Climate Change Impact on the Arctic

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Introduction

If there is a single image that universally signifies the impact of climate change, it would a polar bear, alone on a small chunk of ice floating in the Arctic, struggling to find food or shelter. It's a pervasive image, and you can't help but feel an overbearing sense of guilt or pity for the animal when you see it. However, this image shouldn't symbolize an insurmountable challenge or a lack of hope. It's important to look beyond the image and understand not only the extent of climate change's impacts, but also the potential to overcome this change. Majestic creatures like the polar bear are not doomed to suffer the cruel fate of an uninhabitable environment. There are actions we can take to slow climate change and help protect species we hold dear.

The Arctic Monitoring and Assessment Programme recently published a report on Snow, Water, Ice and Permafrost in the Arctic, which asses the state of the Arctic and the projected impact climate change will have on this part of the world. Most importantly, this report confirms a shift that scientists have feared for years: that the Arctic's climate will be significantly transformed to one that is warmer, wetter, and more variable. Already temperatures are rising faster than the global average: several months out of the year are already 5°C higher than the average of the past several decades.[1] Ice sheets and glaciers are becoming smaller and younger, and summer sea ice may disappear altogether as early as a couple decades from now. Perhaps more worryingly, increases in Arctic temperatures are causing greater levels of permafrost thaw in northern latitudes, thereby releasing carbon that has previously been locked

Austfonna Ice Shelf (Norway) calving. Photo by Amanda Graham/ CC BY-NC-ND 2.0.

away in this frozen soil into our atmosphere.

Of course, the effects of climate change are not limited to differing weather patterns, as we know from the heart-wrenching images of polar bears on dwindling sea ice. Polar bears spend most their lives on sea ice – it's where they hunt, seeks mates, raise their young, and den – so there is no doubt that a loss of sea ice would have a dramatic effect on their livelihoods.[2] And as we know, everything in nature is connected. The polar bear is the apex predator in the Arctic, and meaning that when their population declines, the entire food web could fall out of balance.

Already, climate change has proven to have a damaging effect on the Arctic environment, and careful analyses are revealing that this transformation will only become more dramatic if climate change remains unmitigated. Fortunately, we do not have to sit idly by as climate change affects beloved species, causes a series of cascading effects related to both weather and the Arctic ecosystem. Policies and partnerships that aim to slow climate change could help substantially slow down the projected changes we'll see in the Arctic, and therefore protect our planet's species and ecosystems.

Decline of the Polar Bear

Polar bear cubs. Photo by Alaska Region U.S. Fish & Wildlife Service/CC BY-NC-ND 2.0]

Today, the polar population is estimated to be between 22,000 and 31,000 bears and is made up of 19 different sub-populations across the Arctic. For nine of these sub-groups, numbers are not known and studies are on-going; some populations are considered stable; one is improving; and three are known to be in decline.[3] It is important to note that improvements in number are relative to the past several decades, where polar bear populations were decimated due to widespread hunting. Hunting may have been the leading cause of decline in polar bear numbers in the late 1900s, but regulations and multi-national

agreements curbed polar bear take – i.e. hunting, killing or capturing – allowing numbers to stabilize.[4] Today the challenge that climate change brings could be much more difficult to regulate.

In 2016, the U.S. Fish and Wildlife Service published a conservation management plan for the polar bear, citing loss of sea ice and inaction against climate change as the most significant challenges to this species' survival. With estimates that predict a complete disappearance of summer sea ice in the next several decades, there is no doubt that climate change will have a deeply negative effect on polar bear survival.[5] A study by the Royal Society, released in 2016, at which point no global assessment analyzing polar bear populations relative to sea ice had yet been published, dove into this in more detail. This report found undeniable trends in a loss of sea ice from 1979 to 2014 in each of the 19 regions for polar bear sub-populations. Considering polar bear population projections and taking variable and incomplete information for some populations into account, the study found a high probability for a 30% decline in the mean global population size for polar bears within the next 40 years.[6] Less conservative methods in this study put projections at 50% and upwards.

It has been suggested that the loss of sea ice might not be so detrimental to the polar bear. Perhaps, in fact, the polar might take advantage of its increased time on land to consume terrestrial foods to enhance their survival. While many species can adapt to changing conditions, the polar bear is highly specialized to this habitat, and evidence does not suggest that they will be able to adapt to warmer climates with less sea ice. Where terrestrial food consumption has been observed, it has not been sufficient to offset the loss of sea-based nourishment, and it was seen in a very small fraction of individuals within polar bears populations.[7] For some populations, exploration into terrestrial foods might help, but overall, data has shown that this is not a viable strategy for polar bear survival.

