97.23 MBD, while Alaskan production averaged 0.49 MBD, making up approximately 0.5% of total production (Figure 4) (Energy Information Administration, 2016b). Additional production of available, technically recoverable, resources in the Arctic Refuge would total about 0.6% of current

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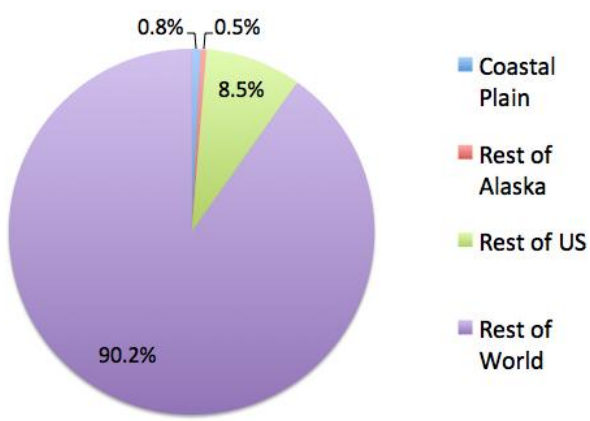
[2] A set of known or postulated oil and gas accumulations sharing similar geologic, geographic, and temporal properties, such as source rock, migration pathway, timing, trapping mechanism, and hydrocarbon type (Klett, et al., 2000).

annual global supply. However it is important to keep in mind that only 1.8 BBO, at most, could be produced before 2035, indicating its overall percent contribution to global supply could vary and ultimately be negligible depending on the rate of global oil consumption, new discoveries in existing wells across the world, and the strategic decisions of OPEC[3] (Energy Information Administration, 2008). As of 2015, OPEC members held a market share of just over 40% of global oil production, allowing a degree of market power over non-OPEC producers who act as a price-taking[4] competitive fringe (Behar & Ritz, 2016). With this market power, OPEC can choose one of two strategies to maintain considerable control over prices, both of which can be optimal for the organization under certain conditions: 1) Accommodate non-OPEC producers to maximize profits via a "high" oil price which allows high-cost non-OPEC countries to remain profitable, or 2) squeeze out non-OPEC producers by driving up production/refusing to cut current supply, thereby driving down price and inducing high-cost producers to exit the market (Behar & Ritz, 2016).

Figure 4. Percent of Global Annual Production of Crude Oil by Region[5]

Source: Adapted from Energy Information Administration, 2016b



With the rapid increase of U.S. shale production in the past decade, many analysts agree that OPEC's decision not to cut production in November 2014, leading to a crude oil price crash, was a strategic move to squeeze out U.S. unconventional oil producers (Behar & Ritz, 2016). Understanding OPEC's past decisions to cut or flood supply provides context for how OPEC may act in the future. These characteristics and trends in the global oil market suggest that any increased production on Alaska's North Slope is only a drop in the barrel in the first instance, and, if it ever were to be an important source of supply it could be subject to OPEC's strategic behavior. High-cost producers/plays, which would include the Arctic, would likely be the first "squeezed" out of the market if OPEC supply expands in the global market, resulting in decreased oil prices.

[3] OPEC (Organization of the Petroleum Exporting Countries) is an intergovernmental organization created in 1960 with the purpose of coordinating and unifying petroleum prices among member countries in order to attain fair and stable prices for producers, regular supply for consumers, and a fair return on capital for investors. The founding members include Iran, Iraq, Kuwait, Saudi Arabia, and Venezuela, and has since been joined by ten other countries (OPEC, 2017).

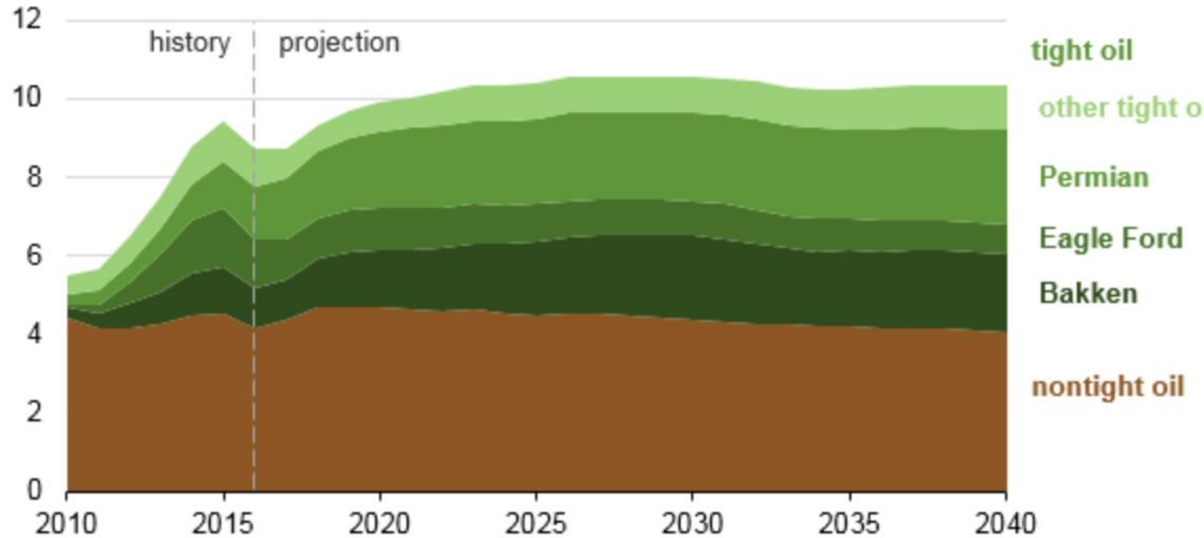
[4] In economics, price-takers are agents that must accept prevailing market prices because their transactions are not a great enough share of the total market to influence prices.

[5] Annual production figures drawn from 2016 EIA reports, Coastal Plain estimate for *peak* annual production retrieved from a 2008 EIA report on hypothetical production from the Arctic Refuge.

The Future of Tight Oil and U.S. Energy Production

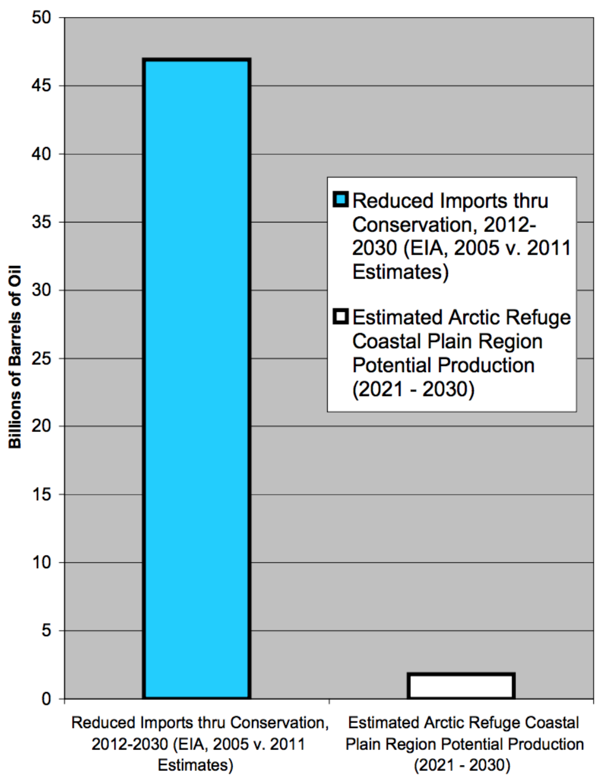
The outcome of the most recent oil production glut in the world market is still unclear; the U.S. tight oil boom drastically altered the structure of U.S. oil production in the past few years, and while OPEC's refusal to cut production left oil prices below $30/BBL at the start of 2016, the falling cost of producing tight oil has kept unconventional U.S. production competing in the world market at lower oil prices (Murphy, 2017). By 2037, which is the approximate time frame the Arctic Refuge would reach peak production if drilling were to be authorized in 2017-2018, tight oil is predicted to make up 57% of U.S. oil production (Figure 5) (Murphy, 2017). Even so, in the next few decades U.S. tight oil will not become a major source of oil in the world. The U.S. only contains 3% of the world's reserves, and even if technical advances allow more U.S. oil to become economically recoverable, U.S. supply will not become a significant portion of world production (Murphy, 2017).

Figure 5. U.S. Oil Production (2010-2040) (million barrels a day)
Source: Energy Information Administration, 2017b



Projections in the demand for oil show a tapering, slowed growth as technological advances and economies of scale make electric alternatives and conservation measures increasingly viable (Energy Information Administration, 2017d). Gains in energy efficiency have proven to have a much more significant impact on oil imports than domestic production; U.S. imports increased annually since the 1980s, but from 2005 to 2011, net petroleum imports decreased by almost 30%, going from 12.5 MBD to less than 9 MBD (Fineberg, 2011). Additional domestic crude oil production is a contributing factor in the trend reversal, but reduced dependence can be largely attributed to lower consumption. Figure 6 quantifies the 25:1 ratio of conservation to production in reducing U.S. oil imports through a discrete timeline, which could be pushed back to 2017-2035 considering at most 1.8 billion barrels of oil could be produced in the Coastal Plain by 2035 if Congress approved drilling today (Fineberg, 2011).

