Notes with Victoria Herrmann and Clare Fieseler:

- Co-management of systems.
- Wilderness as a legal concept.
- Canada co-management models and Greenland as model.
- To drill or not to drill? The next chapter of ANWR
    - Now was have the opportunity of management without oil in the equation.
    - The interesting point to write
    - Co-management is a new framework for Western pandemic.
    - ANWR has two alternative views on use.
- Arctic Ecosystem Co-management for Pandemic Prevention: a ANWR case study

Alaska's Role in Preventing Future Pandemics: an overview of risks posed by an oil and gas program in the Arctic National Wildlife Refuge

Executive Summary

Almost 100,000 Americans had died of the COVID19 pandemic at the time this report was completed. This is deeply tragic and possibly preventable. While the novel coronavirus has roots in tropical ecosystems and Chinese animal markets, there is clear evidence that future epidemics could potentially spillover from Arctic ecosystems. This report provides a broad overview of Alaska's environmental and socioeconomic susceptibility to a public health emergency caused by an Arctic-borne zoonotic disease. The current implementation of an oil and gas program in the Arctic National Wildlife Refuge serves as a useful case study for an Alaska policy decision that should be revisited through the lens of human, animal, and environmental health. Bolstering this triad of health sectors is an evidenced-based way of preventing public health emergencies and decreasing the likelihood of pandemics.

Before the current pandemic, President Trump signed into law P.L. 115-97, which provides for an oil and gas program on ANWR's Coastal Plain. While the impacts of climate change and energy development on public health have been documented in different contexts, almost nothing has been published on the range of virus-related public health risks that energy development in ANWR poses, specifically to Alaskans.

This report begins by explaining the evidence for how Arctic landscapes, and more specifically permafrost, become sources of harmful viruses that are not well understood. The second section summarizes how increased habit disruption by climate change and energy development may accelerate the release and transmission of Arctic-borne viruses. Within the Arctic and subarctic latitudes of North America, climate change is expected to increase the prevalence of acute and chronic diseases among human and animal populations. The third section examines ANWR's bird population as a representative case of how wildlife, even when declining in numbers, can serve as global vectors of Arctic-borne diseases, transporting them from Alaska to six continents. Alaska's decision makers are challenged more than ever to balance public health priorities, conservation goals, and their state's economic dependence on the oil and gas industry. The fourth and fifth sections outline new economic and local community circumstances introduced by COVID-19 impacts, which should be evaluated as part of the ANWR

drilling plans. These factors are important because of the virus-related human health implications that were overlooked in the Environmental Impact Statement published in 2017 concerning the ANWR oil and gas program.

Preventing the next pandemic will require U.S. state governments to invest in new public health research and change certain nature-altering economic activities. As the only state that contains Arctic landscapes and highly remote and vulnerable Native communities, Alaska is uniquely challenged by this task. This document does not present an alternative economic model for the ANWR region nor does it critique previous environmental management decisions related to the area. However, a thorough review of the available research suggests that the changes to wildlife, Alaska Native communities, and Arctic habitats brought by energy development in ANWR poses multiple risks that may leave the region more susceptible to Arctic-borne disease transmission and spread.

The authors of this report recommend that special funding be established to empirically research, prior to any permitted resource extraction, the ANWR region as a source and driver of Arctic-borne zoonotic disease spread.

Viruses and Permafrost

Background

85% of Alaska is covered in permafrost ground that has been frozen for at least two years.(1,2) It has an active layer, composed mainly of ice, which thaws in the summer and refreezes during the winter. Underneath is a stable layer that remains frozen; the depth varies with annual temperatures, snow depth, soil, and ground slope.(3) This frozen area contains large amounts of organic carbon so as it melts, it can release carbon dioxide, mercury, and even viruses into the air. This section will review the many threats posed by Alaska's melting permafrost, including their largely overlooked threat as a source of potentially harmful viruses.

Rising global temperatures are causing permafrost to thaw and become unstable. When frozen, permafrost is harder than concrete, creating a stable foundation for roads and buildings. Many communities rely on this stability so if permafrost thaws, it sinks, damaging the infrastructure built on it. While 85% of Alaska is covered by permafrost, 70% of that is susceptible to caving or sinking due to the thaw driven by climate change.(4)

In the past half-century near the North Slope of Alaska, the temperature of the permafrost increased by 2.5°C and,(5) in 2016, a record high was recorded on Alaska's North Slope near ANWR.(6) Climate projections suggest that permafrost will continue to melt as soil temperature increases and it is anticipated that by 2100, 16 to 24% (of the 38%) of near-surface permafrost that underlies mainland Alaska will have disappeared.(7)
In addition to impacts on infrastructure, Sarah Yoder, Environmental Public Health Program Manager for Alaska Department of Health and Social Services, states that the loss of permafrost will affect the wildlife who inhabit the region.(4) Many of Alaska's residents rely on fish and wildlife as a food source, but, with habitats changing due to permafrost thaw, traditional harvesting locations are subject to change. The thawing of permafrost also alters river travel, trails, and other access routes to these harvest locations. Further, the loss of permafrost alters water distribution as the uneven ground created by the melting alters water patterns and drainage networks. The resulting changes in hydrology, as some areas become wetter

and others drier, change the vegetation, soil, and ecosystem processes that provide food and habitat for wildlife.

Permafrost thaw as an economic threat

The melting is occurring more rapidly than previously believed. Based on a simulation model developed in 2012 on the rates of carbon emissions and permafrost degradation in Alaska, scientists have concluded that widespread permafrost degradation could begin between 2040 and 2099; an estimate for large-scale degradation of the permafrost previously proposed by Jafrov et al. in 2012 was pegged at 2100.(8)

This fast-pace degradation poses a serious threat to the extraction and usage of natural resources in Alaska. Almost four million people and 70% of the current infrastructure that is on permafrost are in areas that are categorized as having high potential for thawing by 2050. Natural resource extraction is at risk because parts of the Trans-Alaska Pipeline System and other major gas pipelines are located in these vulnerable areas.(9)
The melting of the permafrost is impacted by human activity, such as drilling. Engineering is a potential solution however it bears a heavy economic cost that poses an obstacle to addressing the problem at a regional scale. According to Dr Ted Schuur, Professor of Ecosystem Ecology at Northern Arizona University, insulation and other engineering strategies can be implemented in an attempt to slow down the negative impacts of thawing on existing energy development sites. However, for new infrastructure, Dr Schuur is more sceptical; the existing research is inconclusive on the effectiveness of mitigation for the future.(10)

Conversely, according to the U.S. Climate Resilience Toolkit website, there may be some benefits to accelerated permafrost thaw in Alaska and the Arctic region. Operations that use marine transportation could benefit from less ice and a more open sea on their routes. Moreover, the warmer climate would mean a longer shipping season so more products could be moved before colder weather in the winter can block waterways.

Permafrost thaw as a public health threat

Permafrost degradation could be fatal from a public health perspective. Trapped in the permafrost are frozen, harmful viruses.(11) As the permafrost thaws, these viruses may infect humans upon contact or, alternatively, the virus could transmit to a migratory animal, such as birds, and be spread throughout the world to more densely populated areas, resulting in a potential epidemic or pandemic. These dormant viruses that humans haven't evolved with and thus haven't developed immunity for could severely impact modern human health.
However, some scientists argue that a global health crisis of this nature is unlikely and the chance of a previously dormant virus becoming strong enough to affect large populations is low but still concerning.(11) For example, in 2016, a heatwave in Siberia melted permafrost that exposed the carcass of a reindeer infected with anthrax, as a result, a 12-year-old boy died and eight others were sick; this was the first Anthrax outbreak in the Russian tundra since 1941.(12) Other anthrax outbreaks in recent history cannot be definitively tied to thawed permafrost but scientists deem that the link is plausible.

