Resource Brief
Alaska

National Park Service
U.S. Department of the Interior

Inventory and Monitoring Program
Alaska Region

Arctic Network | Central Alaska Network | Southeast Alaska Network | Southwest Alaska Network

Lichens and Mosses

Important and Diverse in Alaska

Lichens and mosses are a significant component of many arctic and sub-arctic ecosystems. In Gates of the Arctic National Preserve, for example, non-vascular plants likely account for more than 50% of the species present. Relative to vascular plants, however, lichens and mosses are poorly documented. Inventories conducted within national parks of Alaska have revealed that lichen abundance and diversity is quite rich. An inventory completed in Klondike Gold Rush National Historical Park (2008) reported the largest number of lichens per unit acre on record and the largest number of lichen species recorded from any national park. A recent inventory of the Western Arctic parklands (2010) described 491 species, 16 of which are new to Alaska or North America and three of which are new to science.

Photo: James Walton/NPS

***Erioderma pedicellatum*, pictured above, was first recorded for the U.S. in Denali National Park in 2007 and was found in a monitoring plot at Katmai National Park in 2009. This species of lichen is critically endangered, partially due to air pollution.**

Lichens play an important role in ecosystems by providing a sizeable portion of fixed-nitrogen in the nutrient-poor ecosystems of the Arctic. In addition, they are an important winter food source for caribou and muskox.

Indicators of Change

Lichens and mosses are sensitive to changes in the environment and, thus, are an important part of vital signs monitoring efforts in Alaska's national parks. Warmer temperatures and permafrost melting associated with climate change may encourage increased growth of tall shrubs into dwarf or low shrub tundra, an area that currently hosts abundant terrestrial forage lichens. Thickets of tall shrubs are generally poor habitat for terrestrial lichens. Shrub invasion has been documented on the North Slope of Alaska, and **vegetation composition and structure vital sign monitoring** will examine rates of shrub increase in tundra habitats in the Arctic (ARCN), Central Alaska (CAKN), and Southwest Alaska (SWAN) Networks. Lichens and mosses serve as indicator species for overall air quality. Heavy metals, nitrogen, and sulfur pollution degrade lichen communities, and local, regional, and global pollution sources have the potential to damage these sensitive communities. Therefore, lichen monitoring is a significant component of the **air contaminants vital sign** in Alaska's national parks. The Southeast Alaska Network (SEAN) monitors lichen tissue samples to detect air contamination levels. SWAN and ARCN sample moss tissue to measure air contaminant levels. Permanent lichen monitoring plots are established throughout the Networks to better understand the relationship between lichen communities and contaminant levels.

In addition, trends in lichen foraging by caribou, and associated trends in the herds, are components of the **caribou vital sign** in ARCN.

Lichen & Moss Lingo

Bryophytes: a group of non-vascular plants that includes mosses, liverworts, and hornworts; the first land plants

Dry deposition: the accumulation of particulate air pollutants, including sulfur and nitrogen oxides, onto any surface

Indicator species: a species that serves as a signal of biological change and is often the focus of monitoring efforts; lichens and mosses, for example

Lichen: a symbiotic organism including fungi and algal partners, such as algae or cyanobacteria; can thrive in a variety of conditions

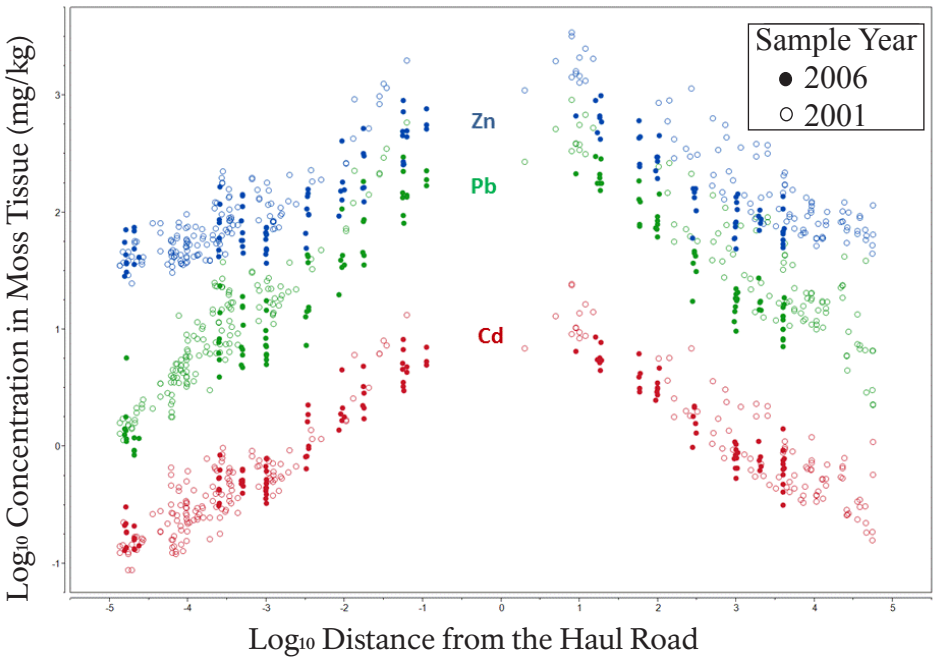
Moss: non-vascular plant that reproduces via spores or specialized asexual structures, often prefer wet environments

