Arctic Network

Bering Land Bridge N Pres. • Cape Krusenstern NM
Gates of the Arctic NP & Pres. • Kobuk Valley NP • Noatak N Pres.

Wet & Dry Deposition Resource Brief

January 2011, no. 03

Biological technicians survey pollution effects in vegetation plots along the Red Dog Mine Haul Road in Cape Krusenstern National Monument, 2006.

Status & Trends

Wet and dry deposition in the Arctic Network

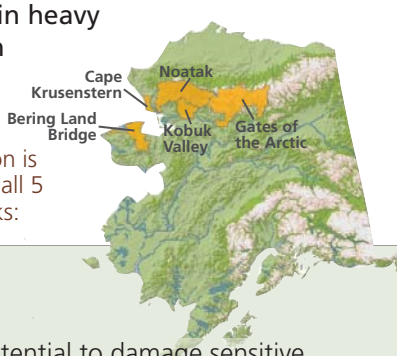
The extensive Western Airborne Contaminants Assessment Program (WACAP: http://www.nature.nps.gov/air/studies/air_toxics/wacap.cfm) established that there are extremely low levels of most toxic organic pesticides and industrial pollutants in most media in the ARCN parks. Nonetheless, levels of mercury and of the banned pesticide Dieldrin were just above EPA exposure thresholds for increased wildlife risk of health effects among piscivorous (fish eating) birds and mammals at a few sites. Spatial patterns of heavy metal (lead, cadmium, zinc) distribution in 2001 in Cape Krusenstern National Monument have also been mapped, and were at levels sufficient to cause damage to vegetation according to a widely-reviewed risk assessment. A follow up assessment of spatial patterns of metals distribution and of vegetation impacts conducted in 2006 is in peer-review.

The widespread feather moss Hylocomium splendens *is used network-wide as a passive sampler of contaminant deposition.*

Objectives

What do we want to know about wet and dry deposition in the Arctic Network?

- Determine long term trends of mercury and Persistent Organic Pollutant concentrations in piscivorous freshwater fish (e.g., lake trout, northern pike and selected whitefish species) on a decadal basis.
- Monitor concentrations of airborne heavy metals, sulfur and nitrogen at all network vegetation plots using the moss *Hylocomium splendens* as a passive sampler.
- Monitor changes in deposition of heavy metals and lichen community structure along the Red Dog Haul Road in CAKR.
- Assess the effects of observed pollutant levels on changes in lichen community structure network-wide in Terrestrial Vegetation plots.
- Monitor changes in heavy metals, S and N in aquatic systems.



Wet & dry deposition is being monitored in all 5 Arctic Network parks:

Importance

Why is wet and dry deposition important in the Arctic Network?

The steady input of low levels of contaminants from local, regional and global sources makes pollution a concern in ARCN. Point sources include heavy metals, sulfur (S), and nitrogen (N), from the Red Dog Mine, the world's largest zinc and lead mine. Regional sources include northwest Alaskan communities and industrial development. The farthest-ranging pollutants are organic pollutants, mercury (Hg), S, and N from global sources.

There are numerous biological implications of contaminant deposition in ARCN. Heavy metals have locally degraded tundra lichen communities along the Red Dog Haul Road corridor in CAKR. Increasing loads of S and N from global coal-burning have the potential to damage sensitive lichen communities—a key forage for ungulates—and aquatic invertebrates network-wide. Food chain accumulation of mercury, other heavy metals, and organic toxins increases risk factors for wildlife and human health. A recent study of two lakes in ARCN found that mercury levels in older, piscivorous fish exceeded EPA consumption guidelines for human health and wildlife in some cases (Western Airborne Contaminant Assessment Program, 2008). With a few exceptions, toxic pollutants do not appear to be concentrating in ARCN's food chains; however, increasing use of industrial and agricultural chemicals globally may increase future levels.

