Ny-Ålesund Ecosystem
Svalbard, Norway

Ava Spencer
Undergraduate Student
Fish, Wildlife and Conservation Biology Department
FRS310 - Assignment 14: Ecosystem Poster

BIOME AT A GLANCE

The Ny-Ålesund NOAA climate station is located on a small airport on the southern boarder of the island of Spitsbergen in Svalbard, Norway. Previously a mining town, Ny-Ålesund now largely serves as a scientific mecca where researchers from around the globe come to study polar climates, especially as our planet warms. Polar climates are defined as the warmest month having an average temperature between 0-10 °C. Therefore, vegetation is limited to few vascular plants but has an incredible amount of bryophyte and lichen diversity. Wildlife are somewhat limited by the lack of vegetation, but many unique animals roam the island freely. As mentioned, the high-artic is highly affected by climate change, which creates cascading effects to weather, wildlife, vegetation, and requires special management in order to withstand further pressures. Given the artic circle is responsible for keeping many of the checks and balances of water distribution and climate regulation, it's essential that we maintain this "untouched" land to the best of our ability.

CLIMATE

- Ny-Ålesund is defined as a polar climate (with a tundra distinction) according to the Köppen classification system.
- Interestingly, it does not face as harsh of winters as other polar climates due to the North Atlantic drift, which pushes warm currents upwards, though this does create more moist conditions than areas with similar latitudes (Rossby 1996).
- The average high temperature is in July at 7.7°C, while the average low is in March at -15.1 °C (NOAA).
- Total yearly precipitation is 409mm but precipitation is increasing with warmer temperatures--causing cascading damages to plant life (increasing relative percentage of lichens to bryophytes) and receding glacial features (Pedersen et al. 2022).
- Winter rain is also becoming more prevalent (Pedersen et al. 2022).

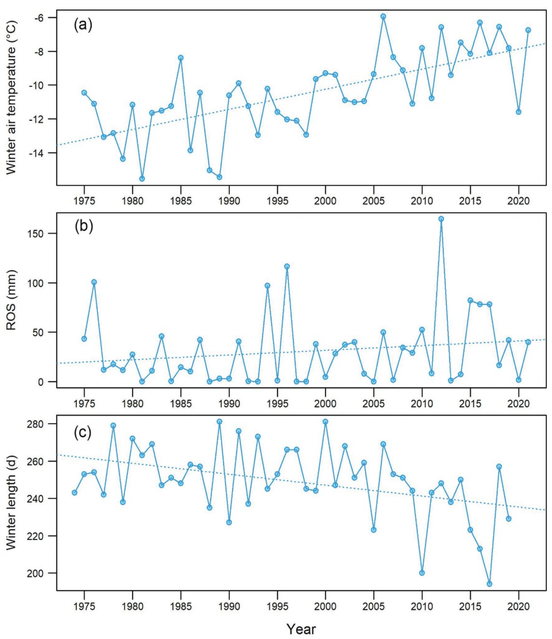

Figure 1: Three winter climate diagrams spanning from 1975 to 2020. The top graph shows the relationship of winter air temperature (in °C) over time, the second graph is the rain on snow (in mm), and lastly, the final graph shows the length of the winter season (Pedersen et al. 2022).

WILDLIFE

- Several notable wildlife species are able to withstand the extreme conditions of the arctic circle. For example, polar bears have adapted thick pelts that have a high percentage of adipose tissue (fat reserves), guard hairs, and black skin.
- Climate change is causing drastic changes across the high-alpine archipelago including the reduction of sea ice for daily hunting, foraging, and breeding opportunities, historic migration route limitations, trophic cascade level changes, and overall species composition (Descamps et al. 2016).
- Svalbard reindeers, which are endemic to the island, graze on the few vascular plants present on the landscape but have faced starvation in recent years due to warming sea ice (Karasz 2019).
- Only three terrestrial mammals inhabit Svalbard, but over a hundred migratory birds pass through the area annually (eBird).

Figure 2: Polar bear (*Ursa maritimus*) walking along sea ice bank. Polar bears are the largest carnivorous land mammal, consuming a diet largely composed of ringed and bearded seals. © Artic Wildlife Tours

VEGETATION

- Due to harsh conditions, the majority of plant cover is low growing and nonvascular - diversity of lichens and bryophytes present on the island is noted in the table below (Coulson et al. 1992).
- Water is one of the largest limiting factors of bryophytes. However, as mentioned, increased rainfall due to climate change is increasing the percentage of mosses in artic tundra (Pointing et al. 2015).
- Vascular plants in this region likely have a small vessel size to prevent freezing and embolisms.
- Many abiotic effects of climate change (increased rainfall, harsher winters, warming soil temperature, easier pathways for pathogens, and more) can be detrimental to vegetation conservation on the landscape (Pedersen et al. 2022).