Beyond the Polar Bear

The Arctic food web is complex; as scientists strive to better predict the impact of climate change, we cannot be fully certain how the loss of the polar bear will directly impact the Arctic ecology. Barring any other changes, the decline of this predator would like cause imbalances in species at lower trophic levels, but climate change will not impact the polar bear alone. Many of the prey species that polar bears depend on, like ringed and bearded seals, will likely see population declines,

as the suitability of their ice habitats decrease. This could have a significant impact on the polar bear.

Other familiar species could be impacted as well. Once such example is the musk ox, a species that has been affect by global climate change before. Historical data, derived from the bones and remains of musk oxen alive thousands of years ago, has shown that the musk ox is very sensitive to changes in climate.[8] Its population has risen and fallen in such a way that has shown a strong correlation to changes in the Arctic ecosystem.

Musk ox and calf. Photo by Tambako The Jaguar/CC BY-ND 2.0

These trends serve as a strong indication that the rapid changes we are seeing in today's climate will also have a significant effect on musk oxen. In Greenland, for example, expeditions in 2013 and 2015 have already shown evidence of the musk oxen's struggle.[9] Warmer winters means more rainfall. When it rains on top of snow, it will be more likely to freeze over, forming a hard layer of ice that is often too difficult for the oxen to push through to find patches of grass. In the summers, where average temperatures in the region have risen by 3-6°C over the last two decades, new parasites and diseases can now affect the survival of musk ox populations. When new pathogens emerge, this could also give rise to new vectors to transmit diseases to humans, reminding us that changes that impact other species are not isolated events.

The implication for species population is apparent, and it is important to note that Artic climate change will have a broader impact. Changes in the Artic will likely cause warmer temperatures in the tropics and drastically different weather patterns around the world.[10] A report by the Arctic Monitoring and Assessment Programme explains that the Arctic acts as a "global refrigerator," accounting for northern Europe's relatively mild climate compared to other northern territories. Driven by differences in salinity and wind patterns, the Gulf Stream carries warm water from the

south up north. As it moves northward, it cools, releasing heat (helping to keep Europe's temperature milder) and increases in salt content. As cold northern air cools this current, it becomes denser, finally sinking down again towards the south, resetting this loop.[11] Should climate change continue on its current trajectory, melted Artic ice will introduce vast amounts of freshwater, changing the salinity of ocean waters. Diluting ocean waters would disrupt the necessary difference in salt content for the Gulf Stream to flow, thereby stalling it out and potentially leading to more extreme temperatures and unexpected weather conditions in all regions.

The changes wouldn't end there, since the Arctic is also a significant carbon sink, meaning climate change would create a positive feedback loop. As the planet warms, carbon and other greenhouse gases trapped in glaciers and permafrost would be released, further exacerbating climate change.[12] Already permafrost has started to thaw, but the extent of this change can be limited. A letter published in Nature Climate Change detailed findings that revealed stabilizing the climate at 2°C (3.6°F) above preindustrial levels would still result in a loss of approximately 6.6 million km^2, or 2.5 million $miles^2$ of permafrost, a 40% loss relative to today. Mitigating climate change such that we stabilize temperatures at 1.5°C (2.7°F) would save 2 million km^2, or 770,000 $miles^2$, from thawing. Thawing permafrost also affects the 35 million people who have made their home in that region. These populations who have built directly on and rely on permafrost would face serious infrastructural damage from ground collapse or lake formation.[13]

Policy Options for the Future

Considering so much disruption in the Arctic ecosystem, in the face of all the doom and gloom, what can we do to help the survival of so many species and to reduce climate disruption? Fortunately, there a range of policy options that can help promote a healthy Arctic ecosystem by promoting ways to mitigate climate change.

Even policies targeted at saving just the polar bear can be broadly beneficial. For example, the U.S. Fish and Wildlife Service's draft conservation management plan outlines a high priority recovery plan and emphatically notes that that the "first and foremost action for the purpose of recovery is to stop Arctic warming and the loss of sea ice by limiting atmospheric levels of greenhouse gases; the principal mechanism for doing that is to substantially reduce greenhouse gas emissions."[14] To

address this threat, the plan goes on to outline key strategies for protecting the polar bear, including supporting greenhouse gas reduction plans, supporting conservation efforts, conducting careful monitoring and research, and engaging stakeholders. In supporting the reduction of greenhouse gases, the US Fish and Wildlife service acknowledges some limits. The organization itself may have limited impact in directly reducing carbon emissions, but they plan to actively engage in science-based communication efforts to circulate the urgency of addressing climate change.

