

Geography 3991  
Linda Marie Sheehan  
Final Project Submission  
Donri Helmer  
T00599672  
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*This report will investigate the effects of climate change on the Arctic Regions, including ongoing and future impacts. I will explain how resource development and extraction from Arctic waterways will exacerbate global warming conditions, bringing tragedy to the entire Arctic environment.*

### Our Final Chance to Save the Last Frontier

The fact that the Arctic is warming faster than the rest of the Earth is undebatable, but it is also magnifying effects of global warming for the entire planet. The reason for this is albedo; how much of the sun's light is either reflected or absorbed by a surface. As our planet warms, polar ice melts to expose dark ocean water. This dark surface absorbs even more of the sun's energy; accelerating the Arctic ice melting process to create a feedback loop.

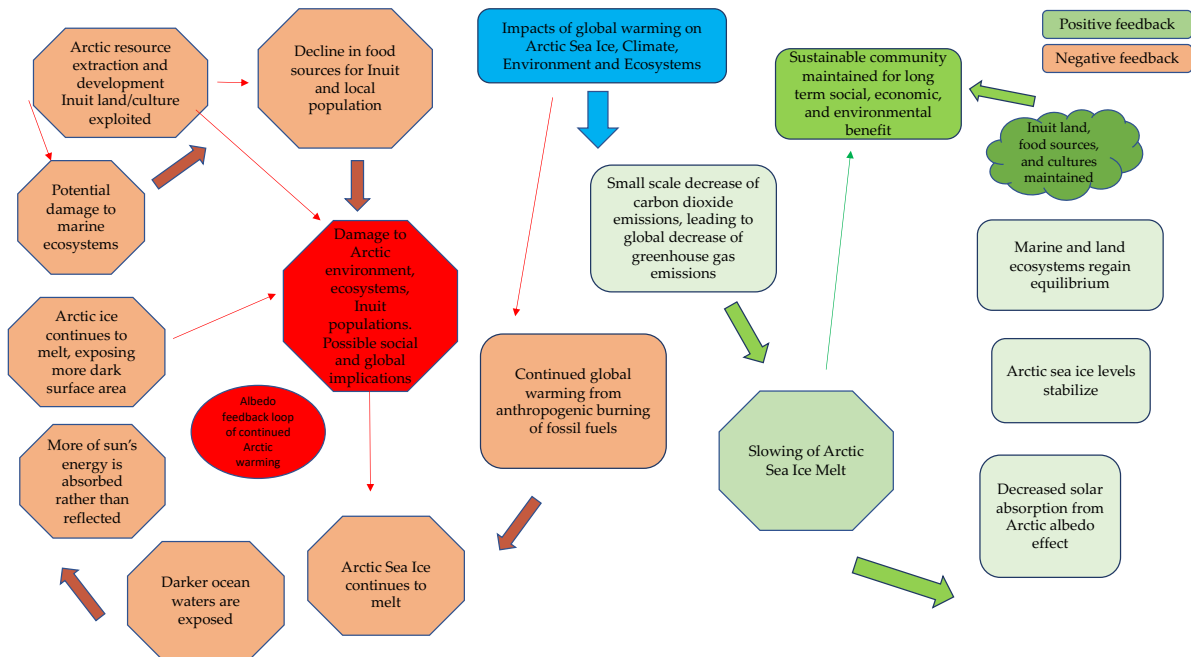


Figure 1 (Helmer, 2019)

Ice and snow reflect about 80% of the sun's radiation, while the water reflects only 20% (Mortillaro, 2018). The effect of Albedo emphasizes the urgency for slowing anthropogenic global warming.