Taxon	% Cover			
	Outer Fjord		Inner Fjord	
	Jun	Aug	Jun	Aug
Lichens	21.7	32.0	10.1	30.2
Bryophyta, various	20.4	19.1	85.2	87.4
Dryas octopetala	13.2	11.5	1.0	1.4
Cassiope tetragona	0	<0.1	12.5	11.0
Salix polaris	3.2	9.6	9.2	17.8
Saxifraga oppositifolia	6.8	6.8	1.0	0.5
Silene acaulis	0.6	0.2	1.1	1.0
Carex plus *Luzula* spp.	2.0	1.7	6.0	4.1
Pedicularis spp.	0.2	0.5	0.1	0.5
Polygonum viviparum	0.4	2.5	6.0	0.8
Oxyria digyna	0	0	4.0	0.3
Draba spp.	0	<0.1	0	<0.1
Total	68.5	83.9	136.2	155.0
Exposed rock	30.4	22.6	0	<0.1
Bare ground	10.0	13.9	1.6	0

Table 2: Species composition of several notable taxa of vegetation within the Ny Ålesund. Vegetation is measured in percent cover for the inner and outer parts of the fjord (Coulson et al. 1992)

Common Name	Scientific Name
Svalbard reindeer	*Rangifer tarandus platyrhynchus*
Sibling vole	*Microtus levis*
Arctic fox	*Vulpes lagopus*
Polar bear	*Ursa maritimus*
Bearded seal	*Erignathus barbatus*
Ringed seal	*Pusa hispida*
Walrus	*Odobenus rosmarus*
Bowhead whale	*Balaena mysticetus*
Northern minke whale	*Balaenoptera acutorostrata*
Beluga whale	*Delphinapterus leucas*
Humpback whale	*Megaptera novaeangliae*
Orca	*Orcinus orca*
Narwhal	*Monodon monoceros*
Arctic tern	*Sterna paradisaea*
Northern fulmar	*Fulmarus glacialis*
Black-legged kittiwake	*Rissa tridactyla*
Black guillemot	*Cepphus grylle*
Pink-footed goose	*Anser brachyrhynchus*
Brent goose	*Branta bernicla*
Barnacle goose	*Branta leucopsis*
Common eider	*Somateria mollissima borealis*
Glaucous gull	*Larus hyperboreus*
Little auk	*Alle alle*
Svalbard ptarmigan	*Rangifer tarandus platyrhynchus*

Table 1: Notable vertebrates located at Ny-Ålesund in Svalbard, Norway. While this is not a comprehensive list, common name and scientific name are given for the major categories of mammal and bird species found in the artic circle.

ECOSYSTEM SERVICES

Since the closure of mining operations in 1963, 18 research institutions have taken up permanent residence in high-artic regions to explore issues in ecology, glaciology, toxicology, atmosphere and more.

- The albedo effect from snow in this area is essential for climate regulation, as the reflectance of white helps cool the earth by reflectance (Jeffries et al. 2013).
- While fairly small, the artic ocean is responsible for water circulation worldwide. Both the Atlantic and Pacific oceans are greatly influenced by the artic ocean and relies on it for the movement of intermittent cooled water, reliable currents, and maintained flow (Woodgate 2012).
- As noted historically, Ny-Ålesund and Svalbard as a whole has historically been used as a fruitful mining operation. Although now operations are closed, coal was once the largest resource collected.
- Scientific research is perhaps the largest source of current services the island provides. Along with the 18 institutions that remain, 107 peer review publications were created in 2021 alone (Ny-Ålesund Research Center)

Figure 3: Settlement of Ny-Ålesund with a view of Zeppelinfjellet. Beyond previous mining operations, Ny-Ålesund is known as a launching off point for historic expeditions into the north pole. © Mode Et Voyages

Figure 4: Example of one of the few vascular plant species present in the Svalbard region. This species, *Saxifraga cernua*, however, is fairly common in high artic regions. © Vascular Plants in Svalbard - The Flora of Svalbard

MANAGEMENT

PROBLEM

- Polar bears are often considered a symbol of climate change.
- While polar bears are not the most abundant wildlife on the island, home range shifts due to shifting conditions may make them more abundant in irregular areas (Prop et al. 2015)
- Body condition of bears is correlated with available sea ice (main food source is ringed or bearded seals) for hunting, so as this ice is reduced these animals move to alternative sources of food—often closer to humans (Derocher et al. 2013).