Figure 6. Reduced Oil Imports vs. Potential Coastal Plain Production 2012-2030
Source: Fineberg, 2011



What may not have been foreseen even 5 years ago is the increasing affordability of electric vehicles; from 2014 to 2016, the number of electric vehicles on the road worldwide *tripled,* reaching 1.2 million vehicles last year (International Energy Agency, 2017). The growing niche in the automobile market could displace oil demand of 2 MBD by 2023, enough to create an oil glut equivalent to what triggered the 2014 oil price crash (Randall, 2016). Electric vehicles will soon compete with their gasoline counterparts without the help of subsidies, but policy may continue to shape the automobile market, leading to a more rapid transition away from traditional cars. A handful of nations, including Norway, India, and Germany, have set goals to reach 100% zero-emission cars in the next twenty to thirty years (Pressman, 2017).

Arctic Refuge Drilling Impact on National and Global Oil Prices

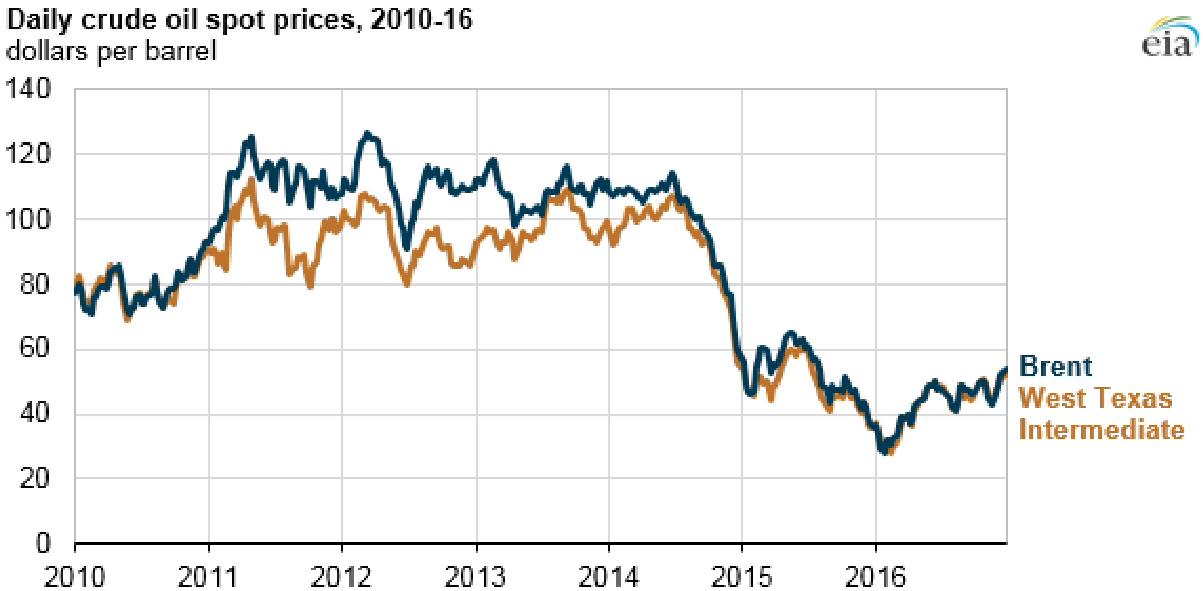
While oil prices would influence energy corporations' decisions regarding whether and when to invest in exploration and development of oil in the Arctic National Wildlife Refuge, there is very little chance that oil production from the refuge would have any effect on oil prices or downstream gas prices for consumers. The effect on national oil prices would be brief and minimal at best, largely because prices are determined in the global market and non-OPEC producers act as price-takers rather than price-makers. Increased production within a single region would not lower prices noticeably for consumers, and even if that was the case, Alaskan oil reaches markets on the West Coast and markets for export exclusively (DeRosa & Flanagan, 2017). Hahn and Passell (2008), assert that decreases in crude oil prices associated with production areas currently closed to development, "are likely to be on the order of one percent, and would thus not have a significant impact on prices that consumers pay at the gasoline pump now or in the future."

The most recent government estimates for the oil price impact from potential Arctic Refuge production are approximately ten years old, when oil prices were significantly higher and unconventional oil in the continental United States had not reached the high levels of production achieved in the last five years. In their 2008 analysis on Arctic drilling, the EIA asserted, "Additional oil production … would only be a small portion of total world production, and would likely be offset in part by somewhat lower production outside the United States." In the EIA reference oil resource case, the peak impact of Arctic drilling would result in a $0.75 decrease in oil per *barrel* in 2025 (what would now be projected in 2035, adjusted to 2017 dollars), a less than one percent impact on prices for consumers at its peak influence (Murse, 2016). This $0.75 price drop per barrel was projected at a time when prices hovered around $131 per barrel, which suggests the absolute price drop may be even smaller as prices currently sit closer to $50 per barrel (United Press International, 2008). The USGS 2009 resource assessment does not provide an estimate for oil price impact in its economic analysis, and the Arctic National Wildlife Refuge Primer provided to Congress by the Congressional Research Service (2011) reinforced the perspective of Alaska and the United States as a price-taker: "Whether oil is produced domestically or imported, it is traded in a global market, and any one part of the market can affect other parts. The result is that oil prices are set in world markets."

World Price Projections

World price projections for the next five years, which precede any point when Arctic oil could reasonably be commercially produced, continue to be revised downwards amid the U.S. shale boom of recent years. Goldman Sachs, JP Morgan, and Credit Suisse all cite increased tight oil production as a reason for short term oil price projections staying relatively low, with Credit Suisse now predicting the price to stay below $60/BBL through 2020 (DiCristopher, 2017). These projections for tight oil production make conventional oil prospects, particularly Arctic drilling, less attractive for oil companies considering profitable exploration in the Arctic may require much higher prices. A recent Deloitte report concludes that the average cost of extracting oil from the Arctic is $75/BBL, which is almost three times the cost of extraction in the Middle East, where a significant historical market share of oil originates (Hoag, 2016).

Figure 7. Weekly U.S. and International Crude Oil Prices
Source: Energy Information Administration, 2017a



America as a Price-Taker

Oil prices are notoriously difficult to predict, as small shocks to oil supply and demand can lead to, "large movements in the price of oil" over time (Arezki, et al., 2017). The difference between changes in national prices versus international prices can be impossible to disentangle. And while natural gas prices fluctuate regionally, they are also tied to crude oil prices, which operate in the world market, meaning any one major producer of oil can impact output and subsequently price (Behar & Ritz, 2016). OPEC's most recent attempt to cut output was offset partly by an increase in supply from Nigeria and Libya, which were exempt from the agreement reached among other OPEC members (DiCristopher, 2017). This development reinforces that any action from a major producer can influence the price of oil, which in turn could impact the profitability of oil production in the Arctic. Regardless, even if OPEC members did not alter output in response to the opening of the Arctic, the increase in supply would have essentially no effect on international prices for oil, making up at most 1% of global production in any given year (Energy Information Administration, 2016b).

The 2014 oil price crash (Figure 7) did not just hurt the prospect of Arctic oil exploration for American companies on Alaska's North Slope; after Shell abandoned its offshore operations, Statoil, Norway's largest energy company, announced it would drop 16 active leases in the Chukchi Sea that were "no longer competitive in Statoil's global portfolio" (Hoag, 2016). Russia, which receives approximately half its state income from oil and gas revenue, only followed through with 2 of the 14 offshore wells it planned to drill in 2017 (Hoag, 2016). These cases augment the relationship between oil prices and Arctic oil production. With an overwhelming amount of the oil supply being produced at a much cheaper cost than Arctic production both in Alaska and outside the U.S., oil prices are a significant factor in potential Arctic production, not the other way around.

Empty Promise of Lower Prices at the Pump

Constituents are often inclined to support legislation that would yield short-term if not immediate relief rather than long-term benefits. Proponents of Arctic drilling claim economic benefits for the American consumer, but fail to provide any details on the timeline, extent, or magnitude of price reductions. According to both the EIA (2008) and USGS (2009), the two government agencies publishing information on potential resources in the Arctic Refuge, commercial production could begin 7 to 10 years after Congressional approval. Once production begins, any impact on prices at the pump would likely only be felt during a single peak production year that happens another 10 years down the road (Energy Information Administration, 2008). At best, consumers would save 1% on gas 15 years from the point in which Congress approves drilling in the Refuge (Energy Information Administration, 2008). Even more likely, which the EIA notes in its most recent analyses, Coastal Plain production would amount to 0.4 percent to 1.2 percent of total world oil consumption in 2030, which is low enough that, “OPEC could neutralize any price impact by decreasing supplies to match the additional production from Alaska” (Lavelle, 2008). Lower gas prices at the pump are simply not a strong argument for drilling in the Arctic, and U.S. government agencies have avoided making any assertion that Arctic drilling would yield any lower prices for consumers perhaps because the economic evidence is absent.