Additionally, human health is at risk because the harmful substance mercury (Hg) enters the food chain due to thawing permafrost; as microbial matter decay resumes and releases Hg to the environment. Due to its high toxicity and proclivity to bioaccumulate, mercury is a large threat to both wildlife and humans. Permafrost soil contains nearly twice as much mercury as all other soils, the ocean, and the atmosphere

combined, and this Hg is vulnerable to release as permafrost continues to thaw. According to Paul F. Schuster, a Hydrologist at U.S. Geological Survey, the mercury that is absorbed by the atmosphere reenters the global mercury cycle,(13) in turn increasing the global background levels of mercury which redeposits Hg to the landscape in increasing concentrations.(14) When mercury moves through the terrestrial landscape it works itself up the food chain, concentrating in body tissues of both humans and wildlife. Schuster states that the geochemical processes initiated when mercury is released in the terrestrial environment cause microbes to "chew" on the mercury-laden organic matter. The methylmercury, a byproduct of these processes, is incredibly toxic to living organisms.
Drilling in ANWR is likely to result in an increased release of mercury from permafrost soils to the environment because sufficient evidence suggests that higher mercury concentrations are found where permafrost soils have been disturbed by both natural processes such as thermokarst collapse and bioturbation and manmade disturbance such as development in ANWR.(14)

Arctic populations are particularly vulnerable as it is already experiencing disproportionate effects of mercury pollution due to long-range transport mechanisms. Arctic marine biota and Inuit populations are at risk, specifically marine top predators who have exhibited concentrations of mercury in body tissue that have exceeded biological effect thresholds.(15) A 2009 review reported that recently, more than 92% of the Hg body burden of Arctic animals are of man-made origins, indicating that Arctic species are exposed to higher Hg concentrations today than historically.(16) Thus, drilling in ANWR will likely increase the risk to marine animals and Inuit populations.

An Alaskan case study

Since the infrastructural and public health consequences of permafrost degradation are potentially serious, it is important to consider the quantity of permafrost affected by the proposed drilling in addition to the severity of the effects. The 2017 bill that opened ANWR to leasing, places a 2,000-acre limit on surface development.(17) An Environmental Impact Statement published by the U.S Bureau of Land Management (BLM) for energy development in ANWR states this figure as its predicted area of permafrost impact, with the caveat that the 2,000-acre limit is rolling–land that has been developed can be abandoned and reclaimed so that it no longer counts toward the total, freeing up new acreage for development. The BLM predicts potential permafrost damage within those 2,000 acres or more as new land is developed within the rolling limit.(18) This suggests that the permafrost impacted will be limited to the land that is directly developed, such as the land underneath gravel roads or the land that will be displaced for material extraction. However, a 1987 case study of an earlier Alaskan drilling project claims an impact area that extends beyond just the developed land, as indirect impacts radiate outward and create lasting damage.(19)

An important case study is the Prudhoe Bay Oil Field, west of ANWR along Alaska's North Slope, which has been a drilling site since 1968. A study of the cumulative environmental impact of the project some 15 years after its start found that the area of permafrost impact greatly exceeded the area of surface development. Researchers compared direct impact, or impact to permafrost within the developed land, with indirect impact, which includes flooding, thermokarst (the thawing of localized areas of permafrost) and other damage to lands around, but not within, development sites. In the areas they examined, the indirect impact area could reach up to twice as large as that of direct impact. Though the terrain of the Prudhoe Bay Oil Field is not identical to the areas of the proposed development in ANWR, the authors argue that ANWR's hilly terrain and acidic soil make it even more susceptible than Prudhoe Bay to thermokarst caused by alkaline road dust and other disturbances.(19)

The Prudhoe Bay case study suggests that the BLM's prediction of permafrost damage for ANWR is confined to the developed area and does not sufficiently consider effects such as flooding and thermokarst that could disturb permafrost well beyond the program demarcation. While the 2,000-acre limit does constrain the area of the direct impact on a rolling basis, the indirect impact could greatly exceed this limit, enhancing public health risks by endangering a greater quantity of permafrost.

Additionally, beyond the risks posed by resource extraction, seismic surveying could have even more wide-reaching consequences to ANWR's permafrost layer. Seismic surveying is used to locate subsurface oil deposits prior to leasing. The process requires heavy vehicles to traverse the territory, forming a grid of trails that can last for decades and disrupting the permafrost layer. While building and development in ANWR is restricted to 2,000 total acres, surveying would cover the entire 1002 area, affecting far more permafrost.(20)

Furthermore, a 2019 University of Alaska study of the environmental impact of a proposal by SAExploration to survey the entire 1002 area found that if the proposal is implemented, surveying would directly impact 150,000 acres of land. Though the severity of the damage could vary, ANWR's permafrost is rich in ice, making it particularly susceptible to thaw. ANWR's hilly terrain also increases the potential for long-term harm. While some permafrost damage may naturally heal, effects of surveying could be long-term and even permanent, particularly since the permafrost is already fragile due to the warming climate.(20)

Researchers agree that consequences to permafrost from surveying and development are currently difficult to predict in full; however, the two case studies suggest that the damage caused by surveying and development will extend well beyond 2,000 acres, potentially thawing or otherwise degrading areas of permafrost throughout the entire 1002 area.(20) Figure 1 demonstrates the extent to which pipelines and industrial areas are at risk from thawing permafrost; the public infrastructure that supports extraction, including roads and airports, could also be affected by the thaw. Developing in ANWR and thawing or destabilizing thousands of acres of permafrost throughout the territory could have serious consequences for infrastructure in Alaska, as well as for public health worldwide.

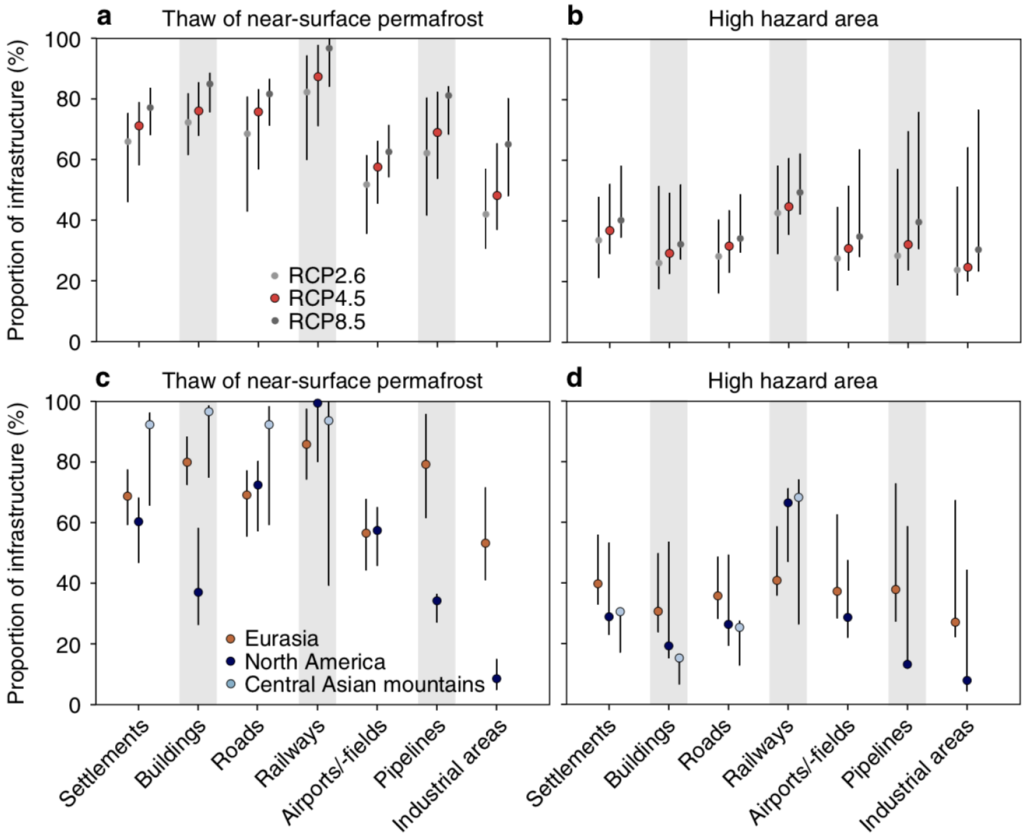

Figure 1: From Hjort at et al. 2018 study that summarizes the results of the infrastructure hazard computations. The authors interpreted the figure above are follows: "Proportion of all residential, transportation, and industrial infrastructure in areas of near-surface permafrost thaw (a) and high hazard (b) in the pan-Arctic permafrost area based on different Representative Concentration Pathway (RCP) scenarios by the middle of the century (2041–2060). The comparable results of RCP4.5 for geographical sub-regions (Eurasia, North America and central Asian mountains) are presented in (c) and (d) (also 2041–2060; %ages for airports/-field, pipelines and industrial areas are not shown for central Asian mountains owing to too few observations). The numerical results are presented in Supplementary Table 3. The uncertainty ranges (bars) were based on the uncertainty in the mean annual ground temperature (a–d) and active layer thickness predictions (b and d)."(9)

