Arctic National Wildlife Refuge, USA: Conserving Arctic Biodiversity

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Abstract

The Arctic National Wildlife Refuge (Arctic NWR), a 7.8-million hectare protected area in northeastern Alaska, USA, was established to conserve fish and wildlife populations and their habitats in their natural diversity. The Refuge is managed by the United States Fish and Wildlife Service. It comprises several ecological zones, including boreal forest, alpine and coastal plain tundra, and near-shore regions of the Arctic Ocean. Distinct flora and fauna are associated with each zone, with the result that an impressive array of Arctic and sub-Arctic biodiversity occurs here. Refuge biologists conduct inventory and monitoring studies to evaluate status and trends of fish, wildlife and plant populations. We also conduct research to investigate the causes of observed trends, often in collaboration with other governmental agencies, non-governmental organizations, and universities. Current research includes studies of the effects of climate change and industrialization on Arctic biodiversity, with a focus on broad (landscape-level) spatial scales. Here we provide an overview of select studies of birds, mammals, plants, aquatic organisms and habitats to demonstrate our contribution to understanding and conserving Arctic biodiversity.

Caribou may be negatively affected by rain-on-snow events and changes in vegetation.

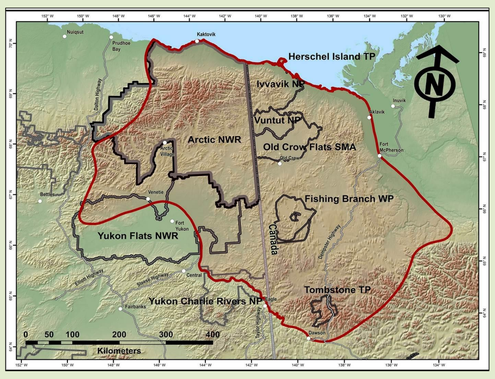
Caribou

(*Rangifer tarandus granti)*

The Porcupine caribou herd ranges over a vast 290,000-km^2 region within northwestern Canada and northeastern Alaska, including the entire Arctic NWR. This herd is one of the largest barren-ground caribou herds in the world - estimated at 196,000 - and is the only large herd thought to be increasing. Caribou return annually to the Refuge during critical seasons to utilize sensitive habitats such as the Arctic coastal plain for calving, and lichen-rich taiga habitats on the south side of the Brooks Range for wintering. The herd is cooperatively managed by federal, state and provincial governments, Alaska natives and First Nations peoples. Porcupine caribou are an important subsistence and cultural resource in both countries.

Objectives:

- Conserve sensitive habitats;
- Collaboratively monitor seasonal distribution, abundance, and reproduction;
- Evaluate potential effects of resource development and climate change;
- Provide continued subsistence opportunities.



Porcupine caribou herd range (red shaded area) in northeastern Alaska, USA and northern Yukon Territory, Canada. Conservation areas within the herd's range are also shown.

Common Eiders

(*Somateria mollissima*)

Common eiders nest on barrier islands in the Beaufort Sea within Arctic NWR. The species has declined in Alaska, is an important subsistence resource, and is particularly vulnerable to environmental change resulting in overwash, range expansion or increased abundance of predators, and changes in the distribution of woody debris used for nesting cover.

Objectives:

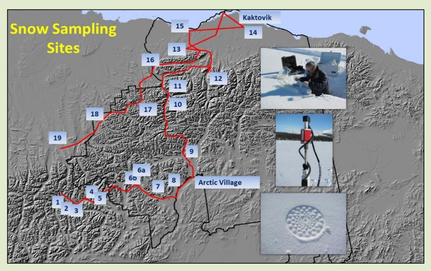
- Evaluate the potential impacts of climate change, industrial development, and other factors on survival and productivity;
- Document distribution and phenology of nesting to inform conservation actions, e.g., protection of sensitive habitats, oil spill preparedness.

Snow

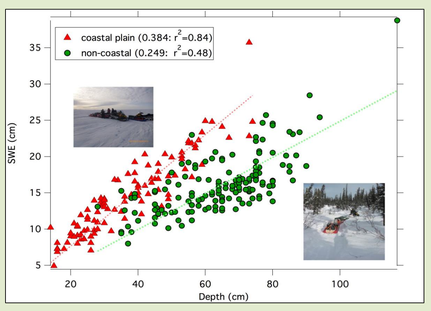
Much of Arctic NWR is snow-covered from September to May. Snow drives hydrologic and thermal balances in the region, and survival and reproductive success for many species is largely determined by winter conditions. Changes in length of the snow season, snow depth and density, and occurrence of rain-on-snow or winter thaws could have significant ecological ramifications.

Objectives:

- Monitor spatial and temporal trends in snow cover (depth and snow water equivalent);
- Quantify the spatial extent and thickness of ice layers related to rain-on-snow and mid-winter thaw events;
- Model seasonal snowpack evolution and relate current and predicted future conditions to wildlife-species fitness. Future research will compare model outputs to polar bear den site selection, and habitat selection and timing of migration for ungulates.



1200-km traverse to collect baseline snow-quality data, March 2014.