Potential Jobs Associated with Refuge Development

Changes in employment associated with potential oil production in the Arctic National Wildlife Refuge depends on factors including the phase of development (e.g., exploration or production), the number of wells and rigs, specific geographic location, and the type of project (onshore or offshore drilling) (Wood Mackenzie, 2011). In turn, some of these factors depend on economically recoverable discovered oil, global demand and the market price of oil.

In addition to “direct” oil industry jobs in Alaska–jobs with oil producers or oilfield service companies–there are jobs in related industries such as security, catering, accommodations, transportation, engineering services, and pipeline transportation (Fried, 2017). These “indirect” jobs as well as “induced” jobs[6] are commonly estimated using a “multiplier” representing the number of indirect and induced jobs “created” for each direct job. These multipliers are obtained from empirical studies or input-output models (such as RIMS II or IMPLAN[7]).

Because oil is a non-renewable finite resource, even direct oil industry jobs in the Refuge would not be long-term. After peak production, production levels would diminish and employment would decline as well. Once the oil is depleted, companies would abandon the region and related employment would cease.

Refuge Job Projections

Employment estimates for allowing oil and gas leasing in the 1002 Area of the Alaska National Wildlife Refuge vary widely and all are based on higher oil prices than currently prevail. The most recent estimates, prepared for the Institute for Energy Research (an industry trade association), assessed the economic effects of opening restricted Federal lands and waters (Atlantic and Pacific Outer Continental Shelf, Gulf coast, and Alaska National Wildlife Refuge) to oil and gas leasing (Mason, 2013). Results suggest an increase of 61,314 job-years nationwide during the pre-production phase, or 8,759 jobs annually for each of 7 years[8] (Mason, 2013). During production, 199,044 job-years were forecast for the U.S., or 6,635 over each of 30 years (Mason, 2013). These estimates represent less than 0.01% total US employment of 137 million in December 2013 (Bureau of Labor Statistics, 2017). These employment projections are based on economic activity resulting from oil sales at an assumed oil price of $101.34 per barrel (in 2012 dollars), oil reserves of 8 billion barrels, and a multiplier of 5.1 indirect and induced jobs per direct job (Mason, 2013). Because oil prices are about half that today and the oil reserve assumption is based on twenty-year-old model results, these job estimates are overestimates and outdated.

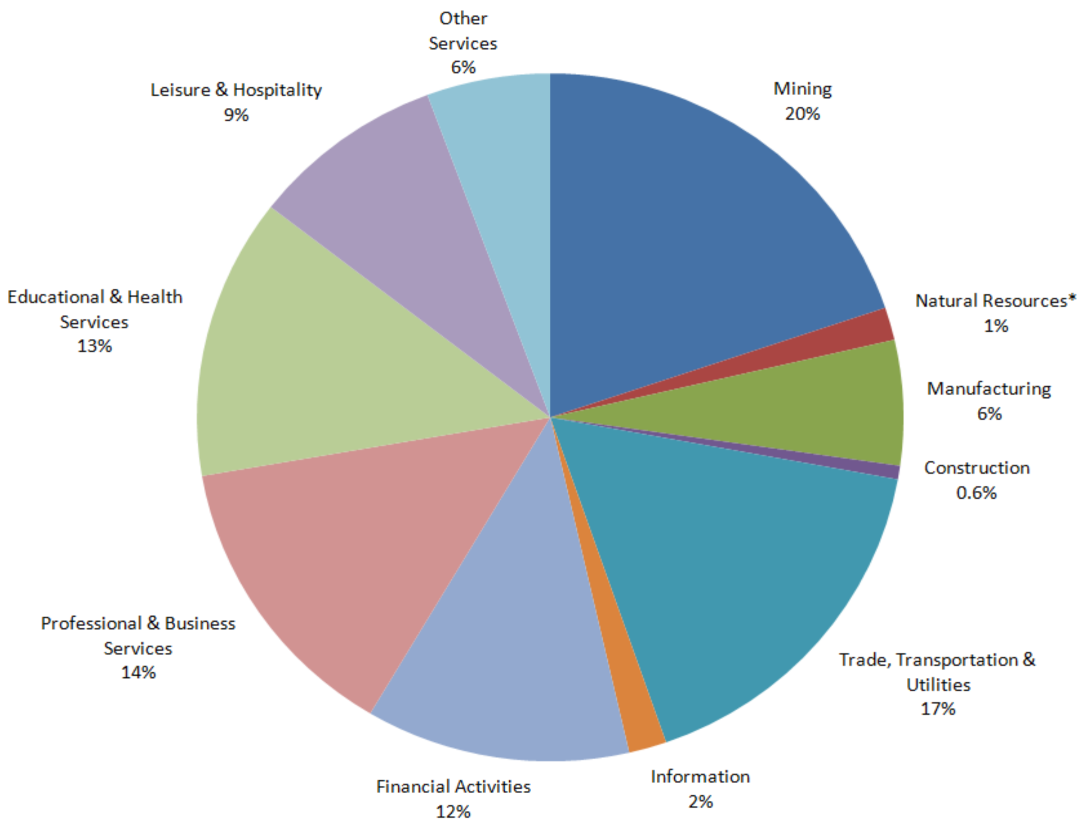
[6] “Induced” employment results when those directly employed in the energy industry and those employed indirectly (at companies doing business with the energy industry) spend their paychecks at grocery stores, service providers, and other businesses in the community.

[7] RIMS II, the Regional Input-Output Modeling System, is available from the U.S. Bureau of Economic Analysis; IMPLAN is a model available from MIG, Inc., a software firm in North Carolina. As with any predictive model, the relative accuracy of results depends on the assumptions, data, and method used.

[8] The author states, “It may help the reader to interpret the resulting jobs numbers as “job-years” or divide the number of jobs by the number of years to establish the number of jobs created for the life of the project. I use the job-years concept …. in reporting my results—the standard method for reporting results of RIMS II analysis — and leave it to the reader to interpret the numbers appropriately” (Mason, 2013, footnote 61).

Mason (2013) also forecast expected employment by industry associated with opening restricted Federal lands and waters to leasing. Jobs in trade, transportation and utilities; professional and business services; educational and health services were projected to represent nearly half (44%) of all new positions (Figure 8) (Mason, 2013). Because the same employment multiplier would apply to all areas considered, based on Mason's assumptions a similar proportion of jobs by industry would apply to potential Refuge oil and gas production.

Figure 8. Jobs Forecast by Industry during Oil and Gas Production
Source: Mason, 2013



The State of Alaska's ANILCA Section 1002(e) Exploration Plan and Special Use Permit Application submitted by Alaska's Governor Parnell to the U.S. Department of the Interior in July, 2013 claimed that oil in the Alaska National Wildlife Refuge would generate, "from about 20,000 to over 170,000 jobs…according to analyses based on data from the Bureau of Labor Statistics" (Ribbink, 2015). As this document is no longer accessible from the

Alaska Department of Environmental Resources[9] further details on these estimates—such as whether jobs were estimated for Alaska or the U.S.—are not readily available.

A study by Wood Mackenzie (2011) for the American Petroleum Institute examining the implications of enacting policies to encourage the development of North American hydrocarbon resources forecast a total of 60,000 new jobs in the U.S. annually for production in the Refuge, with increases each year thereafter. These estimates assume Refuge oil resources of 10.8 BBL; oil priced at $80 per barrel (in 2012 dollars), inflated at 2.5% annually; and a multiplier of 2.5 indirect and induced jobs for every direct job (Wood Mackenzie, 2011).

A much earlier study by Wharton Econometric Forecasting Associates (1990) projected development of oil reserves would create 736,000 new jobs nationwide over 10 years, of which 84,000 would be in the mining sector (Arctic Power, 2001). These are estimates of total jobs – jobs directly associated with the oil operation, as well as indirect and induced jobs: "These jobs would benefit workers in every U.S. state, in supplying equipment and services needed to develop the expected oil discoveries" on the Refuge's coastal plain (Arctic Power, 2001). The results of this nearly 30-year old study have been critiqued by many, including the Congressional Research Service; Economic Policy Institute; and Chemical and Atomic Workers Union (Natural Resources Defense Council, 2001). They found job estimates to be overstated and based on improbable assumptions.

Current Alaska Oil and Gas Industry Employment

Oil and gas industry employment[10] – jobs in oil and gas exploration and oilfield services – averaged 10,156 for the first three months of 2017, about 3% of state employment totaling 315,773 (Alaska Department of Labor and Workforce Development, 2017). The decline in oil prices since 2014 led to job losses for the oil and gas industry in 2016, a 20% reduction compared to 2015 (Fried, 2017; Alaska Department of Labor and Workforce Development, 2017). In 2016 several firms (BP, ExxonMobile, and ConocoPhillips) reduced the number active rigs and other operations in the region (DeMarban, 2016). Shell and Apache Corporation announced they were ending their efforts to find oil in the Alaska region, and ENI, Repsol and Brooks Range Petroleum planned project delays (DeMarban, 2016).

The Alaska Department of Labor and Workforce Development reports that the North Slope of Alaska accounts for two-thirds (66%) of all industry jobs, and Anchorage—which is the headquarters or service center for many firms–for about a quarter (26%) (Fried, 2017). They add that other related jobs are in Valdez, the end of the Trans-Alaska Oil Pipeline (counted as transportation jobs) and in Fairbanks, a major logistic and supply center for the North Slope. Over one-third (36%) of all industry employees are residents of states other than Alaska (Fried, 2017), so major portions of their wages are likely spent out-of-state and do not benefit the state's economy.

