

NE Temperate Network Vital Signs Meeting

Acadia National Park

Overview

Park Mission:

The National Park Service at Acadia National Park protects and conserves outstanding scenic, natural, and cultural resources for present and future generations. These resources include a glaciated coastal and island landscape, biological diversity, clean air and water, and a rich cultural heritage. Acadia National Park also offers opportunities for high quality non-consumptive recreation, education, and scientific research.

Important Natural Resource Challenges

Located within a day's drive from many large cities within the northeastern United States and Canada, over three million people visit the Park annually. ACAD has increasingly become identified as a mecca for outdoor recreation in Maine. This intense demand for public use at ACAD threatens many sensitive habitats in the Park and comprises high quality visitor experiences. Increasing residential development abutting the Park's boundary and air pollution from upwind sources also pose significant risks to natural resources.

Vegetation Resources. No federally-listed vascular plants are known to occur at the Park, however, 183 species are either State listed or designated as locally rare (Greene 1990). Six of these are identified as globally rare (New England Wildflower Society, in press). The park flora includes coastal and sub-alpine endemics, species with disjunct distributions, species at the edge of their range, and species with very narrow habitat preferences. The Park also contains a number of plant communities that are considered rare by the Maine Natural Heritage Program. These include old growth pine and red spruce stands, a northern white cedar forests, heaths and sub-alpine communities on mountain summits. These resources are subject to potential changes in species composition and productivity from acid deposition, air pollution, climate change and increasing park visitation.

Exotic plants pose a significant risk to native species and ecosystems at the Park. Nearly 35% (283) of the park's vascular flora are non-native. A number of these species are known to be extremely invasive (e.g., oriental bittersweet, Japanese knotweed, alder buckthorn); other weedy species have recently appeared. All pose direct threats to native plants and communities.

Increasing visitor use in the Park is impacting vegetation. Plants in the front-country, sub-alpine habitats on mountain summits and offshore islands and park bogs and wetlands are particularly sensitive to trampling. Soil compaction and/or erosion, destruction of vegetation, and development of social trails have all been observed in these fragile habitats. Park development can also impact Park vegetation. Advance planning is

currently underway to upgrade Park utility systems, improve campgrounds, and rehabilitate roads.

Forest succession is eliminating significant Park vistas. Many national register cultural landscapes that had outstanding views of the surrounding countryside and Acadian Archipelago are no longer present.

The Park contains several communities and assemblages of plants that will be particularly sensitive to global change, in particular the anticipated atmospheric warming.

ACAD is at a prime mid-latitude location to exhibit the largest climate-related changes. In Maine, 28% of the woody taxa in the state and many herbaceous species reach either their northern or southern range limits in a broad band that extends through the Park. By being located in this "tension zone", the Park includes a rare mix of plant species unique to the east coast of North America.

ACAD's relatively small size, fire history, the high degree of interface with private lands, and increasing forest fragmentation caused by development outside the Park boundary, may influence browsing effects on Park vegetation. Both white-tailed deer and snowshoe hare reside in the Park, and have the potential to alter plant productivity, succession, composition, and structure.

Animal Resources. Two recently de-listed Federally endangered species nest in the park, peregrine falcons and bald eagles. Both are threatened by the large numbers of ACAD visitors. These species can be disturbed by human activities and birds in the Park have traditionally nested in heavily used areas. Parklands on the southern shore of Isle au Haut are a major wintering area for the western Atlantic population of harlequin ducks. The duck's status is unknown, but recent surveys indicate that the western Atlantic population is declining from the estimated 1989 population of 400.

Beaver water impoundments and dam creation have been an ongoing problem at the Park since the 1960s; their activities flood and undermine roads (some of these are historic), flood private property, and in some cases create safety hazards. Although, beaver populations at the Park may be declining (due to reduced habitat associated with changes in forest composition following the 1947 fire on MDI), incidents of flooding park facilities and historic structures remain a significant problem.

Panhandling raccoons and foxes pose ongoing problems along the Park Loop Road and at the Blackwoods Campground. Individual animals have unfortunately learned to associate Park visitors as a source of food and beg, steal, and occasionally threaten them to obtain human food. Easily accessible trash cans, local merchants promoting wildlife feeding, campers leaving food unattended, and inadequate Park staffing all exacerbate the problem.

Habitat fragmentation is now recognized as a major threat to wildlife around the globe. Given that Park lands consist of islands, are small in acreage, contain a highly irregular

boundary, and are surrounded by private land that is increasingly becoming developed, habitat fragmentation may pose a threat to the viability of some Park animals.

Natural forest succession may also be affecting wildlife populations. After the 1947 MDI fire, white-tailed deer and beaver populations dramatically increased. Since that time, however, both species are at much lower densities in the Park. If forest succession continues toward a mature spruce-fir community, it is possible that deer and beaver populations may decline even further.