CURRENT EFFORTS: CLIMATE MITIGATION

- The only effective management for this region is to address climate change, head on. Efforts to prevent further destruction are various, addressing many private and public sectors.
- Reducing carbon emissions from biking to work to flying "greener" airplanes and advocating for pristine environments by rallying against oil and gas extraction are just two examples of efforts being made against polar bear extinction.

ALTERNATIVE EFFORTS: MINIMIZE CONFLICT

- Allows polar bears to coexist in more suitable areas in a changing landscape.
- Some scientists advocate for diversionary feeding where stockpiled food is placed in a designated area for consumption.
- This tool can help move polar bears from more human-populated areas (e.g. town centers), effectively reducing human-wildlife conflict and ultimately, mortality.
- This solution can create more issues, however, including but not limited to the spread of pathogens and intra-specific competition.

CITATIONS

Coulson, S., et al. "Simulated Climate Change: The Interaction between Vegetation Type and Microhabitat Temperatures at NY Ålesund, Svalbard." *Polar Biology*, vol. 13, no. 1, 1993, https://doi.org/10.1007/bf00236585. Accessed 13 Dec. 2022.
"Daily Observational Data." *NOAA*. National Centers for Environmental Information (NCEI), https://www.ncei.noaa.gov/maps/daily/. Accessed 13 Dec. 2022.
Derocher, A.E., et al. "Rapid Ecosystem Change and Polar Bear Conservation." Conservation Letters, 2013, https://doi.org/10.1111/conl.12009. Accessed 13 Dec. 2022.
"Ny-Ålesund, Le Village Polaire." *Mode Et Voyages*, 16 Oct. 2015, http://mode-et-voyages.com/ny-alesund-spitzberg-arctique/. Accessed 13 Dec. 2022.
"Glaciers Online - Svalbard." *SwissEduc*, https://www.swisseduc.ch/glaciers/svalbard/plants/index-en.html?id=1. Accessed 13 Dec. 2022.
Jeffries, M.O., et al. "The Arctic Shifts to a New Normal." Physics Today, vol. 66, no. 10, 2013, pp. 35–40, https://doi.org/10.1063/pt.3.2147. Accessed 13 Dec. 2022.
Karasz, P. "200 Reindeer Starved to Death. Experts Call It a Sign of Climate Change." *The New York Times*, The New York Times, 31 July 2019, https://www.nytimes.com/2019/07/31/world/europe/norway-reindeer-climate-change.html. Accessed 13 Dec. 2022.
"Ny-Ålesund Hotspots." *Ebird*. https://ebird.org/hotspots/L22415447?yr=all&m=&rank=mrec. Accessed 13 Dec. 2022.
Pedersen, A.Ø., et al. "Five Decades of Terrestrial and Freshwater Research at Ny-Ålesund, Svalbard." *Polar Research*, vol. 41, 2022, https://doi.org/10.33265/polar.v41.6310. Accessed 13 Dec. 2022.
Pointing, Stephen B., et al. "Biogeography of Photoautotrophs in the High Polar Biome." *Frontiers in Plant Science*, vol. 6, 2015. https://doi.org/10.3389/fpls.2015.00692. Accessed 13 Dec. 2022.
Prop, Jesko, et al. "Climate Change and the Increasing Impact of Polar Bears on Bird Populations." Frontiers in Ecology and Evolution, vol. 3, 2015, https://doi.org/10.3389/fevo.2015.00033. Accessed 13 Dec. 2022.
"Research, Monitoring and Flagships." *Ny Ålesund Research Center*, https://nyalesundresearch.no/research-and-monitoring/. Accessed 13 Dec. 2022.
Rossby, T. "The North Atlantic Current and Surrounding Waters: At the Crossroads." Reviews of Geophysics, vol. 34, no. 4, 1996, pp. 463–481., https://doi.org/10.1029/96rg02214.
"Svalbard Photo Tour in Late August Travelling with Arctic Wildlife Tours." *Arctic Wildlife Tours*, 23 Nov. 2022, https://arcticwildlifetours.com/tours-and-expeditions/svalbard-photo-expedition-2/. Accessed 13 Dec. 2022
"Vascular Plants in Svalbard." *Vascular Plants in Svalbard - The Flora of Svalbard*, http://svalbardflora.no/index/. Accessed 13 Dec. 2022.
Woodgate, R. "Arctic Ocean Circulation – Going around at the Top of the World." http://psc.apl.uw.edu/HLD/AW/Woodgate_ArcticCirculation_NaturalEd2013_May2012preprintwithJGRrefs.pdf. Accessed 13 Dec. 2022