Viruses and Arctic Habitat Destruction

Background

The newest novel coronavirus (2019-nCoV) was transmitted from animals to humans after the human extraction of those animals from their native habitats. Previous emerging novel coronaviruses SARS-CoV and MERS also jumped from wild animals in tropical forests to humans. Almost 70% of new infectious diseases came from animals, and habitat fragmentation is a clear driver cause whether the habitat is in a tropical rainforest or in the Arctic tundra. As roads and human activity push further into near-pristine areas, the likelihood of zoonotic disease transmission increases.(21) In a globalized world where the next pandemic is 'just a plane flight away,' it is imperative that humans learn to respect wildlife and recognize the heightened potential of contracting a disease that accompanies encroaching into natural habitats. Deforestation is particularly threatening as a form of habitat destruction as a study conducted in 2019 contends that a 10% increase in deforestation would increase the number of malaria cases by 3.3%; that

would be 7.4 million people worldwide. Expanding energy development in ANWR could see similar implications.(22)

Amidst the COVID-19 pandemic, regarding drilling in ANWR, it is crucial to consider this increased risk of zoonotic disease spread. Allowing drilling in ANWR would open the landscape up to civilization; the Environmental Impact Report predicts increased human presence in ANWR but lacks projections for this increase in population size.Development projections layout the maximum possible creation of permanent oil and gas facilities, resulting in habitat destruction and fragmentation.(18) These projections hypothesize the building of 174 miles of roads, four airstrips, 212 miles of oil pipelines, 14 satellite pads, one seawater treatment plant, one barge landing, one storage facility, and 296 acres of gravel pits and stockpiles. This development is projected to disturb approximately 2,000 acres within ANWR's 19 million acres.(18) This possible degradation of habitat is linked to zoonotic disease emergence in the Arctic.(23)

The state of ANWR is pristine, scientifically defined in the Coastal Plain Oil and Gas Leasing Program Environmental Impact Statement as "pure, original, and uncontaminated."(18) Other scientists have attempted to create a baseline for pristineness, instead referring to largely untouched landscapes as "near-pristine",(24) arguing there is no undisturbed baseline for comparison because ecosystems are constantly being transformed by floods, fires, disease, and the human-induced introduction of alien species.(25) According to the *New York Times,* ANWR is the "last great stretch of nothingness in the United States."(26) The landscape is home to polar bears and the migrating caribou.The landmass is devoid of roads, remaining largely untouched by man, with a Native American village located at the Northern tip and the occasional hunter, seasonal scientist, or backpacker. (26)
Human activity in pristine habitats creates danger by generating conditions for pathogens to jump between species.(27) Scientists have recorded 335 new diseases in the past thirty years, strongly linking habitat destruction and disease emergence. This is because the destruction of habitats disrupts the ecosystem including host species. As a result, there is decreased protection from disease transfer between species. This disruption forces pathogens to jump to other species, mixing pathogens and leading to emerging diseases. (28)

Increased habitat fragmentation is theorized to cause coevolutionary engines, defined as the hosts, obligate parasites, and pathogens within each fragment, to isolate and coevolve.These diverging coevolutionary engines, driven by population shifts within fragments, accelerate the rate of increase of the pathogen's genetic diversity. When combined with bridge vectors, which exist in both tropical ecosystems and the Arctic, this divergence in evolution increases the risks of a pathogen variant developing that can become zoonotic.(27)

In this discussion, it is also crucial to consider preventing outbreaks and how to identify them early. To this end it is important that scientists and epidemiologists have the ability to study wild habitats and test mammals such as civets and pangolins that are known to carry coronaviruses; this form of surveillance existed in the form of USAID's PREDICT program but was recently defunded.(22) Programs such as this are more important now than ever and it is vital to ensure sustainable funding and widespread reach so it covers not only tropical forests but also Arctic habitats such as Alaska. The majority of the research linking habitat destruction and disease emergence has been conducted on tropical ecosystems but also applies to Arctic ecosystems. Both areas have viruses transmitted by vectors, generating similarities between these climate-sensitive viruses as climate change expands vector ranges and vector populations.(28, 23) Therefore, the disruption caused by drilling in ANWR is likely to accelerate the emergence of zoonotic diseases.

A Scandinavian case study

The development of pristine and Arctic regions is not unprecedented; there are a number of cases or analogues that may be helpful in considering what could happen if the development of ANWR proceeds. One such case is that of Fennoscandia–the region composed of the Scandinavian and Kola peninsulas as well as mainland Finland. Arctic populations of both humans and animals in Fennoscandia have a number of general parallels that may be helpful in understanding the consequences of industrializing the region.

First, it is important to address the larger issue of declining biodiversity as it relates to the emergence of new zoonotic diseases in the region. Human-driven habitat loss can have a profound effect on the diversity and health of animal populations which as a result, increases the threat of zoonotic transmission of pathogens. For example, when there is less biodiversity in the host population of generalist pathogens–those able to survive in a broad range of habitats – such as Lyme disease in ticks, they become more prevalent in humans.(29) Therefore, the subarctic is particularly vulnerable as there are lower zoonotic host and species diversity than other places so the animals in the subarctic carry more unique zoonoses than hosts from other regions.(30)
Thereby, preserving the biodiversity of pristine regions could have a positive effect on the health of human communities since it protects against the spread of zoonotic diseases. R.S. Ostfeld of the Cary Institute of Ecosystem studies explains, "The weight of evidence suggests that protection against exposure to infectious diseases should be added to the list of utilitarian functions of biodiversity."(29) Hence, It is important to recognize that human activity is often linked to the decline of biodiversity, and is liable to have an impact on species that carry diseases as well as host populations, thus it is crucial to minimize disruptive human activity in such pristine locations.

Additionally, habitat destruction and climate change are inextricably linked given that Arctic regions will be among the most severely affected by global warming. The observed correlation between habitat fragmentation and disease emergence in the tropics applies to the Arctic because transmission by vectors generates similarities between climate-sensitive viruses in both areas.The Arctic is warming at twice the rate of the global average air surface temperature rise. (23) This is because of a phenomenon known as "Arctic amplification," wherein polar regions warm faster than other parts of the world.(31) Changes in climatic factors can expand disease vector ranges and enlarge vector populations as unseasonably warm periods alter the behaviour of animals and effectively change the range of habitat for important species. As the Earth warms, vectors uncommon to the region could migrate to the Arctic.(23) This impacts indigenous populations in Fennoscandia, such as the Sámi who have seen the introduction of new diseases to both humans and reindeer.(32) Further, warmer temperatures accelerate the spread of pathogens in vectors, as efficient disease transmission requires warmer temperature.(23) For example, scientists hypothesize that warmer temperatures could allow some vectors, such as rodents, of diseases harmful to humans including *Brucella spp., Toxoplasma gondii, Trichinella spp., Coxiella burnetti* and Puumala hantavirus to survive through Arctic winters, increasing their population size and habitat range.(33) These severe implications of climate change combined with the reliance on animal populations by Alaska natives increases the risk of exposure of indigenous people to zoonotic pathogens through animals.

Moreover, pathogens such as *Brucella spp.*, *Toxoplasma gondii*, *Francisella tularensis*, *Bacillus anthracis (*Anthrax), as well as rabies, and tick-borne viruses have been identified as potential concerns in polar regions. The changing and destruction of habitats due to human activity and climate change can create environments that facilitate the transmission of the aforementioned infectious diseases.(33) An example of a similar phenomenon was the sudden outbreak of a strain of hantavirus in northern Fennoscandia in 2007. Hantaviruses are a genus of viruses that are carried by rodents, and typically high rodent

populations correlate with high instances of human cases of hantavirus. In northern Sweden in 2007, the winter was especially mild, which allowed a large population of rodents called bank voles to survive. Ultimately these animals spread the virus as they came into contact with humans.(34) Therefore, it is evident that habitat destruction and shift due to climate change can increase the reservoir of pathogens in carrier populations, and this general principle may help anticipate future outbreaks. Hence, drilling in ANWR coupled with impacts of climate change may severely alter the ecosystems of the Arctic and potentially cause outbreaks.