The Arctic ecosystems cannot adapt as fast as the Arctic climate is changing. With ice melting at such a rapid rate, there is little time for an adjustment (Figure 2a & 2b). The ice is habitat to the root of an entire Arctic marine ecosystem: algae. Zooplankton eats the algae, fish eat the zooplankton, seals eat the fish, and polar bears eat the seals (McKie, 2017). The polar bear numbers in Canada's Beaufort Sea have decreased by 40%, from 1500 to 900 bears (WWF 2019). Polar bears use the ice for hunting seals, and as the ice melts, their access to food decreases, creating an imbalance in the ratio of polar bears to seals, leaving polar bears on the verge of extinction. Another species at risk is the narwhal. They hide from whales among the sea ice. If

there is no ice left to protect them, the killer whales may obliterate the narwhal population. The Inuit will, therefore, face malnutrition, since they depend on the narwhal to prepare a traditional dish called muktuk.

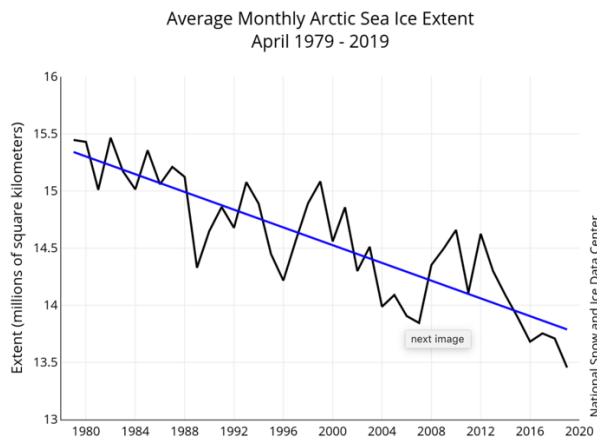


Figure 2a (NSIDC, 2019).

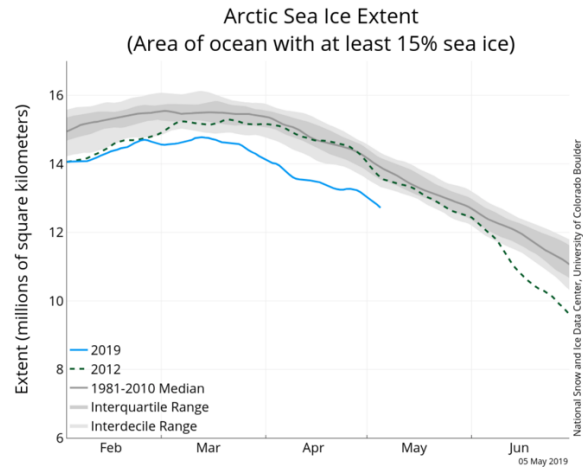


Figure 2b (NSIDC, 2019).

The melting of sea ice also contributes to ocean acidification. Freshwater from the ice and surrounding rivers drains into the saltwater oceans, lowering the pH. Besides, increased oceanic CO<sub>2</sub> levels are problematic in Arctic Oceans, resulting from fossil fuel emissions and decaying organic matter along the Arctic Coasts (Cheek, 2014). Carbon dioxide from the melting shore land releases into the water. Ocean acidification, plus the rising temperature of the sea water will affect marine ecosystems, such as the predator-prey relationship of the Atlantic cod and capelin. An influx of warmer water may encourage non-native species like King crab and herring to enter Arctic waters,

creating habitat destruction of native Arctic species. Furthermore, ocean acidification may cause the extinction of delicate saltwater organisms.

Land animal ecosystems will suffer because of Arctic climate change, especially Reindeer and Caribou. The shift in climate is causing the plants they eat to bloom earlier in the season, but the Caribou still breed at the same time every year. Therefore, there is no nutrition left for the female Caribou. Fewer Caribou calves are being born as a result (McKie 2017). If global warming slows, the animals might have a chance to adjust to an altered food chain, but, as it stands now, the climate is changing too rapidly for proper adaptation. Mitigation to eliminate global fossil fuel emissions is the only chance the Arctic region has to regain balance.