Even though they may face some limits, to "limit global atmospheric levels of greenhouse gases to levels appropriate for supporting polar bear recovery and conservation" has been listed as the first high-priority item in their Conservation and Recovery Actions.[15] They have broken out specific policy items, including developing and delivering strategies to communicate the impact of climate change on polar bear populations, continuing the US Fish and Wildlife Service's commitment of achieving carbon neutrality, and encouraging appropriate market-driven, regulatory, or voluntary actions to address anthropogenic causes of Arctic climate change.[16]

The Arctic Monitoring and Assessment Programme's Snow, Water, Ice and Permafrost in the Arctic (SWIPA) report looked beyond individual species and looked more broadly at investigating the state of the Arctic. With this report, they published a summary targeted at policy makers to help them better understand the science behind how climate change will affect the Arctic along with important recommendations for mitigating climate impact. First, the report emphasizes the value of adhering to the Paris Agreement, noting that the full implementation of the plan is essential to stabilizing Arctic temperatures. Another key planning area involves prioritizing research as a means of filling in knowledge gaps and facilitating the adoption of effective adaptation responses. Like the US Fish and Wildlife Plan, SWIPA highlights the importance of communicating information about Artic climate change, along with as risks, uncertainties, and mitigation options.

The above strategies can certainly be replicated for conservation efforts for other species and even habitats beyond the Arctic. Key elements of the US Fish and Wildlife conservation plan, such as stakeholder engagement and monitoring and research, are essential to any conservation effort. Fostering conversations among various partners and interest groups allow them to come together to find solutions that are beneficial to all, making strategies more effective. Transparency and information are also essential to making informed decisions and effective policy change. Without a

proper understanding of potential changes, policies could be put in enacted that serve little or no positive effect. Poorly planned programs could even have unintended adverse effects, so it is essential to plan carefully with as much information as possible.

At the same time, it's important to act. Species like the polar bear do not have to be fated to decline and extinction. Rather, we have every opportunity to protect beloved species through climate change. By doing so, we can even see benefits that protect our own way of life, so long as our efforts are concerted and that climate strategies are made a priority.

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Notes

1. *Snow, Water, Ice and Permafrost: Summary for Policy-makers.* Report. April 25, 2017. Accessed May 13, 2017. http://www.amap.no/documents/doc/Snow-Water-Ice-and-Permafrost.-Summary-for-Policy-makers/1532.

2. Polar Bear Recovery Team, including Michael C. Runge, Jenifer Kohout, and others. *Polar Bear (Ursus maritimus) Conservation Management Plan*. Report. 2016. Accessed May 13, 2017. https://www.fws.gov/alaska/fisheries/mmm/polarbear/pdf/PBRT_Recovery_%20Plan_Book_FINAL_signed.pdf.

3. "Polar Bears International." Status and Threats - Polar Bears International. Accessed May 13, 2017. http://polarbearsinternational.org/climate-change/status/.

4. Agreement on the Conservation of Polar Bears. August 30, 2013. Accessed May 13, 2017. http://pbsg.npolar.no/en/agreements/agreement1973.html.

5. *Snow, Water, Ice and Permafrost* report.

6. Regehr, Eric V., Kristin L. Laidre, H. Resit Akçakaya, Steven C. Amstrup, Todd C. Atwood, Nicholas J. Lunn, Martyn Obbard, Harry Stern, Gregory W. Thiemann, Øystein Wiig. "Conservation status of polar bears (Ursus maritimus) in relation to projected sea-ice declines." *Biology Letters*, December 2016. Accessed May 13, 2017. http://rsbl.royalsocietypublishing.org/content/12/12/20160556.

7. Rode1, Karyn D., Charles T Robbins, Lynne Nelson andSteven C. Amstrup. "Can polar bears use terrestrial foods to offset lost ice-based hunting opportunities?" *Frontiers in Ecology and the Environment*, April 1, 2015. Accessed May 13, 2017. https://www.researchgate.net/publication/277640478_Can_polar_bears_use_terrestrial_foods_to_offset_lost_ice-based_hunting_opportunities.

8. Lajeunesse, Sara. "Musk Ox Population Decline Due to Climate, Not Humans, Study Finds." Penn State Science. March 8, 2010. Accessed May 13, 2017. http://science.psu.edu/news-and-events/2010-news/Shapiro3-2010.

9. Eriksen, Ida. "Climate change threatens the existence of Arctic musk oxen." Sciencenordic.com. October 19, 2016. Accessed May 13, 2017. http://sciencenordic.com/climate-change-threatens-existence-arctic-musk-oxen.

10. Snow, Water, Ice and Permafrost report.

11. Max, Arthur. "New fresh water in Arctic could shift Gulf Stream." Phys.org. April 5, 2011. Accessed June 13, 2017. https://phys.org/news/2011-04-fresh-arctic-shift-gulf-stream.html.

12. Chadburn, S. E., E. J. Burke, P. M. Cox, P. Friedlingstein, G. Hugelius and S. Westermann. "An observation-based constraint on permafrost loss as a function of global warming." *Nature Climate Change*, April 10, 2017. Accessed May 13, 2017. https://www.nature.com/nclimate/journal/v7/n5/full/nclimate3262.html.

13. Ibid.

14. Polar Bear Recovery Team, *Polar Bear (Ursus maritimus) Conservation Management Plan*.

15. Ibid.

16. Ibid.