Emerging Diseases in Alaska

While the COVID-19 pandemic has recently shined a light on the risk of zoonotic diseases spreading from wildlife to humans, research into these diseases—even in the Arctic—has been happening for over 70 years. Prior to this research, the traditions of many Alaska natives involved recognizing the potential of contracting diseases through interaction with other species, for example, polar meat was cooked thoroughly before consumption, and foxes showing signs of rabies were quickly removed.(35) Today, as developers and oil companies convene on ANWR without giving scientists due time to study diseases that may exist within its boundaries, humans are failing to heed generations of basic preventative measures.

Alaska is known to house the following zoonotic diseases: brucellosis, toxoplasmosis, trichinellosis, giardiasis/cryptosporidiosis, echinococcosis, rabies and tularemia.(36) Brucellosis, a disease found in both domestic and wild animals, can spread to humans via ingestion of raw food as well as exposure to animals' cuts and infections. The first human case, linked to the consumption of raw caribou, was documented in 1959 and while many caribou herds were known to be infected, a glaring gap of knowledge remains to be addressed.More research is needed into the specifics of where the bacterium *Brucella* originates, how it spreads, and its effects on humans. Until that gap is filled, scientists are unable to accurately devise preventative measures to protect oneself against the disease. Echinococcosis is another disease carried in part by caribou, and although its effect on humans is often benign and hosts can be asymptomatic as with COVID-19, it can result in the unchecked and undetected spread of the illness.(36)
Numerous diseases exist in Alaska, and they are all at risk of increasing their range and spread in the coming years as warmer winters allow a greater number of infected host animals to survive and propagate. Thus, Alaska natives face an acute risk of infection given their close relationship with and reliance on wildlife for sustenance hunting.(36) Many traditional hunting methods require relatively close proximity to wildlife, and meal preparation always involves bodily contact with animals' insides. Therefore, infection is nearly impossible to avoid, and it presents a difficult challenge for Alaska natives, finding ways to safely continue existing traditions or adapting traditions to align with a new reality of disease spread.

Another aspect to consider is the spread of novel pathogens and zoonoses as a result of development (e.g. construction of roads and other critical infrastructure or oil extraction and commerce) and the projected increase in population that accompanies it. Diseases could spread among indigenous populations as well as new populations of workers required for such development. Increased human migration and interaction with pristine ecosystems exposes humans to previously isolated areas, leading to pathogen exposure.(37) Moreover, Arctic populations are more at risk for contracting zoonotic diseases, given that some indigenous populations rely on caribou calving grounds within ANWR.(38)

The oil industry will also increase the emergence of pathogens in ANWR. According to correspondence with John Vidal, an environmental journalist specializing in zoonotic disease at *The Guardian*, "wherever

the oil industry goes, it causes massive air, soil and water pollution, from spills, drilling, and heavy machinery…with the pollution will also come illness for any wildlife". The pollution that drilling creates will increase wildlife and human susceptibility to illness, in turn increasing the transmission of zoonotic disease.(39) Degrading ANWR's pristine landscape, allowing road building, drilling, and increased populations will increase the susceptibility of zoonotic disease transmission due to increased disease vector range, increased vector population, and increased susceptibility to illness.(23) Disrupting ANWR's ecosystem leaves the landmass susceptible to disease emergence.

Alaska natives will continue to face an increased risk of disease transmission due to climate change and drilling in ANWR will only increase the threat. To combat this and understand the long-term implications of climate warming, further research is needed to foster a comprehensive understanding of interactive and synergistic environmental processes.(40) Such knowledge can only be gathered with the opportunity to study a virtually undisturbed wilderness.(35)

The threat of disease spread isn't unique to populations inhabiting ANWR and neighbouring regions but is relevant to the entire world. This is because the Arctic ecosystem is linked to the rest of the world via the 201 migratory bird species in ANWR, at least 57 of which are found regularly in the 1002 area.(41) The migration routes and wintering areas of these bird populations cross through all 50 states, six continents, and reach as far as coastal Antarctica.(42) Thus if there are emerging diseases that birds could be potential vectors of, the world could anticipate another global pandemic.

Overall, habitat destruction and habitat fragmentation are clearly linked to disease emergence from tropical habitats and this research is strongly applicable to ANWR's Arctic habitats. Given the parallels between Fennoscandia, the plethora of known zoonotic diseases in Alaska, and the clear links between habitat destruction and disease in the tropics and the Arctic, oil drilling would turn ANWR into a potential hotspot for emerging infectious diseases. In summary, oil drilling may catalyze the spread of zoonotic diseases and also pose a significant risk to Arctic wildlife.

Wildlife Extinctions & Population Declines

Understanding Extinctions and Population Decline in ANWR

A major concern in ANWR pertains to how development could affect local biodiversity thus it is crucial to scrutinize how data in this field is analyzed. The potential effects on ecosystems are based on ecological predictions that are summarized in the Environmental Impact Statement (EIS). In order to effectively understand the environmental status and relevant concerns related to the drilling leases, it is necessary to critically evaluate how exactly data is used and interpreted with the consideration of other sources. Often, the excessive emphasis has been placed on extinction data–an indication of a loss of wildlife that can't be reversed–overlooking trends of population declines. This focus on extinction data can lend to a common underestimation of significant global biodiversity loss than is actually occurring.(43) Recognizing data that suggests a trend of a declining population can provide an early indicator regarding the sustainability of that species. Wildlife population decline driven by habitat loss may occur at slower rates, and so it is often overlooked, however, this data allows for pre-emptive action as opposed to extinction data which may provide information when the damage is nearly irreversible.(44)

It is also worth considering how population decline in and of it itself can contribute to the possibility of extinction. Scientists have highlighted the potential factors that can contribute to amplified population decline–where population decline increases the likelihood of extinction. The factors that make species more vulnerable to extinction if they are already in a state of population decline include reproduction rates, habitat specialization, and local human population density.(44)

Monitoring these trends of decline are critical for Alaskan conservation organizations and policymakers to be able to set priorities and assess the vulnerability of species. On the other hand, uniquely prioritizing extinction data is not very helpful in attempting to fully understand the possible threat of drilling leases in the ANWR region to local ecosystems. This is because extinction data has a high threshold that excludes wildlife that is threatened but not threatened to the point of extinction. For example, Stan Stenner, the current VP for bird conservation and former executive director of Audubon Society, evaluated the consideration of extinction data in the EIS report as quite weak given that a species is considered as meriting inclusion only if it is intensely threatened or endangered. Little attention is given to evaluating the potential future risks of amplified population decline trends. The EIS is also largely mammal focused, according to Audubon, due to a lack of local baseline surveys. It, therefore, excludes critical review of population decline in other species (i.e. insects, birds, etc).
Alternatively, conservation specialist, Peter Marra has also suggested the possibility that ANWR would be a great place to establish a program to monitor the population trends and stability of local species.(45) Pursuing programs such as these, perhaps alongside industrial development if not instead, provides an ample opportunity to demonstrate proactive efforts to preserve Alaskan biodiversity. In the long run, pursuing programs that prioritize monitoring population decline, and thus conserving species before they are endangered, are believed by Marra to be "much cheaper from a taxpayer perspective." This cost analysis is based on the fact that it is easier and less expensive to maintain a population's stability than it is to recover or save an endangered, declining species population.

Climate Change

Another key component of any evaluation of the potential effects of development on the local environment is how it may contribute to issues of climate change. This concern is considered in the EIS and is very pertinent to the ANWR region specifically. A scientific debate currently exists over the relative causal link of climate change and habitat loss to population declines. However, focusing on this debate seems to be relatively counter-productive. It is critical to acknowledge the relationship between climate change and habitat loss, but in terms of proximate causes, habitat loss is the bigger driver of population decline. Climate change can contribute to habitat loss, but in the immediate and near future, it is industry and otherwise human-driven habitat changes that are the more aggressive and immediate drivers. Nonetheless, the relationship is entirely cumulative, and though the leases may potentially contribute minimally to these issues, the possible consequences of the super-imposement of multiple effects is still a threat that needs to be evaluated.