Hunting and trapping is prohibited within Acadia National Park. However, these activities do occur at the Great Ponds and intertidal areas within the Park. Under a 1641-1647 Colonial Ordinance of the Massachusetts Bay Colony, and now codified in Maine Statute, the public has a right to "fish and fowl" on Great Ponds and intertidal areas regardless of ownership. Great Ponds are defined by Maine law as any inland body of water which in its natural state has a surface area in excess of 10 acres or any impoundment with an area greater than 30 acres. Because of the complexity and potential controversy over jurisdiction on Great Ponds and intertidal areas within the Park, the NPS has not taken action to stop hunting and trapping on these areas. While management concerns over hunting and trapping primarily focus on visitor safety, visitor experiences and aesthetics, the effects of these activities on harvested species (in particular, furbearers and waterfowl) are unknown.

Native fish and aquatic biota are threatened by introductions and self-reproducing populations of exotic and hatchery reared native fish. The Maine Department of Inland Fisheries and Wildlife regulates and manages freshwater fishing at the Park with the goal of promoting sport fish production. In addition to stocking, state biologists have also manipulated prey species as a management tool to enhance populations of game fish. To date, the NPS has had limited involvement in fisheries management programs at the Park. The effects of stocking and non-native species on native aquatic organisms is not known.

Air Resources. Based on years of data on fog chemistry, annual ozone and mercury health advisories, and 15 years of NADP precipitation chemistry, it is clear that ACAD is the recipient of some of the highest levels of atmospheric inputs in the northeastern United States. Modeling of regional emission source data and back trajectory analysis, indicate that airborne pollutants carried from the eastern mid Atlantic and coastal New England states and northern Midwestern/Great Lakes (including Canada) industrial corridors significantly affect Park's ecosystems. Nitrogen, ozone and mercury are among the pollutants of most immediate concern to the Park. The imminent deregulation of the electric utility industry raises the additional concern that deposition of nitrogen compounds and mercury may increase in the future. New EPA regulations will possibly favor operation of dirtier coal-fired power plants in the midwest and mid-Atlantic states, leading to more long-range transport of pollutants to northern New England.

Park ecosystems are extremely vulnerable to change from chemical environmental perturbations. Strong marine chemical and meteorological influences, thin soils, low natural buffering capacity, frequent bedrock exposure and cold climate contribute to the

highly fragile and sensitive character of the Park. Atmospheric inputs are deposited in both wet and dry form, with a significant contribution from coastal fogs. Air pollutants are currently affecting park surface waters and native plants.

The mean precipitation pH at the Park is 4.6; fog pH commonly ranges below 4. These values are among the most acidic of any national park. Episodic acidification of park streams has been documented. However, little is known about the actual effects of increased acidity on aquatic systems and organisms at the Park.

Elevated levels of ozone are known to cause human health problems. In response to high ozone concentrations at the Park during summer (greater than .081 ppm), the NPS has routinely issued public health advisories for visitors and local residents. Recent research at the Park identified six native plant species injured by ambient conditions of ozone.

Mercury concentrations in aquatic biota at the Park are among the highest in the nation. This discovery eventually lead to the release of a mercury human health advisory for the entire State of Maine. Atmospheric deposition is believed to be the important source of mercury in the northern United States. Although the Park is located in rural Maine, accumulation rates of mercury in sediment at the Park are comparable to those reported from urban lakes. Presumably these high concentrations reflect deposition of mercury from upwind sources.

Sulfur dioxide/sulfate emissions contribute significantly to visibility impairment and to acid deposition. Visibility data collected since the early 1980's indicate visual air quality at the Park is among the poorest in the national park system. Although this time period is too short to determine a trend it is generally believed that standard visual range at Acadia has been reduced dramatically over the past several decades and thus represents an existing adverse impact.

In addition to impacts from the long range transport of pollutants several hundred miles away, there is concern with the continued development of major and secondary emission sources within the state. The possible development or modification of fossil-fuel or biomass electrical power plants and large paper mills, within 100 km of the Park, have been proposed for different areas of central Maine.

Aquatic Resources. Concern for the protection of drinking water sources, and the ecological, aesthetic and recreational attributes of water resources on MDI and at the Park has been a dominant theme for Park managers, State agencies and local communities for nearly a century. Today, air pollution and nutrient loading associated with waste water systems and atmospheric deposition of nitrogen pose the greatest threats to Acadia National Park water resources.

As described above, the Park's water resources and watersheds are threatened by an array of atmospheric inputs: acids, sulfur, nitrogen, and toxic contaminants such as mercury, lead, and chlorinated organics. These chemicals are deposited in both and wet dry form,

with a significant contribution from coastal fogs. Toxic air contaminants and their bioaccumulation in the food chain are also of major concern.