Job Forecast through 2024

The Alaska Department of Labor and Workforce Development forecasts there will be 19,652 new jobs in the state by 2024, an increase of 5.8% over the decade (Martz, 2016). A third of the new jobs are projected to be in

[9] This document is no longer available on the Alaska Department of Environmental Resources website: http://dnr.alaska.gov/commis/priorities/ANWR/ANWR_Exploration_Plan_7_9_13.pdf

[10] The Alaska Department of Labor and Workforce Development defines this as North American Industry Classification System codes 211, 213111 and 213112.

health care and social assistance (7,176 jobs) with other substantial additions to accommodation and food service (3,205 jobs) and retail trade (2,744 jobs) (Martz, 2016). Because Alaska's unemployment rate is 7.2% (in September, seasonally adjusted; Alaska Department of Labor and Workforce Development, 2017), greater than the 3% to 5% rate generally associated with full employment, some of these jobs would be filled by people previously unemployed and therefore count as "new." Other openings could be filled by workers already employed in Alaska, or in other states, resulting in no net increase in job creation or decrease in the unemployment rate.

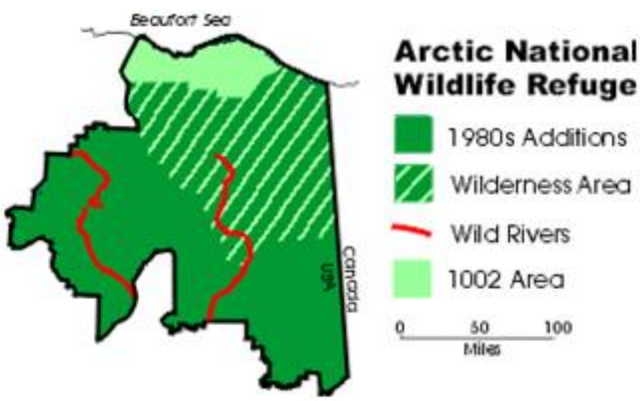
Without credible estimates of the number of jobs that could be associated with potential Arctic Refuge oil and gas development based on current geologic conditions, technology, and forecasts of price and demand, it is difficult to hypothesize the extent to which such opportunities might benefit Alaska in the future. Previous employment estimates of these changes vary widely and rely on out-of-date assessments of oil volume and oil prices nearly twice what they are today. While it is certain that extracting oil from the Coastal Plain would support some employment, the gains would be temporary and may simply represent a shift of jobs from other regions. Newer data and better models of *net* changes in economic well-being—that is, those that consider potential loss of traditional and current economic use of the Arctic Refuge—are needed.

Hypothetical Timeline for Refuge Oil Development

The Arctic National Wildlife Refuge encompasses 19.6 million acres in northeastern Alaska (U.S. Fish and Wildlife Service, 2017). Most of the original Arctic National Wildlife Range established in 1960 was designated as Wilderness in 1980 by the Alaska National Interest Lands Conservation Act (ANILCA) (P.L. 96-487, Dec 2, 1980). The exception has been 1.5 million acres on the coastal plain (Figure 9). Management of that area was addressed in Section 1002 of ANILCA, and is now often referred to as the "1002 Area." The 1002 Area and 10.1 million acres added to the Refuge by ANILCA are “minimal management” areas — managed to, “maintain existing natural conditions and resource values” and open to recreational (including motorized access) and subsistence uses (U.S. Fish and Wildlife Service, 2017).

ANILCA stipulates that the, "production of oil and gas from the Arctic National Wildlife Refuge is prohibited and no leasing or other development leading to production of oil and gas from the [Refuge] shall be under-taken [sic] until authorized by an Act of Congress" (Section 1003). Thus, without Congressional approval, oil and gas development may not occur in the 1002 Area.

Figure 9. Management Areas in the Arctic National Wildlife Refuge
Source: U.S. Fish and Wildlife Service, 2017



Oil & Gas Development Prohibited in the Refuge

Oil and gas development of the coastal plain of the Alaska National Wildlife Refuge has periodically been debated in Congress—as has designation of the area as Wilderness— in the years since ANILCA expanded the Refuge and prohibited oil and gas production within the Refuge. The current Administration has stated that opening the Refuge to drilling is among its top priorities, and in January 2017 bills were introduced in both the House (H.R. 49) and the Senate (S. 49) to allow oil leasing in the Coastal Plain of Alaska (Young, 2017; Murkowski, 2017). In July 2017 the House Subcommittee on Energy and Mineral Resources held an oversight hearing on oil and gas development in Alaska and potential benefits to the U.S. if the Arctic Refuge were opened to exploration and development and if development of the National Petroleum Reserve-Alaska were expanded (House Committee on Natural Resources, 2017). These presumed benefits include an abundance of oil, reduced oil imports, additional federal and state revenues from leasing and royalties, and job creation. The Trump

Administration's budget request for fiscal year 2018 includes $1.8 billion in revenue from federal oil and gas leasing in the Alaska National Wildlife Refuge between fiscal years 2022 and 2027 (as one of many proposed deficit reduction measures) (Office of Management and Budget, 2017).

Timeline of Typical Development

Various U.S. government, industry, and other entities have estimated how long it would take to get from Congressional approval of oil and gas development to actual production. Their estimates range from 7 to 20 years:

- The Energy Information Administration (2002 and 2004) used the 1998 USGS assessment to establish a timeline from approval date to exploration and development of 7 to 12 years (Thomas, et al., 2009).
- The managing director of Hillhouse Resources, an independent oil and gas company in Houston, asserts, "It's going to take seven to fifteen years to finish the seismic review, the geological review, and then begin to develop the technological aspects of building the play" (Granitz, 2013).
- The progression from exploration to development is expected to take about 15 years or more. These long lead times result from the remoteness of the region, concerns for protection of the environment, and the regulatory requirements (Arctic Power, 2013).
- The Brooks Range Petroleum Company (2011) "Brooks Range Petroleum Timeline" projected a 15-year process for exploration to production for their North Slope operation: 2001 exploratory studies, 2014 development, and first oil production 2016.
- The 2009 USGS "Economics of Undiscovered Oil and Gas in the North Slope of Alaska" (Attanasi & Freeman, 2009) considered two scenarios to investigate the effect of timing on the economics of new oil and gas developments: (1) 10 years between discovery and production, and (2) a 20-year delay between discovery and production.

Sample North Slope Alaska Timeframe

The Mineral Leasing Act (1920, as amended) and Federal Onshore Oil and Gas Leasing Reform Act (1987, as amended) govern the leasing of public domain lands for oil and gas (Hatch, 2017).

If one assumes that approval is granted in 2018, development and production could occur between 2025 and 2030 based on U.S. Department of Energy estimates (Thomas, et al., 2009). The steps in their timeline assume a minimum of 10 years to complete development and also that there would be no inordinate delays due to litigation. The timing is envisioned as follows (Table 1) (Hatch, 2017; Thomas, et al. 2009), with the first receipts from production to the U.S. Treasury in 2030:

Table 1. Potential North Slope Exploration and Production Timeline

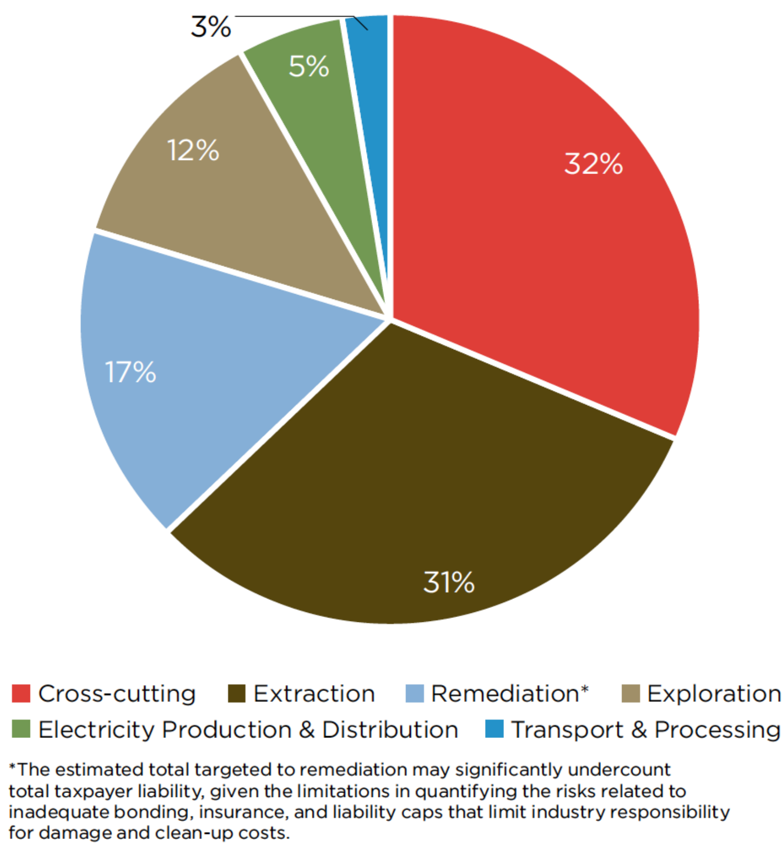
Year(s)	Milestone
2018	Exploration and development in the 1002 Area of the Arctic Refuge approved
2018-2020	Update resource assessments of undiscovered technically recoverable oil
2018 to 2019	2-D seismic data from 1984-1985 reprocessed (1 calendar year) (Werkheiser, et al., 2017; Thomas, et al., 2009)
or	
2018 to 2020	new 3-D seismic survey conducted (2 calendar years) (Werkheiser, et al., 2017; Thomas, et al., 2009)
2020	Nomination of lease parcels by industry and/or BLM, BLM selects parcels, notice of lease sales
2022	First lease sales held, leases issued (for a primary term of 10 years), drilling permits issued
	Lease terms include rentals of $1.50 per acre for the first five years, then $2 per acre thereafter (Hatch, 2017). If a tract does not receive any bids or the minimum acceptable bid, the tract becomes available to be leased non-competitively for a period of two years following the lease sale to the first qualified applicant (Hatch, 2017).
	Permits. Before drilling a well on a Federal or Indian lease, an operator must file an Application for Permit to drill to the Bureau of Land Management (U.S. Department of the Interior, 2014). The processing time for Applications submitted to the Anchorage Field Office was about 40 days, on average, from 2009 to 2013; the national average was 228 days, about 7.5 months (U.S. Department of the Interior, 2014).
2023/2024	First exploration drilling
2025/2026	First “economic” discovery
2026/2027	Evaluation of first “economic” discovery
2027	Field development begins
2030	First production from the 1002 Area First royalty payments to U.S. Treasury **Lease terms** include royalty interest of 12.5% (Hatch, 2017)