Contact: Peter Neitlich, ARCN Ecologist, Peter_Neitlich@nps.gov (509) 996-3917

Management Applications

How can monitoring wet and dry deposition help protect parks in ARCN?

Pollutants entering ARCN parklands come primarily from local and global sources, though regional sources may increase with increasing resource extraction. Monitoring of local sources (e.g., fugitive dusts from Red Dog Mine) helps NPS engage with all stakeholders to work on pollutant reductions. Monitoring of global pollutants contributes needed scientific data to international efforts to curb inputs of these pollutants and contributes to NPS and broader resource condition assessment efforts.

Long-term Monitoring:

How will we monitor wet and dry deposition in the Arctic Network?

Freshwater, piscivorous fish will be monitored once per decade for two successive years for mercury and Persistent Organic Pollutants. The moss *Hylocomium splendens* will be collected from all Terrestrial Vegetation monitoring sites and more intensively in CAKR and NOAT close to Red Dog Mine operations. The moss tissue will be analyzed for elemental content of a broad suite of crustal and heavy metals, sulfur and nitrogen. The elemental concentration values will be used in concert with the Terrestrial Vegetation vital sign's lichen community composition plots in order to determine if pollution is affecting these sensitive organisms. Metals, sulfur and nitrogen will also be monitored by the aquatic vital signs in lakes and streams. ARCN's instrumented monitor in Bettles also provides weekly measurements of wet deposition and mercury (Air Quality Vital Sign).

Lake trout, a piscivorous fish in many ARCN lakes has in some instances bioconcentrated mercury and dieldrin above threshold levels (left). Zinc and lead ore concentrate truck on the Red Dog Haul Road, 2005 (top right). Abundant tundra lichens are highly sensitive to pollutants (bottom right).

ARCTIC NETWORK

USING SCIENCE TO PROTECT OUR PARKS

THE ARCTIC NETWORK (ARCN) IS A MAJOR COMPONENT OF THE NATIONAL PARK SERVICE'S STRATEGY TO BETTER UNDERSTAND AND MANAGE PARK LANDS USING SCIENTIFIC INFORMATION. IT IS ONE OF FOUR INVENTORY AND MONITORING NETWORKS IN ALASKA AND 32 NATIONWIDE.

The Arctic Network provides scientific support to five parks covering more than 19 million acres. Bering Land Bridge National Preserve and Cape Krusenstern National Monument share similar coastal resources and biogeographic ties to the former land bridge between North America and Asia. Kobuk Valley National Park, Noatak National Preserve and Gates of the Arctic National Park and Preserve span extensive, mountainous terrain at the northern limit of treeline.

The Arctic Network is developing long-term monitoring protocols for 28 'vital signs', or physical, chemical and biological indicators that were selected to represent the overall health of these parklands. Many of these vital signs are expected to show change due to regional and global stressors including climate change and deposition of industrial contaminants. Many vital signs also have important human values including for subsistence.

ARCN VITAL SIGNS:

- Air Contaminants
- Brown Bears
- Caribou
- Climate
- Coastal Erosion
- Dall's Sheep
- Fire Extent & Severity
- Fish Assemblages
- Invasive/Exotic Diseases
- Invasive/Exotic Species
- Lagoon Communities & Ecosystems
- Lake Communities & Ecosystems
- Landbird Monitoring
- Moose
- Muskox
- Permafrost
- Point Source Human Effects
- Sea Ice
- Small Mammal Assemblages
- Snow & Ice
- Stream Communities & Ecosystems
- Subsistence/Harvest
- Surface Water Dynamics & Distribution
- Terrestrial Landscape Patterns & Dynamics
- Terrestrial Vegetation & Soils
- Visitor Use
- Western Yellow-billed Loons
- Wet & Dry Deposition

CONTACT US AT: (907) 457-5752, 4175 GEIST ROAD, FAIRBANKS, ALASKA 99709
OR VISIT HTTP://SCIENCE.NATURE.NPS.GOV/IM/UNITS/ARCN