Western Airborne Contaminants Assessment Project

National Park Service
U.S. Department of the Interior

Air Resources Division

PROJECT OBJECTIVES

- **Determine if contaminants are present in western national parks**
- **If present, determine where contaminants are accumulating (geographically and by elevation)**
- **If present, determine which contaminants pose a potential ecological threat**
- **Determine which indicators appear to be the most useful to address contamination**
- **Determine the sources for contaminants measured at the national park sites.**

BACKGROUND

The "Western Airborne Contaminants Assessment Project" (WACAP) has been initiated to determine the risk to ecosystems and food webs in western national parks from the long-range transport of airborne contaminants. It is being designed and implemented by the National Park Service's Air Resources Division in cooperation with many western national parks, the Environmental Protection Agency, the U.S. Geological Survey, USDA Forest Service, and several universities.

Airborne contaminants can pose serious health threats to wildlife and humans. Some toxic compounds tend to "biomagnify," meaning that small concentrations in air, water, snow, and plants, can result in large concentrations at higher levels of the food chain: like fish, and mammals. Biological effects of airborne contaminants include impacts on reproductive success, growth, behavior, disease, and survival. Subsistence hunters and gatherers in Alaska depend on wild food sources that may be affected by airborne contaminants.

The contaminants of concern are compounds that are sometimes called semi-volatile organic compounds or SOCs. This group contains a variety of persistent organic pollutants (POPs) such as PCBs and DDT. The element mercury (Hg) behaves similarly to SOCs and is also being investigated by WACAP. These materials are direct or indirect products of human industrial activity and can be transported thousands of miles in the atmosphere. In some cases, they can be deposited to aquatic or terrestrial ecosystems and then be re-emitted back into the atmosphere. Some of these materials have physical properties that permit them to accumulate, preferentially, in colder areas of the global environment. This phenomenon has been termed "cold fractionation" and has been observed for some types of PCB, HCH, and even mercury. Therefore, we suspect that high-elevation and high-latitude ecosystems may be at greater risk due to the accumulation of these toxic compounds, simply because they are colder than other locations.

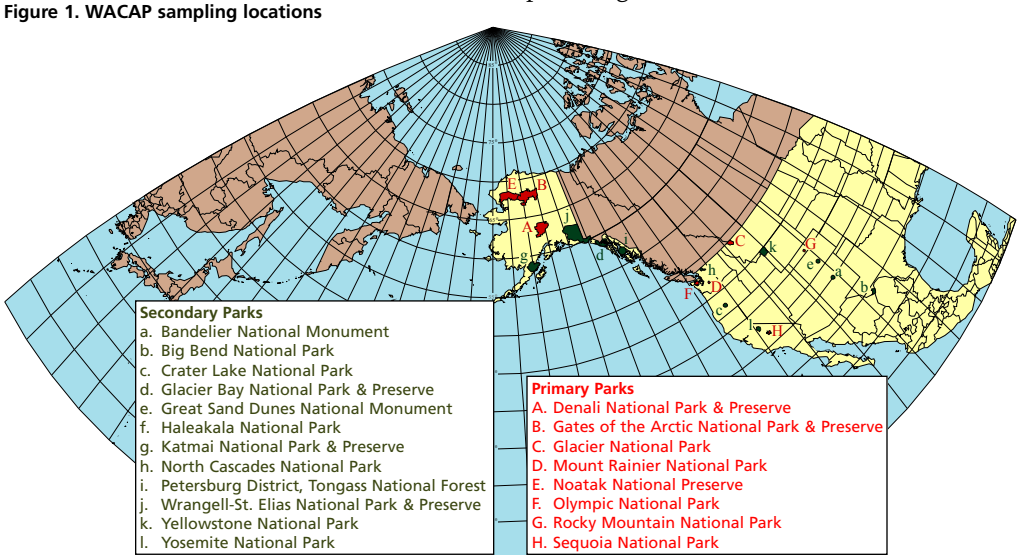
PROJECT OVERVIEW

WACAP sampling is centered on seven key national parks in the West representing a latitudinal gradient as well as a coastal to interior gradient. (For WACAP purposes, Gates of the Arctic and Noatak are considered together as one western arctic park unit.) Figure 1 shows WACAP sampling locations. The red parks represent the keystone parks in which the most intensive sampling will occur. Those colored green represent parks at which a smaller subset of vegetation or snow samples may be taken. At each of the seven park units, two relatively high, small lake catchments have been selected. Samples will be collected at these sites to reveal where and to what extent airborne contaminants have been deposited on these landscapes, and how these contaminants may be distributed within food webs.

CONTAMINANT SAMPLING

There are a variety of ecosystem indicators that have proven reliable in other studies for providing information about contaminant

Figure 1. WACAP sampling locations



accumulation and impacts in terrestrial and aquatic systems. WACAP is collecting field samples of the indicators shown in the sidebar (right) and will carefully analyze them in state-of-the-art laboratories. Next to each indicator is some information indicating what the results should tell us about airborne contaminants in park ecosystems.

A broad suite of persistent organic pollutants that have been used by humans for decades, such as PCBs, DDT, DDE, HCHs, HCB, will be measured in the indicators at each catchment. Many of these compounds are now banned in the United States, and finding them in park ecosystems may indicate that they originate in other countries. More recent "current-use chemicals," including pesticides and flame retardants, will also be assessed. Mercury is of key interest and will be analyzed in all materials along with other metals in specific indicators.