In this hypothetical timeline, the first payments to the U.S. Treasury would be for leases in 2022 and royalties from production in 2030, assuming there would be no delays at any step of the process. These years are consistent with the target dates in the administration's proposed budget for fiscal year 2018 which projects receipts in 2022 and 2023, and later in 2026 and 2027 (Office of Management and Budget, 2017). However, as noted above, time estimates from other government and industry sources suggest the first production could begin 5 or 10 years later, or by 2040.

Opening the Refuge: Cost to the American Taxpayer

Fossil fuel subsidies cost American taxpayers billions every year, and while many in the oil industry may deny receiving government handouts, they come in many forms that are often hidden from the public (Redman, 2017). Subsidies can be a mix of tax breaks, tax credits, liability easements, loosened regulations, or government services provided at below-market rates (Leahy, 2017). An Oil Change International ("OCI") report (Redman, 2017) breaks down the types of fossil fuel subsidies in the U.S. from both the federal and state governments, which totaled over $20 billion from 2015 to 2016. OCI defines a fossil fuel subsidy broadly: "any government action that lowers the cost of production, lowers the cost of consumption, or raises the price received by producers." Fossil fuel subsidies can be given as production or consumption support (Figure 10), and there's strong reason to believe the

Figure 10. U.S. Fossil Fuel Subsidies by Stage of Production, 2015-2016
Source: Redman, 2017



development of the Coastal Plain would be no exception as the current administration incentivizes expanding fossil fuel reserves in the name of "energy dominance." A recent study from *Nature Energy* determined that at $50 per barrel, and assuming projects need a 10% rate of return in order to be considered economic, approximately half of new oil investments are subsidy-dependent and would not be profitable without a government handout (Banarjee, 2017).

Estimated Federal Costs and Savings of Opening the Arctic Refuge

The Department of the Interior ("DOI") has laid out detailed plans for expanded oil exploration in the Arctic Refuge, particularly updating current resource assessments in the 1002 Area on the Refuge's Coastal Plain (Werkheiser et al., 2017). The DOI memo presents two scenarios for updating current resource assessments on the Arctic Refuge. In one, USGS would pay $4.8 million for interpreting, "state-of-the-art industry reprocessing of vintage data" to be completed by the end of 2018 (Werkheiser et al., 2017). In the other, "a new 3-D seismic survey is conducted" and paid for by the private sector, although USGS costs would still be approximately $3.6 million (Werkheiser et al., 2017). (Note that these revised assessments would be just the first step in the process of opening the Arctic to drilling.)

In the Congressional Budget Office analysis for a 2012 bill proposed to open the Arctic Refuge, the estimated administrative costs for a federal leasing program were $8 million in the first five years, or $1.6 million per year (LaFave, et al., 2012). Other implementation costs were expected to total $1 to $2 million annually if the Refuge were to be opened to leasing. Because the previous bill (and both current proposals, S. 49 and H.R. 49) deemed the previous environmental impact statement "sufficient," the cost of complying with any environmental regulation is expected to be minimal (LaFave, et al., 2012).

Drilling proponents tout benefits of drilling in the Arctic Refuge including federal revenue that could help offset the budget deficit. The Trump Administration stands behind this argument, evidenced by the inclusion of Arctic drilling revenue in both the White House 2018 Budget Plan and Congress' blueprint (Office of Management and Budget, 2017; House Budget Committee, 2017). The 2018 House budget, released in July 2017, calls for $5 billion in reconciliations, or savings, from the Natural Resources Committee, $1.5 billion of which is expected to come from the Arctic Refuge (Page, 2017). This sets a dangerous precedent, as any shortfall from the amount assumed by Congress will end up adding to the federal budget deficit.

State Subsidies

The current subsidies received on Alaska's North Slope are a useful indicator for estimating how much future Coastal Plain drilling may cost American taxpayers. Currently, Alaska residents receive the most federal government aid per capita and pay no income or sales tax to the state government. Instead, the state is dependent on the oil and gas industry for approximately 85% of its budget (Semeuls, 2015).

Alaska's total subsidies to fossil fuel production in 2015 totaled about $1.2 billion, which includes over $500 million from a per-taxable-barrel credit for North Slope Production (Redman, 2017). Congressional approval for drilling in the Refuge would have a disproportionate impact on Alaskan taxpayers, who rely on the oil and gas industry for government revenue and thus benefits. The drawbacks to the once-lucrative prospects in the northern part of state have become apparent with lower oil prices: Alaska finds itself in a deep budget deficit, largely because of lower interest in Arctic exploration, reduced production on the North Slope, and generous production subsidies for oil companies on the North Slope (Alaska Oil and Gas Competitive Review Board, 2015). To balance the budget, Alaska's state legislature and governor recently approved oil subsidy cuts that will save the state around $200 million annually (Redman, 2017).

North Slope Lease Bids and Projected Revenue

The Congressional Budget Office's latest estimate of potential federal revenue generated from opening the Refuge assumed the sale of 400,000 acres for drilling at $7,500 an acre, whereas recent bids in Alaska have come in well below $100 an acre (Page, 2017). Alaska's Department of Natural Resources publishes a summary of annual lease sales in Alaska beginning in 1959 (Appendix A) providing data on total acres leased, average price per acre, the total bonus (or cumulative lease bids), and the fixed terms from the sale. Since 2010, the average price per acre on the North Slope has ranged from $14.81 to $80.59, with a weighted average for the cumulative 2,442,868 acres sold in the past six years equaling $41.59. Undoubtedly, North Slope bonus bids are the best indicator of how much federal revenue could be made leasing out the Coastal Plain, and while the minimum bid per acre could be raised, no evidence exists that oil companies may be inclined to pay more for land with no existing infrastructure or proven reserves.

An October 2017 analysis by the Center for American Progress (CAP) found that offering oil and gas leases in the Arctic Refuge will likely amount to no more than $37.5 million in federal revenue over 10 years, which is substantially short of the $1 billion to $1.8 billion that the White House, Congress, and drilling proponents claim could be raised (Lee-Ashley and Rowland, 2017). (Ironically, CAP finds that $1 billion in added federal revenue would not even cover Trump's personal tax breaks under the proposed tax reform plan, which reduces tax revenue by $1.5 trillion annually.)