The EIS report, though willing to highlight some concerns over the possibility of energy development contributing to the atmospheric conditions for climate change, uses a comparative approach in its language to undermine concern. The predicted contribution to CO2 levels is 0.0003ppm globally, which over a predicted production life of 70 years, would result in a 0.02ppm increase in CO2 being released from this region. This contribution is then undermined as it is "compared to a current global CO2 level of around 410PPM."(18) Though the report considers the potential contribution to pollution and climate change on a global level, it does little to consider the more local vulnerability of Alaska's Arctic. It also does not effectively consider the cumulative and reciprocal relationship that exists between climate

change and habitat loss. For example, though the report supports the development of effective contingency plans for problems such as oil spills, it does not outline the actual goals for these plans in prioritizing local ecosystems.(18)

In far north Arctic Alaska, climate change is a pre-existing, intense driver of habitat loss, and is massively contributing to glacial melting that has already severely impacted the natural ecosystems for species such as polar bears. This vulnerability is largely due to "Arctic amplification"–glacial melting that increases the area of dark water that in turn attracts the sun's heat and exacerbates temperature rise in the north two to three times more than other global regions.(46) Researchers are also considering how these northern regions are exceptionally sensitive to changes in atmospheric conditions due to less turbulent air mass.(47)

Generally, the EIS considers the future of the Arctic environment to be relatively predictable based on current trends given the fact that the project is intended for such long-term development. However, due to the fragility of the local Alaskan environment, these trends may not be fully maintainable without steps taken to prevent the exacerbation of climate change effects.

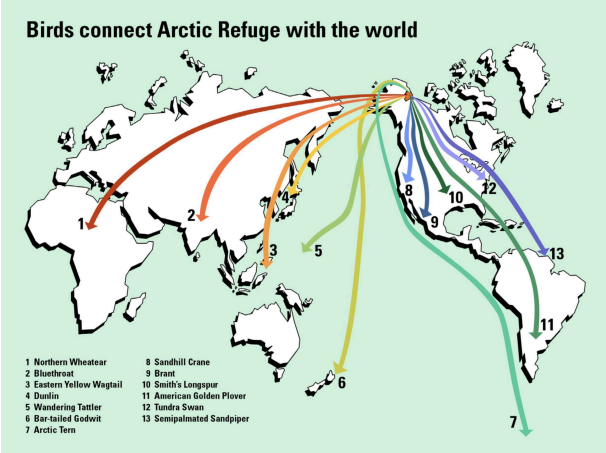

Figure 2: The migration flyways of 13 bird species seen in summer on the ANWR spans six continents, connecting the Arctic refuge with the rest of the world. Source: U.S. Fish and Wildlife Service, Dec. 2013.(48)

Bird Populations in ANWR

Furthermore, it is vital to consider the potential effects of development in the ANWR on bird populations. Although ANWR contains many different wildlife populations, birds act as efficient environmental indicators for overall ecosystem health, since they are often sensitive to environmental change. Bird populations can reflect changes in habitat quality through shifts in overall population numbers or shifts in the composition of species present.(49) Additionally, bird populations are often easier to monitor and study.

201 migratory bird species have been observed in ANWR, at least 57 of which are found regularly in the 1002 area.(41) These migratory birds both play a key role in the Arctic ecosystem and connect the arctic to the global ecosystem. The migration routes and wintering areas of these bird populations cross through all 50 states, six continents, and reach as far as coastal Antarctica.(42) Among these bird species, only the Steller's eider and the spectacled eider are currently listed as threatened under the Endangered Species Act of 1973. Notable bird populations include snow geese which use the area for autumn staging after the breeding season and several shorebird species that breed in the 1002 area. When referencing data on bird populations in ANWR, however, it is important to note that currently only one-third of the 1002 area is surveyed, and this is the area with low-density strata.(41) Thus, detection of migratory bird trends is limited. This poses an issue in establishing baseline data for mapping development sites, as it is difficult to determine the distribution of bird populations. Overall, detailed contemporary data, especially data collected over a long period of time, is lacking for bird species in the area, posing difficulties in predicting long term effects.(18)

The EIS report categorized all effects of development on bird populations as indirect effects including displacement, loss of habitat, loss of food sources, increased mortality and injury, disturbance, and increased predation. For example, road and facility construction could displace birds or completely destroy habitats, as soil and vegetation quality is impacted and becomes unsuitable for bird populations. The construction of ice roads requires large water withdrawals, which may result in lower water levels that decrease the abundance of foods or the availability of nesting sites, displacing bird populations. Moreover, development increases risks of mortality and injury, as birds could collide with vehicles, aircraft, and large structures. Additionally, the possibility of the release of contaminants, such as oil spills, increases risks of mortality and injury for bird populations.(18)

Furthermore, noise disturbance from aircraft, other vehicle traffic, ground-based equipment, and road and facility construction may, if sudden, startle birds or, if chronic, affect their ability to detect natural sounds for communication and detecting prey or predators. During breeding and brood-rearing, migratory birds are especially sensitive to noise disturbance. Noise disturbance may also damage birds' ears or cause chronic stress and reduced reproductive success.

More mundane human activity can also act as a disturbance, causing behavioral changes. Human disturbance of nesting birds can lead to increased nest abandonment and predation of nests, and for breeding birds, human disturbance can cause displacement. Predators are often attracted by areas of human activity and may become more abundant in areas of development leading to increased predation rates of nesting birds and reduced nest survival.

However, the EIS does states that a study conducted at Prudhoe Bay shows no effect of road and air traffic level on habitat use for geese and swans.(18) This finding is corroborated by an artificial nest experiment at Prudhoe Bay which found that distance to infrastructure and roads or infrastructure density did not have an effect on survival of shorebird or waterfowl nests.(50) Similarly, a 2009 study of bird nests on the Arctic Coastal Plain found that human infrastructure did not produce a detectable effect on the nest survival of shorebirds, but nest predation did increase within 5 km of infrastructure for passerine species.(51)

In addition to the effects of infrastructure and human disturbance, the changing climate could exacerbate the effects of development. Climate change affects habitats through changes in vegetation and hydrology that impact the availability of food sources and the quality of the habitat. A habitat may become unsuitable due to these changes, causing birds populations to be displaced. Climate change may also cause rising sea levels which would flood bird nests and erode barrier islands and coastlines, displacing bird nesting populations completely.(18) A study of scientific models and projections predicts that climate change in the Arctic would reduce habitat areas that are climatically suitable for breeding "with 66-83% of species losing the majority of the currently suitable area."(52)

The EIS acknowledged that the potential effects of arctic climate change acting in tandem with the impacts of the development "may result in extinction during the 85-year scope of this analysis," since many migratory bird species are already experiencing both the effects of climate change in their other seasonal habitats and decreasing populations.(18) Despite this conclusion, the EIS's preferred alternative is to render the entire program are available to leasing while designating 359,400 acres NSO for rivers and streams and nearshore marine and lagoon waters and barrier islands.(18) This recommended alternative does not designate protection of coastal areas or other avian habitats.

A special report, *Birds and Oil Development in the Arctic Refuge*, conducted by the Audubon Society's Alaska State Office aimed to take a fresh look at oil development and birds in the ANWR. The report, which predates the EIS report, contains many of the same findings as to the EIS report. The Audubon Society reports that development would require the construction of significant infrastructure which would degrade and fragment essential bird habitats, similar to the fragmentation caused by oil fields at Prudhoe Bay. Snow Geese specifically could be displaced "from as much as 45% of their preferred feeding habitat." The report emphasizes not only the importance of the coastal plain to avian habitats but also points out the "plain is very narrow–as few as 15 miles wide." Since there is limited coastal habitat birds can be displaced into, the development would undoubtedly infringe upon the habitats of bird populations.

The Audubon Society also emphasizes that waterbirds and shorebirds are highly vulnerable to oil spills, and oil spills are a very real possibility, as shown by the spill from the Trans-Alaska Pipeline in 1979. Additionally, the report echoes the EIS report in reporting significant negative effects of potential human disturbance and noise disturbance, citing Snow Geese as highly sensitive to these disturbances. In terms of potential increased predation, the Audubon Society finds that the numbers of bird predators increase in central Arctic oil fields, leading to increased predation on nesting birds near the development.(42) Although the Audubon Society reports many of the same findings as to the EIS report, it reaches a different conclusion. The former emphasizes the "extraordinary value as an intact ecosystem" of ANWR, claiming that permitting any development on the coastal plain would significantly harm bird populations.(42) The report recommends that the refuge be left intact and that bird populations be studied by scientists to research the effects of environmental change. This recommendation is also supported by conservation science specialist Pete Marra, who emphasizes the value of ANWR as a pristine location.