As global warming changes the Canadian Arctic land and water ecosystems, the Inuit face choices to sustain a decent standard of living that includes their traditions and cultures. For generations, they have utilized their knowledge of the land and hunting skills to survive the harsh conditions. Inuit use traditional ecological knowledge, or TEK to gain resilience against Arctic climate change (Pearce 2015). Their understanding and respect for the land allows them the ability to adapt to a changing climate. For example, the decreased availability of wildlife compromises their health and traditional feasts, but Inuit have implemented adaption techniques such as using alternative hunting methods and modifying their seasonal hunting calendar. They are also accepting changing weather patterns. The elders and hunters read ice or snow conditions to navigate by snowdrifts or landforms, ensuring safety when hunting on a softening landscape (Pearce 2015).

This acceptance of a changing environment is an asset that allows the Inuit to adapt to a changing climate. It is a quality that many “urbanized” people do not have. We are so dependent on modern technology that we lack the basic human instinct to adapt. We have lost touch with our Earth. The Inuit can cope with changes and take extra efforts to read the weather and ice conditions (Pearce 2015). This critical thinking application allows them the flexibility to survive a changing climate.

The versatility of the Inuit does not give us the right to abandon the fight for mitigation of global warming. If we don't, the Arctic may never look the same again. It is true that the Earth has gone through periods of glaciation and warming in the past, but the diversity of life was nowhere near the level of today. Those physical changes of past time eras were gradual and caused by nature. However, the current cause is anthropogenic, and the consequences are disastrous.

The future Arctic profile, as projected by the Arctic Climate Change Economy and Society of the EU, has a different face than it does today (Cheek 2014). The dominant change is that the Arctic region may become more seasonal, with possible ice-free periods. If the permafrost zones begin to melt during a new Arctic "summer," carbon dioxide and methane may be released into the atmosphere and oceans, as microorganisms break down organic matter in the soil. Melting permafrost will create yet another feedback loop of global warming. Soils in the permafrost layers hold twice as much carbon as the atmosphere, almost 1,600 billion tonnes (Turetsky et al. 2019). Melting of permafrost also has short-term impacts on the residents of the Arctic. Roads can buckle, and houses can collapse. The frozen soil is holding the land together (Figure 3). Travelling to traplines is now dangerous because of weak roads. People cannot

reach the game traps that have supplied their food for generations, and rivers are murky with debris (Turetsky et al., 2019). The altered water conditions might compromise fish habitats. The unstable permafrost region is creating a dangerous living condition for Arctic residents, affecting their food sources, homes, health, and social security. The stress of living in a house that may collapse at any time must be worrisome.

Along with altered marine and land-based ecosystems comes the most threatening aspect of all, accelerated human activities in the Arctic. With more available access to waterways, exploitation is imminent. Examples include over-fishing, tourism, and the dreaded resource extraction of offshore oil drilling (Cheek 2014).



Figure 3 (CBC, 2019).

Increased traffic through The Northwest Passage is an invitation to environmental disaster. In 2016, a cruise ship called the Crystal Serenity sailed through the Northwest Passage. What was once a life-challenging mission has become a luxury, and the Arctic scenery has become a screenplay rather than a home. In an article by NPR, passengers ironically wish to see a polar bear, the wildlife that is threatened by climate change, which made the cruise possible. Passengers recognize that they are taking advantage of what is happening (Waldholz, 2016). If global warming continues, tourism in the Northern seas is only going to increase. The increased ocean traffic and noise will disturb marine environments, and the damage from an oil spill could destroy marine species. Oil breaks down more slowly in frigid water, and there is no technology to efficiently clean up Arctic oil spills (Goodyear et al. 2012). In a CBC radio interview with Michael Byers, he expressed his concern if "budget" cruise lines started cruising the Northwest Passage. The lower cost equipment on these ships increases the risk of accidents and oil spills within the passage (Byers, 2016).

Furthermore, Vicki Aitaok of Qaiguit Tours commented on how privately owned, and unregulated yachts are causing trouble in the area (Aitaok, 2016). Smaller, faster boats are harder to control than commercial cruise lines for issues like speed, illegal hunting, over-fishing, and improper waste disposal. Carelessness will worsen as the ice melts, opening more of the northern waterway. Figures 4 and 5 show the difference in ice cover in the Northwest Passage between 2013 and 2019. If this much ice has depleted over six years, an ice-free Arctic may not be that far into the future.