The dilute clearwater, low alkalinity Park lakes are susceptible to eutrophication from only modest increases in phosphorus and from modest increases in acidity. Both changes would be detrimental for biological communities, aesthetics, and the visitor experience. Human introductions of "extra-watershed" phosphorus occurs as septic wastes, yard fertilizer, and as runoff from disturbed shoreline soils. With increasing residential development outside the Park boundary, there is a potential for additional introductions of phosphorus to lake and pond nutrient budgets. Park estuaries (Bass Harbor Marsh and Fresh Meadow Marsh) and other nearshore coastal waters are also threatened by human-altered nitrogen cycling.

Five of the Park lakes serve as public water supplies for local communities and need to be managed to protect water quality and public health. Potential threats to these waters are from nutrient loading (associated with increased development in the watersheds of these lakes), chemical contamination (vehicle and motor boat fuel spills), bacterial contamination (inadequate or failing human waste disposal facilities), and sedimentation (soil erosion from shoreline trails).

There are no point sources which discharge upstream of, or directly to, freshwaters within park boundaries. However, at least eight point sources on MDI discharge treated wastewater to marine and estuarine waters in close proximity to park boundaries. These discharges contribute to shellfish flat closures over most of the southern and eastern sides of MDI and may affect aquatic ecosystems. Some Park wastes are tied into municipal treatment facilities and therefore may be contributing to these problems.

Geologic Resources. In general, coastal geological processes do not pose problems to the Park because most visitor facilities are located outside the immediate coastal zone and shorelines are comprised of parent material that is not susceptible to significant erosion from coastal storms. Sand Beach, a small calcareous beach has fluctuated in width due to prevailing climatic and marine hydrologic events, however, there has been little change in beach structure and dynamics during the last twenty years.

The greatest immediate threat to Park geological resources is soil erosion caused by visitors. With approximately three million people annually visiting the park, soils and vegetation at a number of facilities, park trails, and sensitive habitats have been disturbed.

Global change represents a more long-term issue of concern to Park managers. ACAD is located in the region, where models unanimously predict the largest climate change to be exhibited in the future. Climate change may result in altered moisture and chemical regimes, potentially leading to changes in forest communities and to altered nutrient cycling. These changes may also lead to shifts in species distributions. As noted earlier in this chapter, numerous plant species are at the edge of their northern or southern ranges in the Park and could be negatively affected by global warming. In response to global warming, predictions of future sea level rise are variable. Intensely used landforms at the

Park, such as Sand Beach, may be particularly sensitive to accelerated sea level rise. Given that sediment supply at the Park is limited, the pocket beaches may be lost. Salt marshes may also be similarly effected, because they may not have enough time or capability to respond to rapid (in geological terms) changes in sea level.

Aesthetic Resources. The quality of visitor experiences at Acadia National Park is being threatened by crowding, traffic congestion, conflicts among user-groups, and degradation of natural resources. With annual visitation close to three million, the Park has increasingly become identified as a mecca for outdoor recreation. Visitation to the Park has increased dramatically over the last 20 years and some visitors have reported altering their use patterns to avoid the crowds. Protecting high quality visitor experiences in both the front and backcountry given the increasing demand for recreation, is one of the Park's most significant challenges.

Development activities outside the boundary also pose risks to the quality of the scenic landscape visible from within the Park. Given that the area within the permanent Park boundary falls within 11 communities, it is imperative that Park managers work cooperatively with surrounding jurisdictions and other partners to protect scenic resources. The Park's discontinuous parcels and easements, irregularly shaped boundary, and lack of adequately surveyed and marked boundary lines further complicate the pressures placed upon Park resources by developers and adjacent landowners.

Availability of Major Planning Documents:

General Management Plan, 1992
Resources Management Plan, 1998
Water Resources Management Plan, 2000
Commercial Services Plan, 2000
Hiking Trails Management Plan, 2001

Ongoing Natural Resource Monitoring

Purple Loostripe. Since 1989, Acadia annually monitors abundance of *Lythrum salicaria* (purple loosestrife) stems (reproductive and non-reproductive) in 5 permanent monitoring grids within 2 park watersheds. Post monitoring, all *Lythrum salicaria* plants (both inside and outside grids) are sprayed with Glyphosate herbicide. The goal of this long-term monitoring is to track abundance of *Lythrum* stems in relation to herbicide treatments.

Peregrine Falcons. For the last ten years, we have been monitoring the nesting activity and productivity of peregrines. Our monitoring goals are focused on preventing human disturbance to nesting pairs in the park. Results of monitoring are used by park management to initiate hiking trail closures and openings around active nest sites. Park productivity data are also used by biologists within New England to assess the overall population trends of this species in the region. Chicks are also banded in cooperation with the US Fish & Wildlife Service.