New Economic Questions for ANWR in 2020

Economic context and COVID-19 impacts

Given the possible environmental and public health concerns surrounding the opening of ANWR to energy development, it's worthwhile to review the primary reasons provided to begin drilling—namely, the potential for oil reserves to bolster state and local revenues. The Congressional Budget Office estimated federal revenue from the program's first two lease sales at $1.1 billion. However, those revenue predictions did not account for the massive coronavirus-driven disruption to both the state and global economy. Therefore, a reevaluation of both the value of and the consequences of development is important.

Evaluating ANWR as it pertains to drilling reveals Alaska's high dependence on oil, as at least ⅓ jobs and 90% of the state's revenues are connected to the industry.(53) Additionally, oil-related jobs are some of the highest paying in the state, with workers in the field earning 2.6 times the state average.(54) Further, a severance tax on fossil fuel companies' net income usually funds a large portion of government expenditure and 70-90% of its total revenue. However, this income is entirely dependent on the health of the industry, and in years such as 2015 that saw major losses in oil prices, this tax provided virtually no money to the state.(55) With the uncertainty presented by COVID-19 and the potential for continued volatility in oil prices, it is unclear how much revenue the severance tax will earn in future years.

Despite some changes over time, funds from oil have allowed Alaska to build a $60 billion Permanent Fund—the second largest in the US—both as a way to deliver direct cash payments to citizens and also to

provide a budgetary buffer.(56) As the state government cannot go into a deficit, the Permanent Fund allows it to survive losses in years such as 2015.

On the other hand, the damage that over-reliance on oil has done to the Alaskan economy can be seen in the Constitutional Budget Reserve (CBR), which has been mostly exhausted and driven down from a peak of $16 billion to a projected $400 million over only eight years.(57) While the Permanent Fund is not at risk of being exhausted during the COVID-19 pandemic, a similar decrease could harm Alaska's future financial health.

The economic recession brought about by the COVID-19 pandemic will only make (58)this situation worse, reducing state budget projections by at least $500 million.(58) On April 20, Alaska North Slope Oil dropped to below $0 for the first time in its history, at a negative $2.68 a barrel. (59)While forecasters anticipate that the price will rebound, oil is estimated to remain at under $30 for the rest of 2020.(60) This short-term decline has already led to a $470 million of investments being withdrawn from the North Slope,(61) and threatens as many as 50,000 jobs statewide.(53) Given recent dramatic changes in the world economy, this report is accurate as of April 28, 2020.

However, there is more to the economics of drilling in ANWR than the day-to-day oil prices. Firstly, unlike other oil reserves within Alaska, the state government is only set to receive 50% of royalties from any potential leases.(53) This has still been projected to bring in up to $1 billion in new state revenue—however, that assumes extremely high levels of bidder interest in the leased land. If the average price of oil remains constant from past sales in the North Slope, studies show leases and royalties would only bring a few tens of millions of dollars.(62)

Additionally, both the quantity and quality of oil in ANWR remains unclear. In 1998, the US Geological Survey estimated that ANWR contained a mean of 10.4 billion barrels worth of oil, but it remains reasonably possible that the actual amount could be as low as 5.7 billion.(63)10.4 billion barrels could also be an underestimate of the true amount of oil, but this uncertainty presents a risk. Already, five major US banks and 17 international ones have announced that they will end direct finance for Arctic oil and gas extraction projects such as is being proposed in ANWR. (64) Though these decisions were said to be primarily due to environmental concerns, Wells Fargo states that their reluctance to fund North Slope activities was "part of a larger 2018 risk-based decision."(65)

Regardless of potential inside ANWR, oil production would not begin benefiting the state immediately. The US Energy Information Administration, an independent analysis group, wrote in 2018 that it "doesn't expect ANWR oil production to start until 2031 because of the time needed for energy companies to acquire leases, drill exploratory wells, and build the necessary production infrastructure," meaning that the aforementioned severance tax on oil income would be delayed by over a decade.(66) Furthermore, companies would benefit from additional tax deductions during the first seven years of developing North Slope projects. These deductions take place if the price of oil remains under $70, making state revenue even more susceptible to changes in the world energy market.(67)

Finally, it's questionable how much of a benefit job creation created would have relative to other sectors. Compared to a statewide average of 20.7% of workers in a field being non-residents, oil extraction has a rate of 34.8%.(54) While this doesn't affect taxes (given the lack of a state income tax) it does reduce the likelihood that wages earnt are spent in Alaska, especially within the North Slope region. According to Professor Guettabi, PhD of the University of Alaska, wages earned in oil camps do not translate to spending in the local area.(68) Instead, they mostly benefit the home states of non-resident workers who

fly directly to the camp for a few weeks. Given this, property taxes are likely to be the largest source of income for the North Slope Borough, but this is dependent on the value of the leases.

Therefore, although economic benefits are offered as a reason to begin drilling in ANWR, it is questionable whether these benefits will accrue in a post-COVID economy.

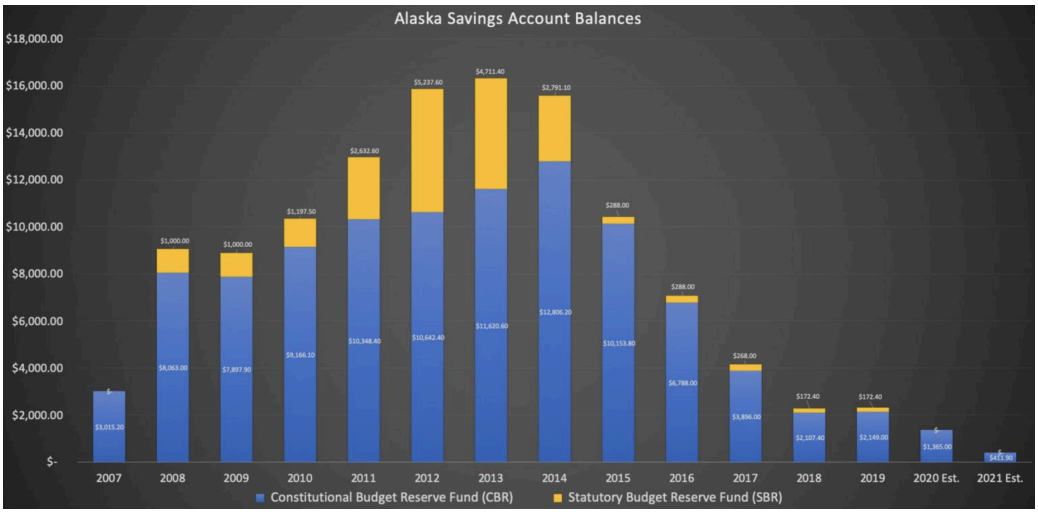

Figure 3: A decline in oil prices starting in 2015 caused Alaska's Constitutional Budget Reserve Fund to decline from over $16 billion in value to an estimated $400 million in 2021. Source: Alaska Public Media.(69)

Economic Alternatives for ANWR: Tourism

In addition to the economic implications pertaining to the energy industry, economic gains from tourism are also uncertain. Currently, there exist problems of accessibility, climate, distance, remoteness, and difficulty in managing terrain which impact the economic gains available from tourism in ANWR. With average annual visitation being under 2000 people, it is clear to observe that the present value of tourism in the Alaska National Wildlife Refuge to the Alaskan economy is minimal.(70)

For travel excursion companies which offer packages for individuals to visit ANWR, the main activities available are limited to include items such as river rafting/hiking, photo tours of the diverse wildlife population, or custom trips including base camping and day hiking. In photographs and in vivid descriptions of the site as a natural paradise, one can clearly observe the aesthetic value of the location with its expansive tundra, network of waterways, crawling mountains, and wandering caribou and polar bears.(70) However, despite the aesthetic value of beautiful wilderness, available infrastructure does not allow for substantial revenue from tourism. The U.S. Fish & Wildlife Service in recognition of this prefaces that: "There are risks. Preparation and self-reliance are essential. We provide no packaged trip plans or trail maps pointing the way. Rather, an experience in Arctic Refuge is one to search out for yourself".(71)

Five major travel companies, Travel Alaska, Alaska.org, Expeditions Alaska, Arctic Wild, and Alaska Alpine Adventures, offer some guidance and travel packages to the region, however the lack of roads, established trails, cell phone coverage, or facilities of any type within borders limits the expansiveness of visits. Due to these challenges and the low opportunities for annual visits, touristic revenue is uncertain.