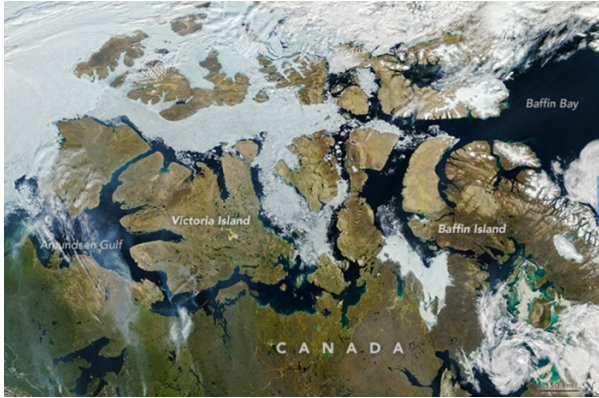


Figure 4 (Kahn, 2016)

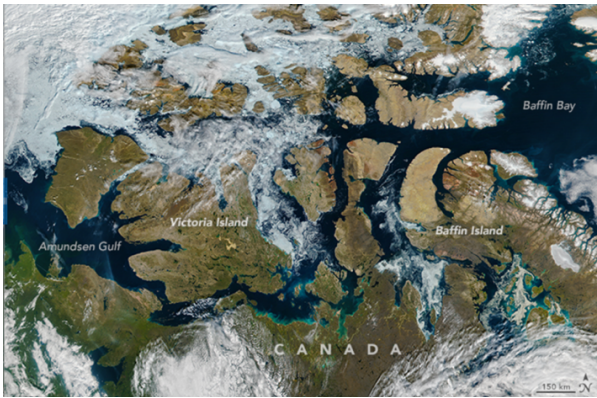


Figure 5 (Kahn, 2016)

Visiting a unique community like the Arctic must be done with extreme care. If it becomes a tourist destination, The Arctic region and its residents will be subject to exploitation (Figure 6).



Figure 6 (EB, 2019).



Increased activity in the Arctic is synonymous with increased noise, a potential source of damage to marine ecosystems. Anthropogenic noise is different than sounds emitted by creatures like whales and narwhals. This noise can be high-intensity and impulsive, or low-intensity and stationary (Peng 2015). It is the high-intensity noise from offshore oil and gas exploration that is incredibly harsh. This noise may interfere with marine organisms' breeding sounds or frighten them from their habitat. Many marine species utilize echolocation for awareness of their surroundings. Interference noise from underwater blasting, for example, will confuse certain organisms (Peng 2015). The Shell Oil Company indicated that if they drill in the Canadian Arctic, 50,000 ringed seals and 5,000 bowhead and gray whales will hear continuous drilling noise. Noises of this magnitude are considered harassment by the Marine Mammal Protection Act (Hackman 2012).

Moreover, stresses induced by underwater noise may even increase species mortality rates. An especially vulnerable species may become extinct and affect the entire ecosystem. For example, if a particular species of fish or whale is sensitive to human-induced marine sounds, and its numbers decline, it may create an imbalance to the predator-prey relationship as well as to any residents, like the Inuit, who eat the marine animals for survival.

The sounds from underwater blasting and drilling won't be the only cause of harm if offshore oil and gas exploration proceeds in the Arctic waters. As with cruise ships through the Northwest Passage, oil spills will result in environmental disaster. Again, the cold water and lack of clean up equipment in northern oceans spell doom for marine organisms should a spill occur. The Arctic species are not as adaptable as those in lower latitudes, and they tend to depend on each other for survival (IAOGP 2013). In

other words, these organisms cannot merely relocate and thrive. For example, If oil gets into a bowhead whale toothplates, they won't be able to filter the phytoplankton from the water (Calandrino et al. 2016). The whales can't adapt to another environment at such a rapid rate. Without being able to ingest phytoplankton, they will starve to death.