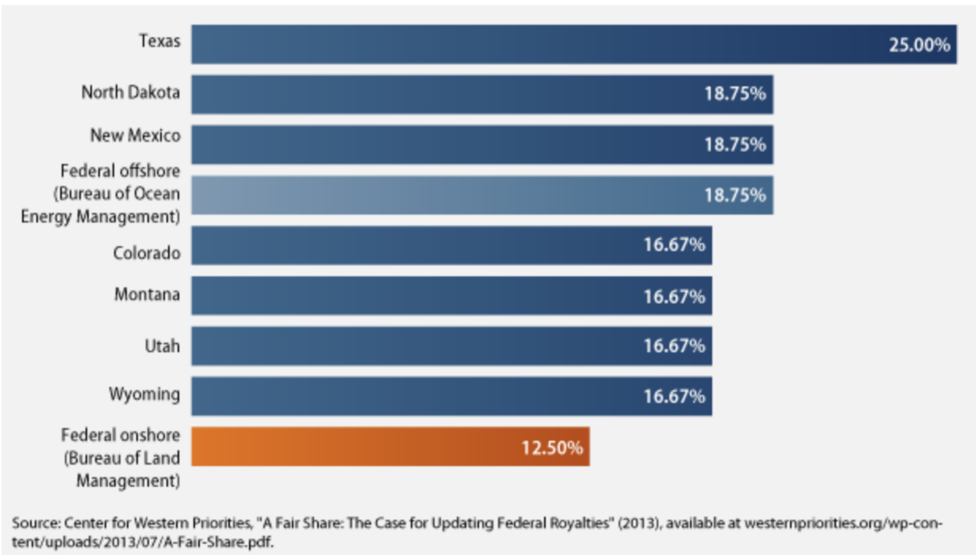
Another unaddressed issue with projected federal revenue lies in Alaska's current law governing lease sales. Oil and gas revenue is split 90%-10% between the Alaska and federal governments respectively, while the projected federal revenue outlined in the Trump administration budget assumes a 50%-50% split, which is the common practice in the continental U.S. (Alaska Oil and Gas Competitive Review Board, 2015). Some estimates of federal revenue gained from opening the Refuge to oil and gas leasing have assumed the federal government, not Alaska, will get 90% of lease bids, while others assume Alaska would receive half of revenue generated from the bids in the Refuge. This single detail, while not affecting how much total revenue is raised from opening the Arctic Refuge to oil development, explains how the revenue would be distributed and who would end up getting compensated. If 90% of the revenue from leasing federal lands on the Coastal Plain were to be distributed to Alaskans, rather than 50%, the average American taxpayer would end up paying more to offset the resulting increases in the federal deficit.

Below-Market Royalty Rates and Estimated Revenue

Royalty payments made on active leases are another source of federal revenue once oil production on federal land has begun, but the federal royalty rate has not been updated since 1920 and stands at 12.5% (Gentile, 2017). While some states, including Texas, Colorado, and Utah, have raised their royalty rates for state lands, Alaska state law offers royalty rates at 12.5%, well below the estimated market rate of 18-25% (Gentile, 2017). This outdated rate is shortchanging American taxpayers, who are receiving a rate 30%-50% less than many private and state royalties.

The total acreage proposed for lease sales in the Arctic Refuge ranges widely, and has a direct impact on the amount of revenue the federal government could expect; H.R. 49, sponsored by Don Young (2017), specifies a minimum of 2,000 acres be leased out on the Coastal Plain, while some of the federal government's estimates for revenue generation seem to assume all 1.5 million acres in the Coastal Plain area of the Arctic Refuge would be leased for oil exploration and drilling (Young, 2017; Lazzari, 2008). While the federal government is able to claim that leasing production on all 1.5 million acres would generate a certain sum from royalty payments, they are simultaneously providing the oil industry with massive subsidies by only charging a 12.5% royalty rate on lands that should arguably receive at least private market rates, which could be twice the amount the federal government charges.

Figure 11. Federal and State Royalty Rates for Oil and Gas Leases
Source: Gentile, 2015



Subsidized Environmental Risk

Not only would American taxpayers fund production of Arctic oil, but they would be financially liable for oil companies' environmental risks and damage. Being one of the last untouched regions of the planet, the environment of the Arctic Refuge is far more vulnerable than other regions of the world known for oil development, and by way of its remote location, cleanup costs from a spill could be much higher than those witnessed from other spills elsewhere in the U.S. All too often, companies pay for direct costs after the damage is done but are not funding resources on standby in the event of a disaster, which should be accounted for as liability for operating in environmentally fragile or vulnerable regions.

Challenges of Frontier Exploration

The climate, geography, and isolation of the Arctic present challenges to oil and gas exploration and development. The Arctic is defined as the area located north of the Arctic Circle, at the northernmost part of Earth at 66°34′ north latitude (Figure 12). It encompasses the Arctic Ocean and adjacent seas, and parts of Alaska, Canada, Finland, Greenland, Iceland, Norway, Russia, and Sweden. About one-third of the Arctic is land and two-thirds is water. The central Arctic Ocean is ice-covered year-round, and snow and ice are present on land for most of the year (National Snow and Ice Data Center, 2017). Large areas of the land are underlain by permafrost, frozen ground (i.e., soil and rock) that remain at or below 32°F for at least two years (National Research Council of Canada, 1988).

Figure 12. The Arctic Circle

Source: National Snow and Ice Data Center, 2017

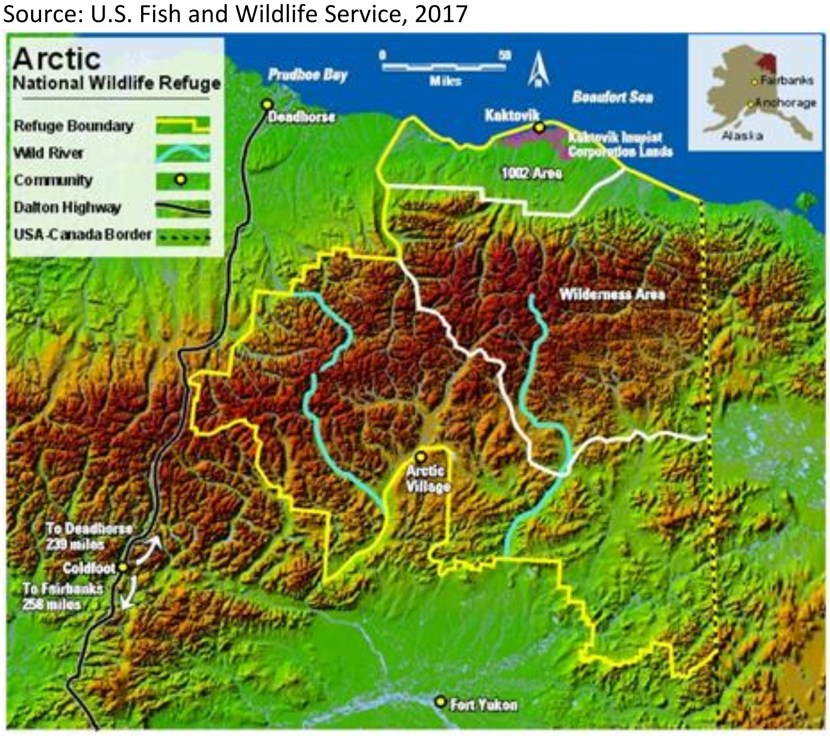
Within the Arctic Circle, there are long periods of daylight during the summer and extended darkness during the winter. The sun remains visible at midnight during the summer months ("midnight sun"); in winter, there are periods of darkness lasting for more than 24 hours ("polar nights") (National Snow and Ice Data Center, 2017). On the North Slope of Alaska, temperatures are below freezing for most of the year, ranging from -20°F in February to 46°F during July. The average annual precipitation is 4 inches or less, mostly in the form of snow (Budzik, 2009).

The North Slope Frontier

The North Slope of Alaska is remote and sparsely populated with only one (mostly gravel) narrow road connecting it with the rest of the state (Figure 13). The 415-mile Dalton Highway, built as a haul road between the Yukon River and Prudhoe Bay during construction of the Trans-Alaska Pipeline, begins 84 miles north of Fairbanks and ends at Deadhorse (The Milepost, 2017). There are no paved roads to Arctic Village or Fort Yukon, both of which can be reached by air; Kaktovik is reachable by air and water (North Slope Borough, 2017).

Energy analyst Pavel Molchanov notes that, "Arctic drilling is a textbook example of frontier exploration—that is to say, drilling in remote, historically underexplored regions….Frontier exploration, no matter the specific geography, is inherently high-risk" (Mufson, 2015). The lack of access and infrastructure are obstacles in exploring for oil and gas resources in frontier basins, defined by the Alaska Oil and Gas Competitiveness Board (2015) as areas away from population centers and existing oil and gas production facilities.

Figure 13. The Dalton Highway and North Slope Towns[a]
Source: U.S. Fish and Wildlife Service, 2017



[a] Population in 2010 - Prudhoe Bay: 2,174; Coldfoot: 10; Kaktovik: 239; Arctic Village: 152; Fort Yukon: 583; Fairbanks: 31,535 (U.S. Census Bureau, 2017).

Arctic Development is Costlier, Riskier and Lengthier

The U.S. Energy Information Administration surmised that Arctic oil and natural gas resources are more expensive, riskier, and take longer to develop than comparable deposits found elsewhere in the world (Budzik, 2009). Studies examining the additional costs associated with oil activities in Alaska compared to those in the continental United States found costs are 1.5 to 10 times larger. For example, the capital costs of onshore Alaska North Slope project developments are from 1.5 to 2 times more than similar oil and natural gas projects in Texas (Budzik, 2009). The subzero weather and remote locations mean drilling in Alaska typically costs three times as much as in the lower 48 states, according to industry researcher IHS Markit, Inc. (Mufson, 2015). And, the Alaska Oil and Gas Competitiveness Review Board (2015) found the investment needed to explore and develop the North Slope's oil resources plus transportation to markets to be an order of magnitude higher—that is, ten times as much—than the investment required to produce and transport oil in much of the continental U.S.