However, past recommendations from government agencies provide precedent to consider the conservation of ANWR in light of potential tourism and ecotourism opportunities. For example, the U.S. Fish and Wildlife Service in the early 2000s proposed to designate almost 4,000 acres on the island of Kauai, Hawaii, as critical habitat for two underground creatures (the Kaua'i cave wolf spider and Kaua'i cave amphipod) of the lava tubes, cracks, and caves.(72) Lost income by not commercially developing the property was estimated at between $547.7 million to $1.5 billion over the 2003–2020 period. However, the Fish and Wildlife Service, cited the value of open space, preservation of the nearby coastline, reduced traffic, earnings from managing the conservation area, the value of not losing the species and land, and most significantly, potential eco-tourism revenues, as claims in support of conservation.(73)

For public officials and the Alaskan government weighing various concerns about opening up drilling, there is a consideration about the potential future value of tourism in the ANWR region as a uniquely remote, isolated, and truly wild destination for visitors to experience. Tourism in general as a revenue source in Alaska is substantial. In the autumn and winter of 2013–2014, 273,100 out-of-state visitors visited Alaska, followed by almost 1.6 million out-of-state visitors in the summer of 2014. This inbound tourism is estimated to have sustained 38,700 full- and part-time jobs, including all direct, indirect, and induced impacts, and generated USD $173,6 million in taxes and revenues, USD $1.83 billion in visitor spending and an overall economic impact of USD $3.92 billion.

In other parts of the world as well, ecotourism has served as an important tool for both conservation and economic gains. In a particular region of Botswana for example, ecotourism has contributed greatly to employment and growth of the community. The ecotourism market within Ngamiland (a northwestern district of Botswana) alone has generated revenues of approximately US$185 million, making a direct contribution toward real GDP of US $67 million.(74) Additionally, the tourism sector in this region serves to directly employ over 20% of the community. Yet, this economic success is largely reliant on Botswana's uniqueness–most of its biodiversity remains intact, with a higher percentage of its total landmass conserved than any other country.(74) Alaska's future could see similar gains if it is sustainably conserved.

In ANWR, striking a balance between an economically stimulating tourism sector and conservation is important. This becomes especially difficult due to the possibility of mass increases in visitation to such a delicate and pristine ecosystem. A way to reconcile these conflicting goals is to ensure the minimal development of infrastructure to cater specifically to luxury and high-end tourism. This could include necessary features to avoid total remoteness and ensure safety and accessibility. Implementing a high-income but low-volume tourism policy helps with conservation and economic development efforts.(74) Additionally, digital tourism through film and documentary projects such as "Where Life Begins" are also creative options to explore. (75) This form of sustainable tourism will be threatened by oil drilling and other forms of intense development in the area.

Economic Consequences for ANWR: Sport Hunting

Another economic consideration is regarding the sport hunting industry in Alaska. The development of ANWR also threatens the sizable sport hunting community which has had a positive economic impact with potential, albeit ironic, to help with conservation efforts also. Along with subsistence hunting, sport hunting is inexorably tied to the Arctic National Wildlife Refuge. The refuge supports hunting of many species, particularly caribou, dall sheep, and grizzly bears. Its untamed landscape and abundance of animals attract many resident and nonresident hunters. According to a May 2019 report from the US Department of Fish and Wildlife's Division of Economics, which was referred to us by the refuge's

manager Steve Berendzen, there were 5,275 visits to ANWR for hunting in 2017.(76) This accounts for about 8.9% of all visits to the refuge that year, as there were 59,625 visits in total. If one incorporates the 2,500 visits for fishing and considers that these statistics reflect only activities from outside visitors, that ANWR is an attractive environment for the sport hunting community.

Not only does sport hunting and fishing occur in significant volumes in the refuge, but it also is a great source of income for local communities. Similar to sustainable tourism, sport hunting entails ecological and economic sustainability since it is regulated and generates large revenues in contrast to ordinary hunting by local people. As with elephants in Zimbabwe and white rhinos in South Africa, sport hunting in Alaska has the potential to incentivize conservation(77) as landowners are encouraged to reintroduce species, protect existing species, and funnel money into conservation efforts via permits.(78)

Combined, hunting and fishing visitors spent $7,775,000 in ANWR, accounting for about 30% of total visitor recreation expenditures. This money goes towards important local industries like lodging, food, and transportation. The fact that sportspeople represent a greater share of total visitor expenditure than their share of total visits demonstrates that on average they contribute more to these local industries. Expanding the number of hunting and fishing related visits would benefit the local economy of ANWR.

An additional benefit of this type of visit is that it produces revenue for the U.S. Fish and Wildlife Service (FWS). While visitors to ANWR are not charged an entrance fee, hunting and fishing visitors pay the USFWS for licenses, permits, and tags. The Game Management Units that compose ANWR (Units 25A, 25B, 25D, and 26C) have relatively liberal bag limits that encourage repeated hunting and can lead to a continuous source of income for the FWS. For example, Alaskan residents are able to hunt ten total caribou in Unit 26C, the Northern part of ANWR that would be developed for energy extraction.(79) This bag limit is significantly higher than in neighbouring Game Management Units, indicating that the FWS is confident in the state of the area's caribou populations. Due to the Pittman-Robertson Act, any purchase of firearms and ammunition includes an excise tax that goes towards conservation efforts. By generating the purchases of these goods and of hunting permits and licenses, hunting in ANWR facilitates all of the FWS's important work in Alaska. There exists an opportunity to expand hunting and fishing within the refuge to produce greater revenue for both the state and local arctic villages.

However, the proposal to extract energy from ANWR would likely mitigate sports hunting within the refuge. Backcountry Hunters and Anglers, a national organization, has been vocally opposed to the development of ANWR. They fear that oil and natural gas extraction would disrupt the pristineness of the environment, which is the main appeal of the refuge to hunters. Barry Whitehill, a member of the organization and a resident of Fairbanks, labeled ANWR the "crown jewel that every backcountry hunter and angler should have the opportunity to fulfill in their lifetime" and the "dream for anybody that's passionate about hunting and fishing".(80)

Whitehill, and many other hunters, view ANWR as the country's last frontier, a unique and irreplaceable environment. For them, the decision to extract natural resources represents a selling out to industry and a rejection of the important cultural tradition of sports hunting. There is very little optimism that both energy development and hunting can coexist in ANWR. The example of Prudhoe Bay, an area directly to the west of ANWR that has been developed for natural gas, is deeply concerning for hunters. An area of Game Management Unit 26B, labeled as the Prudhoe Bay Closed Area, forbids hunters from taking any big game.(81) Many fear that the same regulation could eventually occur in ANWR. At the very least, energy extraction jeopardizes sports hunting in the Arctic National Wildlife Refuge.

Multifaceted Vulnerabilities in ANWR-proximate Native Communities

COVID-19 Era Concerns for Alaska Natives

In the debate on potential development in ANWR, it is crucial to consider the impacts on Alaska Natives. Alaska has the highest percentage of American Indians and Alaska Natives of any state and nearly 20% of Alaska's population identifies as American Indian or Alaska Native.(82) In Alaska, there are 229 Federally Recognized Tribes with more than 80,000 Tribal members and 11 geographically distinct cultures.(83) Yet, despite only comprising of a fraction of Alaska's total population, Native villages are disproportionately affected by economic and environmental changes, as well as new emerging diseases, all of which could potentially be brought about by drilling in ANWR.

According to a report from the United Nations Permanent Forum on Indigenous Issues, because indigenous peoples rely on and maintain a deep connection with the environment and its resources, they directly bear the brunt of climate change consequences. The report adds that the challenges currently faced by indigenous communities, such as political and economic exclusion, loss of land and resources, violations of human rights, discrimination, and unemployment, would be further exacerbated by climate change.(84) Alaska Native groups are subject to similar if not the same issues.

Climate change impacts the availability of species that are used for subsistence or that support local economies.(85) For some groups, such species are also the basis of cultural identity. In general, American Indians and Alaska Natives also experience health disparities and lower health status compared to other groups.(86) This is significant because if new diseases do indeed emerge from melting permafrost in Alaska, Alaska Natives would be at most risk. From colonization to modern pandemics, indigenous communities have historically been susceptible to new infectious diseases. For example, during the 1918 Spanish Flu, 81.7% of deaths in Alaska were Alaska Native people.(87) Moreover, the vulnerability of American Indians and Alaska Natives to new emerging diseases is currently being witnessed in light of the COVID-19 pandemic. Since American Indians and Alaska Natives have a disproportionate burden of and die at higher rates than other groups from diseases, such as heart disease, chronic liver disease, chronic lower respiratory diseases, and diabetes, they are at higher risk for severe illness such as COVID-19. (86,88) In addition, many native communities lack adequate health care infrastructure and resources to combat and prevent the spread of such diseases.(89) Overall future developments, such as oil drilling, have the potential to exacerbate current issues or introduce new impacts due to emerging diseases and mercury pollution, that disproportionately affect Alaska Natives.