Destruction of the whale population will affect the Inuit culture. Whaling is a cultural event and a source of food for the Inuit people. If the whale population diminishes to extinction, they too may starve to death. The Inuit and residents of the Arctic have a close connection with the ocean (Calandrino et al. 2016). The physical consequences of offshore drilling are symbiotic with social implications. If the Inuit do not have access to enough fish or whale meat, they will face poverty because of high grocery prices in northern supermarkets. They have lived off the land for so long and have not had to rely on a monetary existence. It is not in their culture. They will face demoralization if their traditional methods of daily living are no longer available. Investors may even exploit them and convinced to work on the drilling rigs. This speculation echoes actions of the very first European settlers, who came to Canada and manipulated the Indigenous people out of their homelands.

The rights to the Arctic watershed hold the key to Arctic ecosystem survival. In the CBC interview with Michael Byers, he states that Canada's control of the Arctic would help to control tourism traffic through the area (Byers, 2016). Canada's consideration for environmental health outweighs the economic drive of US President Donald Trump. He recently signed an executive order to allow offshore drilling in approximately 125 million acres of Arctic Ocean (CNN, Rosane, 2019). In 2016, Canadian Prime Minister Justin Trudeau said that Canada's Arctic is off-limits for

offshore oil and gas drilling. This restriction will be reviewed every five years, based on scientific reports on climate change (Paraskova, 2019). Canada is willing to respect the Arctic environment. Fortunately, for now, US District Court Judge, Sharon Gleason has restored the ban on drilling in 98% of the United States controlled Arctic Ocean (Paraskova, 2019). It is this type of legislation that is required to keep offshore drilling from destroying the delicate Arctic ecosystems. Canada needs to continue the fight to maintain control of the northern waterways. We cannot allow the US to dominate with careless energy leadership.

The fight to maintain a healthy Arctic ecosystem will require collaboration between physical and social science groups, leaders and communities, businesses and consumers, Inuit and other Arctic residents. The effects of climate change are happening around the world, and conditions in the Arctic are accelerating the process. If we save the Arctic, there is a hope to slow global warming around the Earth (Figure 7). There must be a global willingness to do so. By refusing offshore drilling, we can restore equilibrium in the diverse Arctic environment and preserve the “last frontier” environment of the planet.

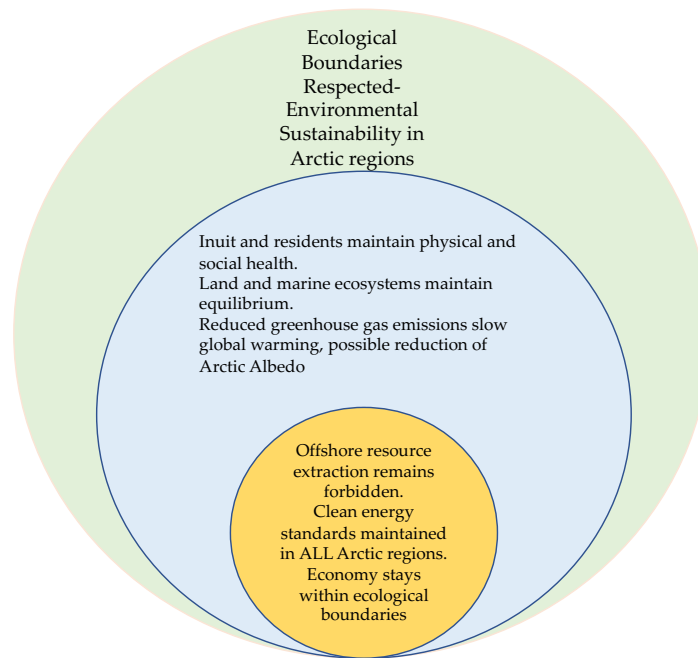


Figure 7 (Helmer, 2019)

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