Fuels. We conduct three different monitoring programs related to its fire management operations. Since 1980, long-term monitoring of fuel loadings, regeneration and vegetative change has been conducted on a 12 to 15 year frequency at 20 permanent monitoring plots throughout the park. As part of the park's vista management program, selected vistas are monitored every 3 to 5 years to track vegetative change within each vista and to compare treatment types (prescribed fire and mechanical) between vistas. Additionally, some individual prescribed fire burn units (Jordan Pond House vista and Schoodic Head jack pine stand) are intensely inventoried and monitored for research purposes.

Lake Water Quality. Lake monitoring by park staff began in the late 1970's, in cooperation with the Maine Department of Environmental Protection. These efforts consisted primarily of monitoring Secchi disk transparency and surface temperature in several selected lakes on Mount Desert Island. This program continues today, with monitoring expanded to include measurement of a larger variety of chemical and physical parameters, including temperature, dissolved oxygen, transparency, pH, specific conductance, alkalinity, color, total phosphorus, total nitrogen, chlorophyll a, lake stage, and light penetration. The program serves to provide baseline and trend data on park lakes, and to act as an "early warning system" to identify the effects of non-point source pollution, acid deposition, and climate change.

Stream Invertebrates. Standardized monitoring of biological indicators such as benthic macroinvertebrates is widely accepted as a useful component of long-term water quality monitoring programs. The benthic macroinvertebrate monitoring program at Acadia National Park began in 1997, when park managers agreed to participate in Maine Department of Environmental Protection's River and Stream Biological Monitoring Program. Monitoring goals are to obtain baseline data, and provide for the assessment of long-term trends and changes to park benthic macroinvertebrates; and to assess potential biological impacts to aquatic ecosystems and water quality from adjacent land use and other stressors. Mesh bag samplers containing rocks are placed in seven representative park streams during the low-flow period (late July to early September). The bags are retrieved after 28 days, and the macroinvertebrates found in the samplers are removed, preserved, and identified to species level. Multivariate analyses are used to calculate a total of 30 indices and measures of community structure, and to ultimately determine one of four water quality groups corresponding to state stream classification.

Air Quality. Core elements of the park's air quality monitoring program include long-term monitoring for ozone, sulfur dioxide, nitrogen oxides, volatile organic compounds (VOC's), fine particulates, visibility, mercury deposition, acid precipitation, and ultraviolet radiation. These long-term data sets provide information on current conditions and regional trends, and support ongoing research to determine the biological effects of selected air pollutants on park resources.

The air quality monitoring program at ANP is a collaborative effort involving the National Park Service Air Resources Division and Northeast Regional Office, the Maine Department of Environmental Protection, and park natural resource staff. In addition,

there are a number of other important partnerships with the US Geological Survey, US Environmental Protection Agency, universities, and other state and regional agencies for conducting air related research and monitoring at Acadia National Park.

GIS: We has been building a geographic information system (GIS) since the 1980s and now have good basic data for the park and surroundings and a few layers for the New England region (cities, major roads, state outlines). Maps and analyses are routinely made for reports, presentation, fieldwork, and planning by park staff and researchers. The part-time park GIS Specialist maintains the data, produces maps and analyses, helps people understand and use data we have gathered, and develops or acquires new data needed by the park. We are currently using ArcGIS version 8.0.2 (one license) and ArcView 3.2a (5 licenses). We have 3 Trimble GPS units and a couple of small handhelds. Lately we've begun working more closely with researchers to ensure any relevant GPS information they collect is documented, reasonably accurate, and compatible with our GIS.

Natural History Specimens. Acadia National Park's Museum Collections contain over 1.3 million historic artifacts, archival documents, and natural history specimens dating from 1596. They are housed in the William Otis Sawtelle Collections and Research Center. This facility includes a secure and climate-controlled storage wing where materials are housed/curated and a research/work area. A good part of the collection is cataloged on the NPS National Catalog database. Access to the collections is available during regular business hours by appointment with the park's museum curator or museum technician.

Monitoring Protocols Completed or Under Development; No Funding for Implementation

Indicators of freshwater emergent wetland ecosystem integrity. USGS

Tools to monitor and predict effects of nutrient enrichment on estuaries. USGS

Long-term monitoring protocols for forest ecosystems. University of Maine

Long-term monitoring protocols for rare vascular plants. College of the Atlantic

Effects of ozone on native vegetation. Boyd Thompson Institute

Key Science Partners

University of Maine

College of the Atlantic

Institute of Ecosystem Studies

USGS, Biological Resources Division, Patuxent Wildlife Research Center

USGS, Water Resources Division, Maine District Office

USGS, Maine Cooperative Fish and Wildlife Research Unit

Natural Resource Conservation Service

Maine Department of Environmental Protection

Maine Department of Inland Fisheries and Wildlife