Energy Development and Subsistence Hunting

While subsistence hunting is at the heart of many native Alaskan communities, this way of life is threatened by climate change and unmitigated oil drilling practices. The Iñupiaq, Yup'ik, Cup'ik, and Gwich'in tribes are some of the tribes that use traditional hunting practices that have been handed down over generations. Climate change already has a direct impact on these practices, with native hunters having to change their methods in order to adapt to the new environments.(86) Sea ice, the main physical change, begins to shrink earlier in the season, forcing natives to begin hunting earlier in the season and abandon tradition timelines. Native populations have been able to adapt to the changing environment with relative success. Although some traditional hunting areas are now impossible to use, most are as long as timing and technique are updated.(88)

Furthermore, some cultural knowledge is lost in the process, but subsistence hunting through native practices is still possible. As climate change continues and more sea ice is lost over the summer, hunting on the ice will become more difficult and may become impossible. The adaptations made by native hunters allow them to hunt and follow many native practices. These adaptations include reducing the time spent on the ice and using scientific knowledge to determine when to begin hunting rather than traditional signals such as the first sighting of an animal.(89) In order to make them, hunters need to continue to receive information from arctic scientists and the Alskan government. They will continue to adapt and hunt on the ice for as long they safely can.

Nonetheless, subsistence hunting is impacted as drilling for oil in ANWR can have a profound impact on migratory animals, especially if calving or other important events in the life cycle occur there. For example, the sound from seismic blasts and other offshore drilling activity was found to negatively impact the surrounding whale populations. Many species of whale rely on sound for communication, and that communication was greatly disrupted.(90) Whales began to stay away from the area, adversely affecting the natives who depended on the whales for subsistence hunting. After several studies, the National Oceanic and Atmospheric Administration released guidelines ways that the harm caused by sound could be mitigated. When adopted, the guidelines proved to be effective and whales have returned to the region.(90)

Competing Interests: the Gwich'in and the Iñupiat

Specifically, there are two Native groups who would be most impacted by ANWR development and who have voiced their perspectives on the issue. The Iñupiat communities of Alaska's North Slope generally support development and the Gwich'in communities throughout Northeast Alaska generally oppose ANWR development.

The Gwich'in are in opposition on the basis of harmful effects to Caribou which subsequently threatens their physical and cultural survival. (90) The Gwich'in are a community of local natives in ANWR who have inhabited and adapted to the land for thousands of years and countless generations. "We're caribou people" elder Sarah James begins as she speaks about how heavily the people of her community, the Gwich'ins, rely on caribou for their survival.(91) "The reason we're here is for the caribou" states David Smith Jr., another Gwich'in native, the second chief in Arctic Village.(92) The caribou provide the some 6,000, Gwich'in natives in ANWR with life, the vast majority of their income, food and products as they are used in an extensive variety of ways: the skin is used to make tents and clothes, their meat used for food, their fur skins used for flooring and bedding, their soap made with caribou fat and their drums made of caribou hide.(93, 94) "Seventy-five % of our diet is still wild meat, and most of it is caribou" describes elder Sarah James and without the caribou, the Gwich'in people would be left with little to live off of.

The caribou are also vital for their cultural survival, as James states "caribou are not just what we eat; they are who we are" going as far to state that the animal shapes the way the Gwich'in people see the world.(91)The caribou can be seen across their culture from their daily lives to the songs they sing. Bernadette Demientieff, the executive director of the Gwich'in steering committee, fears that "the culture that depends on [the caribou], will not survive if oil drilling is allowed to occur".(95) James describes that with drilling, the caribou will be "forced into the foothills where there are more predators, or to the coast where there is no food".(91) The caribou hold a vital piece of life in the Gwich'in communities and without them, both their physical and cultural worlds would fall apart. And while their culture may be threatened by the drilling, the homes of the Gwich'in people are threatened by this drilling too. The

drilling would directly invade the homes of the Gwich'in communities on the "1.6 million-acre coastal plain" that these people call home.(96)

However, a recent study contends that there is not enough data to determine what negative impacts, if any, oil drilling and development has on migrating caribou herds.(97) Studies have been done, but they were too small and localized to offer conclusions on the overall impact of oil drilling. Further research on a large scale is required to determine how any harmful effects can be mitigated. The potential for strategies such as those developed by the NOAA to protect whales should also be explored for caribou so further research and effort into mitigation strategies is crucial to ensure the survival and sustainability of these tribes.(98)

Compared to the Gwich'in, the Iñupiat's culture does not center around caribou and if necessary they can rely on other sources of subsistence such as bowhead whales. The Iñupiat also rely on and benefit from the oil industry. For example, in the City of Kaktovik money generated from annual property taxes paid by the oil industry helps pay for infrastructure such as a fire department, fire trucks, and flush toilets and residents also benefit from employment.(90) As such the Iñupiat who support ANWR development see new opportunities and more benefits for their villages and communities. According to Tribal Administrator Matthew Rexford, "Life is a lot easier nowadays than it was before any of the development occurred."(97)

Although the Iñupiat and Gwich'in communities remain divided on whether to allow ANWR to be opened for drilling, both communities have expressed disappointment at the negligence of the U.S. government. In an article published in *Climatic Change* in August of 2019, via an interview, the Director of the Gwich'in Steering Committee stated:

> "..we have not been contacted in any way whatsoever, this is our homeland, no one is going to protect this for us. I don't understand government, they're supposed to help people but it seems like they're helping corporations instead […] I've gone 3 years in a row to Washington DC, we gain a lot of really good people, they listen with their heart and they know what is it at stake but still don't change their vote; still won't get on board, they have other agendas, they want to stay on people's good side."(85)

The Gwich'in Steering Committee represents the interests and perspectives of all Gwich'in people from all Gwich'in communities.(98)

In an opinion article from *Anchorage Daily News* published in February 2019, Rochelle Adams, an Alaska Native cultural advisor and cultural bearer from the Gwich'in rural villages of Fort Yukon and Beaver, writes that the rushing of the ANWR process violates indigenous rights. Adams claims the draft EIS for ANWR released by the BLM is "extremely one-sided" and contains "little to no knowledge from previous public hearings" which "infringes upon our rights to public process and ignores the voices of the most impacted people."(99) Adams also claims a 1987 Agreement between the Government of Canada and the Government of the United States on the Conservation of the Porcupine Caribou Herd, will be violated by oil drilling. In addition, Adams states that the BLM's failure to translate the draft EIS into both Gwich'in and Iñupiaq languages violates Article 13, Section 2 of the United Nations Declaration on the Rights of Indigenous People.(99)

On the other hand, Matthew Rexford, the Tribal Administrator of the Native Village of Kaktovik, claims that efforts to repeal ANWR drilling programs and establish ANWR as wilderness benefits the Gwich'in at the expense of the Iñupiat and ignores the human rights of the Iñupiat. In an opinion article from *The Hill* published May 2019, Rexford wrote that efforts to repeal ANWR drilling, as the H.R. 1146 bill

would do, “specifically denies the Iñupiat people of Kaktovik – who live inside the 1002 Area where drilling would occur – the sovereign right to develop our land and resources.”(100) Rexford also claimed that “the views of the Iñupiat who call ANWR home are frequently ignored, and H.R. 1146 only reinforces the reality that the wishes of people who live in and around the Coastal Plain are less important than those who live hundreds or even thousands of miles away.”

The Gwich’in Steering Committee, VOICE of the Arctic Iñupiat, as well as the Native Village of Kaktovik were contacted for a statement on government communication and consultation and whether there has been a change in the level of communication and consultation between the government and Alaska Natives since the 2019 statements listed above. At the time of writing, no response was received. If it has not already been done, establishing a medium to adequately and meaningfully listen to, address, and take into consideration the needs and perspectives of both the Iñupiat and Gwich’in people before any action in ANWR is taken is an important step in ensuring Alaska Natives are not neglected.

Conclusion

TBD

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