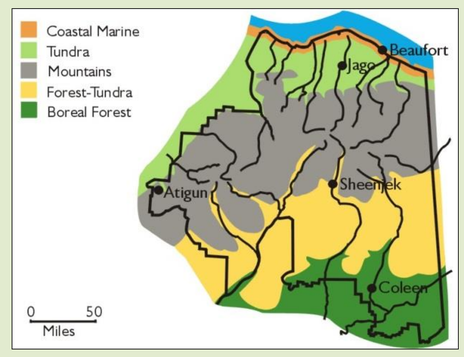


Snow water equivalent (SWE) vs. depth for coastal and interior snowpack.

Long Term Ecological Monitoring

Objectives:

- Monitor vegetation, permafrost, and water quality and quantity in five distinct ecoregions of Arctic NWR;
- Improve understanding of ecological relationships and natural processes;
- Contribute to regional, national and international databases:
  - ITEX (International Tundra Experiment)
  - ACDN (Arctic Coastal Dynamics Network)
  - GLORIA (Global Observation Research Initiative in Alpine Environments)
  - DOI/GTN-P (Permafrost)
  - TEON (Arctic Landscape Conservation Cooperative Terrestrial Environmental Observing Network).



Long term ecological monitoring sites in five major ecoregions

Vegetation and Soils

How is vegetation changing?

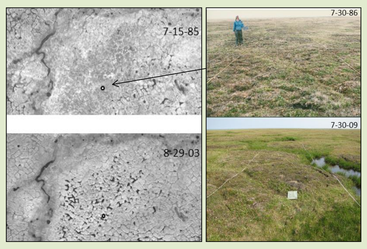
Vegetation community composition and structure in sixty 1-m^2-quadrats.

How are soils and permafrost changing?

Soil stratigraphy and soil temperature sensors at each site.

Active layer depth, microtopography, vegetation composition, and presence of thermokarst and surface water at some sites.

Thermokarst activity has led to changes in microtopography, vegetation, and surface water near some sites. These changes can affect aquatic ecosystems.



Other projects:

Historical vegetation plots
- boreal forest treeline (1951 – present)
- tundra (1984-present)

Coastal Erosion (2001-present):

Aquatic Ecosystems

The Continental Divide in the Brooks Range divides the Arctic NWR hydrologically. North Slope waters flow to the Beaufort Sea, while South Slope waters flow through the Yukon River watershed and eventually to the Bering Sea. There are nearly 100,000 km of streams and rivers, more than 10,000 lakes and ponds, numerous springs, and 16 lagoons and bays in the Arctic NWR. They are important for subsistence and recreational use, and support 42 species of fish and numerous invertebrates and birds. We are responsible for maintaining biodiversity and adequate water quality and quantity, which are likely already affected by climate change and other stressors.

How are physical, chemical, and biological conditions changing in these watersheds?

- Sensors will be used to continuously monitor physical and chemical conditions.
- Discrete water samples will be collected to monitor water chemistry and invertebrate and algal community composition.
- Fish contaminants will be assessed.
- Data will be related to changes in climate, snow and ice, vegetation, and erosion to evaluate stressors and predict future conditions.

Water quality and quantity is affected by climate change and other stressors.

Dolly Varden using glacial rivers may be impacted by changing water levels and ocean conditions.

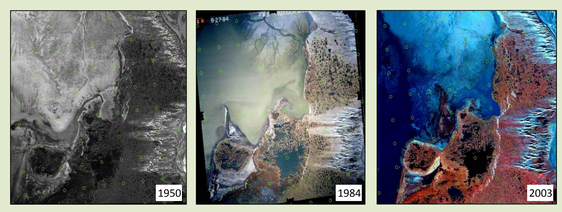
Shorebirds may be affected by drying of habitat and reduced sediment export to estuarine deltas.

Recreation and access to subsistence resources may be impacted by changes in water quantity and quality.

Landscapes

Objectives:

- Monitor changes in shrub and tree cover, erosion, deposition, thermokarst, and surface water distribution throughout the Refuge using remote sensing.



Existing aerial photos and satellite imagery (1950 to present) are compared at 35 sites . These images show coastal erosion and accretion at the Jago River Delta on the Beaufort Sea coast.

Arctic Landscape Conservation Cooperative

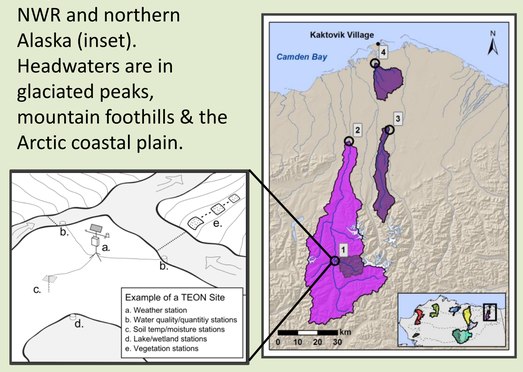
Terrestrial Environmental Observing Network

Objectives:

- Support a sustainable watershed-based ecological monitoring network;
- Distribute and synthesize long-term observational data to detect and forecast effects of climate change on wildlife habitat and access to subsistence resources in northern Alaska and Canada.

Observatory sites in Arctic NWR will serve as "controls" within the Terrestrial Environmental Observing Network (TEON), which includes sites that are influenced by local development.

Proposed sites in Arctic NWR and northern Alaska (inset). Headwaters are in glaciated peaks, mountain foothills & the Arctic coastal plain.



Measurements capture an integrated signal of ecoregion conditions, and promote study of linkages between variables and between ecoregions.

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