Increasing temperatures in the Arctic have shortened winter access across the tundra by more than 50% and led to changes in standards for use of the ice roads that are typically used to reach remote areas during exploratory drilling[11] (Corn, Ratner & Alexander, 2015). The Congressional Research Service suggests that in the rolling terrain of the North Slope, the use of ice roads and pads could be limited due to safety concerns; gravel structures (permitted for exploration on state lands south of Prudhoe Bay) may provide better traction than ice structures. They caution that relying on ice technology may be infeasible in the future, forcing greater use of more expensive gravel structures with longer-lasting environmental impacts—or, projects would need to adapt to a shorter operating season (Corn, Ratner & Alexander, 2015).

Where access is by water, operating costs are increased by the ice-pack conditions that extend over much of the Arctic Ocean. The need for ice-resistant tankers and ice-breaker escorts adds to the cost of transporting oil and natural gas through Arctic waters (Corn, Ratner & Alexander, 2015; Budzik, 2009).

In addition to requiring larger investments than comparable projects elsewhere, the long lead-times required for Arctic projects add risk because economic conditions can change significantly between the time exploration leases are secured and when production begins. For example, crude oil prices could be considerably lower when an Arctic project begins producing than was anticipated at the planning stage. And, longer lead-times reduce the return on capital investment, all other being equal (Budzik, 2009).

[11] These roads may later be linked to large insulated ice pads for housing, storage and maintenance facilities, airfields, and other support (Corn, Ratner, & Alexander, 2015).

Arctic oil and natural gas resource exploration and development are expensive because:

- Harsh winter weather requires that the equipment be specially designed to withstand the frigid temperatures;
- On Arctic lands, poor soil conditions can require additional site preparation to prevent equipment and structures from sinking;
- The marshy Arctic tundra can also preclude exploration activities during the warm months of the year;
- In Arctic seas, the ice-pack can hinder the shipment of personnel, materials, equipment, and oil for long time periods;
- Long supply lines from the world's manufacturing centers require equipment redundancy and a larger inventory of spare parts to insure reliability;
- Limited transportation access and long supply lines reduce the transportation options and increase transportation costs;
- Higher wages and salaries are required to induce personnel to work in the isolated and inhospitable Arctic; and
- Protecting the Arctic environment is costly.

Source: Budzik, 2009

Future Prospects

Ultimately, energy companies make the decision on whether and how much the costs and risks of frontier exploration influence their investment decisions. The president and CEO of the Alaska Oil and Gas Association, Kara Moriarty, has said that low oil prices won't diminish companies' interest in drilling in the 1002 Area; "The reality is companies don't plan on a two-to-three-year horizon, they plan for a 50-60-year one" (Patterson, 2017). But, the EIA cautions, "The high cost and long lead-times of Arctic oil … development diminish the economic incentive to develop these resources" (Budzik, 2009).

Regarding the potential for oil leasing in the Refuge, the spokeswoman for ConocoPhillips (Alaska's biggest oil producer) says if it, "were to be opened, we'd consider it within our opportunities" and that the area, "would have to compete with other regions for our exploration dollars" (Nussbaum, 2017). In contrast, a senior research manager at industry consultant Wood Mackenzie Ltd. says, "There are a lot of other, cheaper areas that are currently open to exploration that big companies can attack" (Nussbaum, 2017). At this point in time, given the uncertainties regarding how much oil could actually be within the 1002 Area, the probability of development in the frontier even if Congress were to authorize it remains unknown.

Conclusion

Despite the frigid climate and isolation of the Arctic National Wildlife Refuge's Coastal Plain, policymakers and energy industry officials periodically raise the prospect of allowing oil and gas drilling in the region. In contrast to the economic conditions during earlier efforts to open the Refuge, oil prices have dropped substantially, and the increase in oil demand has slowed as conservation and the use of alternative fuels grows. The EIA projects the slower growth in demand to continue at least through mid-century, beyond the time any production could occur if development in the 1002 Area was approved this year. New discoveries from established drilling sites in the continental U.S. as well as Alaska's North Slope/Prudhoe Bay are expected to sustain U.S. production for decades, providing oil for domestic consumption as well as for export.

Even the most optimistic estimates of oil production in the 1002 Area (by the USGS and EIA during the past two decades) are projected to have little effect on U.S. imports, global supply, or prices. Leasing and royalty revenues destined for the U.S. and Alaska coffers, as well as jobs, were projected based on *undiscovered* economically recoverable reserves estimated using now-outdated financial data and technological assumptions. These projections did not consider external costs such as climate change, loss of habitat, human health effects of the release of toxins, and spill preparedness and response. Despite their lack of currency, these projected benefits are still being touted.

Federal taxpayers would subsidize any effort towards opening the Refuge—beginning with the first step of updating the assessments of undiscovered, technically recoverable oil and gas resources per Secretary Zinke's directive in May (U.S. Department of the Interior, 2017). Once completed, these resource assessments would influence the industry's interest in exploring the 1002 Area if development were approved by Congress. Ultimately, though, even the hypothetical revenue from Refuge oil and gas leasing in the Administration's fiscal year 2018 federal budget would do very little to alleviate the federal deficit. Projected receipts from leasing represent less than 0.5% of the total budget deficit reductions proposed (Office of Management and Budget, 2017) and would cost the nation the loss of nonrenewable resources and potentially irreparable ecological harm.

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Appendix A: 2010-2017 Lease Bids on the North Slope

Summary of State Competitive Oil and Gas Lease Sales -- 1959 to Present

Sale Date	Sale	Sale Area	Acres Offered	Acres Leased	Percent Leased	Average $/Acre	Tracts Offered	Tracts Leased	Bonus Received	Bid Variable	Fixed Terms
5/26/2010	AP 2010	Alaska Peninsula	Areawide	0	N/A	$0.00	N/A	0	$0	Bonus; $5/acre Min	12.5% Royalty
5/26/2010	CI 2010	Cook Inlet	Areawide	104,629	N/A	$16.40	N/A	35	$1,716,407	Bonus; $10/acre Min	12.5% Royalty
10/27/2010	FH 2010	NS Foothills	Areawide	0	N/A	$0.00	N/A	0	$0	Bonus; $5/acre Min	12.5% Royalty
10/27/2010	NS 2010**	North Slope	Areawide	558,683	N/A	$14.81	N/A	123	$8,271,480	Bonus; $10/acre Min	12.5 % & 16.66667% Royalty
10/27/2010	BS 2010A	Beaufort Sea	Areawide	62,965	N/A	$10.08	N/A	21	$634,485	Bonus; $10/acre Min	12.5 % & 16.66667% Royalty
6/22/2011	AP 2011	Alaska Peninsula	Areawide	0	N/A	$0.00	N/A	0	$0	Bonus; $5/acre Min	12.5% Royalty
6/22/2011	CI 2011 A & B	Cook Inlet	Areawide	449,164	N/A	$17.50	N/A	104	$8,214,181	Bonus; $10/$50/acre Min	12.5% Royalty
12/7/2011	FH 2011	NS Foothills	Areawide	0	N/A	$0.00	N/A	0	$0	Bonus; $10/acre Min	12.5% Royalty
12/7/2011	BS 2011W	Beaufort Sea	Areawide	242,796	N/A	$24.07	N/A	77	$5,845,102	Bonus; $10/$25 acre Min	12.5% &16.66667% Royalty
12/7/2011	NS 2011W**	North Slope	Areawide	295,194	N/A	$40.69	N/A	165	$12,011,666	Bonus; $10/$25 acre Min	12.5% &16.66667% Royalty
5/16/2012	AP 2012	Alaska Peninsula	Areawide	0	N/A	$0.00	N/A	0	$0	Bonus; $5/acre Min	12.5% Royalty
5/16/2012	CI 2012W	Cook Inlet	Areawide	128,300	N/A	$35.58	N/A	41	$4,564,459	Bonus; $25/acre Min	12.5% Royalty
11/7/2012	FH 2012	NS Foothills	Areawide	45,476	N/A	$20.88	N/A	8	$948,646	Bonus; $10/acre Min	12.5% Royalty
11/7/2012	BS 2012W	Beaufort Sea	Areawide	80,699	N/A	$17.86	N/A	25	$1,440,888	Bonus; $10/$25 acre Min	12.5% & 16.66667% Royalty
11/7/2012	NS 2012W**	North Slope	Areawide	152,067	N/A	$69.33	N/A	86	$10,542,283	Bonus; $10/$25 acre Min	12.5% & 16.66667% Royalty
5/8/2013	AP 2013	Alaska Peninsula	Areawide	0	N/A	$0.00	N/A	0	$0	Bonus; $5/acre Min	12.5% Royalty
5/8/2013	CI 2013W	Cook Inlet	Areawide	100,322	N/A	$30.72	N/A	24	$3,081,417	Bonus; $25/acre Min	12.5% Royalty
11/6/2013	FH 2013	NS Foothills	Areawide	0	N/A	$0.00	N/A	0	$0	Bonus; $10/acre Min	12.5% Royalty
11/6/2013	BS 2013W	Beaufort Sea	Areawide	2,560	N/A	$20.47	N/A	2	$52,403	Bonus; $10/$25 acre Min	12.5% &16.66667% Royalty
11/6/2013	NS 2013W**	North Slope	Areawide	157,701	N/A	$32.45	N/A	89	$5,117,140	Bonus; $10/$25 acre Min	12.5% &16.66667% Royalty
5/7/2014	AP 2014	Alaska Peninsula	Areawide	9,561	N/A	$5.00	N/A	3	$47,807	Bonus; $5/acre Min	12.5% Royalty
5/7/2014	CI 2014W	Cook Inlet	Areawide	83,521	N/A	$48.42	N/A	32	$4,044,467	Bonus; $25/acre Min	12.5% Royalty
11/19/2014	FH 2014	NS Foothills	Areawide	0	N/A	$0.00	N/A	0	$0	Bonus; $10/acre Min	12.5% Royalty
11/19/2014	BS 2014W**	Beaufort Sea	Areawide	99,218	N/A	$45.58	N/A	42	$4,522,271	Bonus; $10/$25 acre Min	12.5% & 16.66667% Royalty
11/19/2014	NS 2014W**	North Slope	Areawide	494,530	N/A	$80.59	N/A	254	$39,853,691	Bonus; $10/$25 acre Min	12.5% & 16.66667% Royalty
5/6/2015	AP 2015	Alaska Peninsula	Areawide	0	N/A	$0.00	N/A	0	$0	Bonus; $5/acre Min	12.5% Royalty
5/6/2015	CI 2015W	Cook Inlet	Areawide	20,840	N/A	$32.20	N/A	7	$671,033	Bonus; $25/acre Min	12.5% Royalty
11/18/2015	FH 2015	NS Foothills	Areawide	0	N/A	$0.00	N/A	0	$0	Bonus; $10/acre Min	12.5% Royalty
11/18/2015	BS 2015W	Beaufort Sea	Areawide	0	N/A	$0.00	N/A	0	$0	Bonus; $25/acre Min	16.66667% Royalty
11/18/2015	NS 2015W**	North Slope	Areawide	184,813	N/A	$50.38	N/A	131	$9,311,065	Bonus; $25/acre Min	12.5% &16.66667% Royalty
5/4/2016	AP 2016	Alaska Peninsula	Areawide	0	N/A	$0.00	N/A	0	$0	Bonus: $5/acre Min	12.5% Royalty
5/4/2016	CI 2016W	Cook Inlet	Areawide	0	N/A	$0.00	N/A	0	$0	Bonus: $10/acre Min	12.5% Royalty
12/14/2016	FH 2016	NS Foothills	Areawide	0	N/A	$0.00	N/A	0	$0	Bonus: $10/acre Min	12.5% Royalty
12/14/2016	BS 2016W	Beaufort Sea	Areawide	32,136	N/A	$25.77	N/A	7	$828,292	Bonus: $25/acre Min	16.66667% Royalty
12/14/2016	NS 2016W †	North Slope	Areawide	599,880	N/A	$28.17	N/A	384	$16,900,490	Bonus: $25/acre Min	12.5% & 16.66667% Royalty
6/21/2017	AP 2017	Alaska Peninsula	Areawide	0	N/A	$0.00	N/A	0	$0	Bonus: $5/acre Min	12.5% Royalty
6/21/2017	CI 2017W†	Cook Inlet	Areawide	26,823	N/A	$34.39	N/A	6	$922,393	Bonus: $25/acre Min	12.5% Royalty
TOTAL: 163 Sales									$2,259,179,518		