ACTIVITIES AND ACCOMPLISHMENTS (2003)

During the 2003 fiscal year (October 2002 to September 2003), much was accomplished by the approximately 11 scientists and support staff working on the WACAP project. A comprehensive, integrated research plan was prepared, peer reviewed before an international expert scientific panel, revised based on the comments received, and published as an EPA report. The entire document is now available on the NPS WACAP web site (www2.nature.nps.gov/air/Studies/air_toxics/wacap.htm). A Quality Assurance Project Plan was prepared and is near completion. Field and laboratory methods were developed and thoroughly tested prior to adoption by the program. In addition, field and laboratory equipment was purchased and tested. Analytical approaches that determine over 100 organic compounds for various sample types (i.e. snow, lake water, vegetation) were developed, tested and adopted. WACAP scientists met to plan field and laboratory strategies and to review accomplishments in every sector of the program.

The first field effort was snow sampling in 14 national park sites in late winter. This was very successful except in Olympic National Park which had no lingering snow pack. Field activities during August and September involved 8–12 persons and 2000 lbs of scientific and field equipment that was deployed to two lakes in Sequoia National Park and two lakes in Rocky Mountain National Park over a period of 22 days. All field activities were successful for all sample types that were targeted: snow, lichen, lake water, sediment, and fish. All samples arrived safely at the analytical laboratories and the work of preparing the samples and conducting analysis is ongoing. Atmospheric modeling approaches have also been developed to begin looking at the geographic locations that comprise seasonal air masses impacting WACAP sites (figure 2).

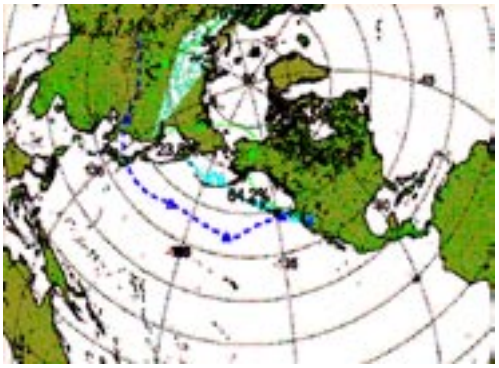


Figure 2. An atmospheric model predicts where contaminants found in Sequoia National Park are most likely to originate.

Very early contaminant analyses show that current-use and banned semi-volatile organic compounds (SOCs) are present throughout monitored indicators in high-elevation ecosystems of Sequoia and Rocky Mountain National Parks (table 1). Sequoia National Park has a broader range of these compounds than does Rocky Mountain National Park. However, all contaminants found in Rocky Mountain National Park also were found in Sequoia National Park. In most cases, contaminants in the snow were also found in the lake water. As scientists continue to examine additional WACAP samples over the next several years, including fish and lake sediments, a deeper understanding will be developed regarding the impacts these contaminants have on remote, high-elevation ecosystems.

PROJECT OUTCOMES

An interdisciplinary team of scientists including aquatic experts, hydrologists, fisheries biologists, atmospheric specialists, and botanists are working together to interpret and integrate the project results. WACAP is a team effort, including not only scientists from a variety of institutions but also resource experts and specialists from each of the participating national parks. NPS personnel are involved in the selection of sampling locations and interpretation of the results. A final database and report will be prepared at the end of the project that will provide evidence of the exposure, historical and seasonal trends, and bioaccumulation of air toxic materials in the ecosystems of the western national parks. Information about contaminants in western national parks that is gained from this project will be used to inform the public about the status of contaminant impact to these areas and determine if long-term airborne toxic compounds monitoring is needed. It will also assist the parks in selecting approaches and indicators to be used in future long-term monitoring efforts aimed at maintaining an ability to detect changes in atmospheric loadings of toxic compounds.

SNOW
Measure of direct atmospheric loading, collected annually, in many alpine cases 50–90% of the annual precipitation

FISH
Direct measure of food web impacts and food web bioaccumulation

WATER
Measure of hydrophilic current-use chemicals

LAKE SEDIMENT
Sediment provides historic trends (~150 yr) of contaminant loading to watershed

LICHEN
Direct measure of food web impacts and metals bioaccumulation

VEGETATION (e.g., WILLOW BARK)
Collected along altitude gradients in all 19 parks, measure of ecosystem exposure, comparisons within and among sites, parks, and elevations

SUBSISTENCE NATIVE FOODS
Direct measure of food sources (moose) used by native people

FOR FURTHER INFORMATION CONTACT

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WACAP WEB SITE

www2.nature.nps.gov/air/Studies/air_toxics/wacap.htm

Project Timeline

2002	2003	2004	2005	2006	2007
PILOT STUDIES Design & methods development	**WATERSHED SAMPLING** Rocky Mountain & Sequoia National Parks	**WATERSHED SAMPLING** Denali, Gates of the Arctic, & Noatak National Parks	**WATERSHED SAMPLING** Mt. Rainier, Olympic, & Glacier National Parks	**COMPLETE ALL LAB ANALYSES**	
	Lichen pilot study in Sequoia	**Moose tissue sampling in Alaska**	**Supplemental vegetation sampling**	**FINAL DATABASES, INTERPRETIVE REPORT, AND PUBLICATIONS**	
	SNOW SAMPLING IN ALL PARKS				