Wet deposition: the accumulation and transport of air contaminants via precipitation

Photo: Troy Hamon/NPS

Lichens are an important winter food source for caribou (above) and muskox. They, along with mosses, also provide dwelling and nesting materials for other small animals.

Contaminant Concentrations in Moss along the Haul Road, Alaska



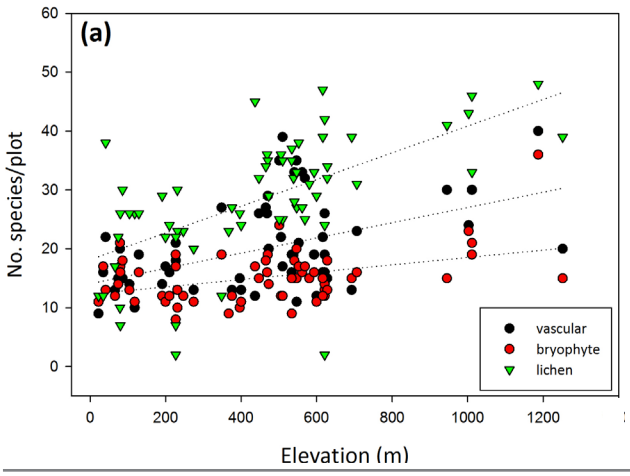
Because lichens and mosses don't possess roots and therefore must get all of their mineral nutrition from the atmosphere, they are uniquely adapted to absorbing required elements and pollutants from air, dust, and precipitation. Lichens and mosses are frequently used as passive samplers for pollutants because of this enhanced absorption ability. The figure on the left shows the concentration of mine-related and fugitive dust-borne heavy metals in moss tissue along the Red Dog Mine haul road in Cape Krusenstern National Monument. Zinc (Zn), lead (Pb), and cadmium (Cd) levels have all decreased with distance from the road in two different sampling years, and have begun to decrease overall due to dust control efforts. Lichen species richness is closely linked to elemental concentrations in moss tissue. Moss and lichen community sampling is a component of ARCN's contaminants and vegetation vital signs.

Monitoring Shifts in Plant Communities in Southwest and Central Alaska

Photo: Annie Farris/NPS

Researchers record plant species in a permanent vegetation monitoring plot in Katmai National Park. (NPS photo)

Lichen and moss species are an important component of plant communities monitored by both the SWAN and CAKN vegetation composition and structure vital sign monitoring programs. In SWAN parks, they comprise up to 60-70% of all plant species recorded in monitoring plots. Through research pertaining to this vital sign, CAKN has produced one of the largest species-level systematic quantifications of ground-layer bryophyte and macrolichen communities in North America. Because many of the species are both abundant and sensitive to changes in the environment, they serve as useful indicator species for detecting long-term trends. Repeat photography and preliminary data from monitoring plots suggest that shrub cover is increasing on the landscape. One of the anticipated effects of this is the encroachment of shrubs into lichen-dominated plant communities. This encroachment has the potential to increase shade and leaf debris at the ground layer, and as a result, cause shifts in species composition through time, including the loss of lichen and moss cover. While initial results can inform management and monitoring decisions, determining long-term trends with a high amount of certainty is expected take a number of years.



Species richness, or the number of species in a given location, is higher for lichen species than for vascular plants. In Lake Clark National Park, species richness increases with elevation (left). This data provides baseline information, which will be used to determine long-term trends over time.

For more information on lichens, mosses, and related monitoring efforts, contact:

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