National Wildlife Refuge Association

May 23, 2018

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Karen Mouritsen, Alaska State Director, U.S. Bureau of Land Management, kmourits@blm.gov

By Electronic Mail

Re: Timeline for Arctic Refuge Leasing EIS

Dear Secretary Zinke, Deputy Secretary Bernhardt, Assistant Secretary Balash, Senior Advisor Wackowski, and State Director Mouritsen,

I am writing to express my serious concerns with the process the Bureau of Land Management (BLM) is contemplating for completing an environmental impact statement (EIS) for an oil and gas leasing program for the coastal plain of the Arctic National Wildlife Refuge. The Refuge is the most sensitive and ecologically and culturally significant undeveloped landscape in North America. An adequate public process pursuant to the National Environmental Policy Act (NEPA) to assess the numerous significant social, cultural, economic, and ecological impacts associated with developing an unprecedented leasing program for the coastal plain must be extensive and will necessarily take a substantial amount of time to complete. It will also require the initial collection of a significant amount of scientific information to inform the analysis.

Yet, consistent with an August 2017 secretarial order aimed at "streamlining" the Interior Department's NEPA compliance through imposition of arbitrary time and page limits for completing EISs, Deputy Secretary Bernhardt has publicly stated his intention to complete the coastal plain leasing EIS within one year.[1] Senator Murkowski also articulated the "strong commitment [of the Interior Department] to work with [her] to get these leases out before the end of the term."[2] On April 27, 2018, the Deputy Secretary issued additional direction for implementing the 2017 streamlining order, requiring all agency teams

[1] Margaret Kriz Hobson, "Road map for ANWR drilling gets clearer," *E&E News*, Mar. 12, 2018 (Bernhardt statement at Alaska Support Industry Alliance meeting).
[2] *Id.* (Murkowski statement at Anchorage business meeting).

preparing EISs within the Department to submit to him, within 30 days, a project schedule for completing the NEPA process within one year and confirmation that the EIS will be no longer than 150 pages. BLM's "tentative schedule" shared last week at a Resource Advisory Council meeting in Fairbanks confirms that the agency is contemplating a one-year timeframe for completing the leasing EIS.

As the former U.S. Fish & Wildlife Service Regional Director for Alaska who has overseen dozens of agency decision-making processes, I can say with certainty that an adequate public process and analysis under NEPA for leasing the coastal plain simply cannot be completed within one year and be limited to 150 pages of environmental analysis. Good planning takes time. This is especially so in Alaska, where the sheer scale and ecological and cultural importance of the landscape and resources are particularly vast and complex. It is also a matter of environmental justice, where meaningful engagement of remote communities and Alaska Native tribes necessarily takes time. In this context, one size decidedly does not fit all. Imposing the timelines and page limits contemplated by the Deputy Secretary to the coastal plain leasing EIS will mean that significant impacts go unanalyzed. Tribal consultation and coordination will likely get short-shrift, important scientific data will not be compiled or considered, and the public's ability to provide meaningful input on alternative courses of action will be compromised. Ultimately, the agency's ability to consider all relevant information, adequately respond to public input, and issue a decision that satisfies all treaty, statutory, and regulatory mandates will be significantly compromised.

By contrast, I was involved with and am aware of several recent EIS-level decision-making processes of significant scope in Alaska that took sufficient time to perform a rigorous NEPA analysis with extensive tribal and public engagement. For instance, the National Petroleum Reserve in Alaska Integrated Activity Plan was completed in approximately 3 years. This plan was not litigated, I believe, because the Department took the necessary time to get it right, including by holding more than a dozen public meetings, conducting significant tribal consultation, and involving many local, state, and federal agencies.

Procedural integrity, not political expediency, must drive the timeline of this unprecedented effort. BLM must identify missing and outdated information, process the best available science, evaluate potential impacts, formulate stringent protective measures, conduct intensive and meaningful government-to-government consultation, and engage the public – this simply doesn't happen quickly. A rushed NEPA process for the coastal plain leasing EIS would be a callous affront to the Gwich'in people, for whom the coastal plain is the "Sacred Place Where Life Begins." It would pose existential threats to wildlife, including the over 200,000-member Porcupine Caribou herd that migrates hundreds of miles each year to their coastal plain calving grounds, and the threatened polar bear that dens and gives birth in designated critical habitat on the coastal plain. It would jeopardize the incredible 200 species of migratory birds that fly to the coastal plain each year from remote corners of the globe, and violate the agency's responsibility to the millions of Americans who cherish the Refuge as North America's last great wilderness.

A rushed approach also undermines fundamental values of government decision-making that are enshrined in NEPA, our country's basic environmental charter. NEPA has been a proven bulwark against hasty or wasteful federal decisions by fostering government transparency and informed decisions. It has ensured that federal decisions are at their core democratic by guaranteeing meaningful public involvement. And it has achieved its stated goal of improving the quality of the human environment by ensuring that decisions rely on sound science to reduce and mitigate harmful environmental impacts. Those promises cannot be met under the pressure of compressed and arbitrary time and page limits.

As you complete the required project timeline for the coastal plain leasing EIS, I ask that you keep these realities in mind and provide a waiver of the Department's one-year/150-page limitations for EISs, which are wholly inadequate for this process. Until the scoping process is complete and BLM has had adequate time to review public comments and determine the scope of the draft EIS, it will not be possible for the agency to produce a defensible project timeline or estimates for the length of the EIS. Even then, the BLM will necessarily need to remain flexible as it engages tribes and the public in this highly significant NEPA process and conducts a robust environmental analysis. In sum, it is critical that BLM allow adequate time and commit the necessary resources to perform a rigorous and transparent study of all the significant environmental, cultural, and socio-economic impacts associated with a leasing program for the coastal plain, and to robustly engage the Gwich'in in a manner that suits their unique sovereign needs and interests.

Sincerely,

Geoffrey L. Haskett

Geoffrey Haskett
President, National Wildlife Refuge Association

Cc: Greg Siekaniec, Regional Director, U.S. Fish & Wildlife Service, greg_siekaniec@fws.gov

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