More about science at Denali

The National Park Service promotes research in parks and wants to make the scientific heritage of the national park system more accessible to scientists and the public. Denali National Park and Preserve strives to share park science via interpretive programs, in-park bus trips, programs for school groups and the public, brochures, articles, and posters, as well as presentations at professional meetings. By promoting science at Denali, and by utilizing the results of scientific studies, Denali reinforces the idea of "Parks for Science, Science for Parks".

Applying to conduct scientific studies

Research permits and collecting permits are required to conduct scientific studies at Denali National Park and Preserve or any other national park. A scientific and administrative review of each proposal helps ensure that the projects are appropriate for the park setting and won't interfere with on-going studies. A web-based application process has been established nationwide. For further information visit the website: http://science.nature.nps.gov/research.

Science results on the web

Each year investigators at all National Park Service parks submit a brief synopsis of their science findings via the Investigator Annual Report. Anyone can read these reports at the website: http://science.nature.nps.gov/research. It is possible to search for projects of interest by National Park Service region, by park, by key words in the title, or by year. More detailed reports of research findings can be obtained from the Center for Resources, Science, and Learning at Denali.

Denali Resources Technical Library

The technical library at Denali houses more than 1500 reports, dissertations, publications, and books that are an outcome of science at the park. Arrangements can be made to use these volumes by contacting the Center for Resources, Science, and Learning.

Denali Science and Learning Center

Nationwide, the National Park Service plans to establish 32 learning centers to facilitate research in the parks and to provide information to the public about the park's resources. Several learning centers are operational now. The Denali Science and Learning Center (DSLC) serves as the focus for cooperative research and educational opportunities for eight park units in northern Alaska. DSLC partners began operating limited programs in 2002. Planning and construction of a DSLC campus with science center, education center, and dormitories will continue for several years.

Sabbatical in the Parks

Scientists who are seeking ideas for sabbaticals, and national parks who have research opportunities are matched according to common research interests in a program called Sabbatical in the Parks. For more information, visit the website: http://www.nature.nps.gov/ sabbaticals.

National Park Service websites

Here are some additional websites of interest to scientists and the public:

- National Park Service: http://www.nps.gov
- National Park Service's Natural Resource Challenge:http://www.nature.nps.gov/challenge/nrc.htm

For further information about park resources and science in Denali National Park and Preserve, contact:

Center for Resources, Science, and Learning

Denali National Park and Preserve
PO Box 9
Denali Park, AK 99755
907-683-2294
www.nps.gov/dena

Photo © Rick McIntyre

Researcher measuring merlin's wing length

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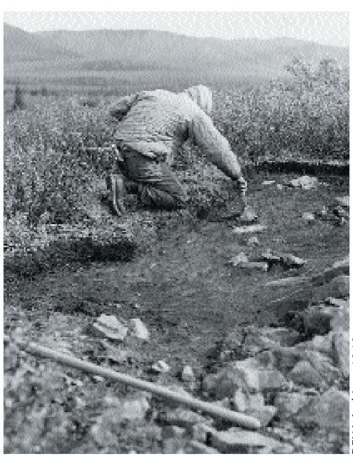
Science at Denali

National Park Service
U.S. Department of the Interior

Denali National Park and Preserve

Photo © Kennan Ward

Why conduct scientific studies at Denali?



DENA Archives. 19.19

Archaeological excavation near Teklanika Campground, 1961

Denali is a remarkable place for piquing the curiosity of visitors, researchers, and park managers. It's easy to ask lots of questions about Denali's resources….Where are grizzly bears most likely to be seen along the park road? What happens to animals and plants in the park during a winter with extremely cold temperatures and little snow? What habitat do northern hawk owls select for nesting? Why do glaciers surge (show advancing waves within the glacier)? How does air quality at Denali compare to other parks nationwide? What are backcountry users' attitudes toward wilderness? Is the elevation of treeline changing because of global climate change? What is the best method to reduce dust on the park road? Do the harvest limits or seasons for trapping or hunting in the preserve need to be adjusted because of what is learned by scientists about wildlife populations?

Seeking answers to questions about Denali's natural and cultural resources – including how Denali's ecosystems work and how they're affected by human activities – is what science in the park is all about. Within Denali's boundaries, there are 2.4 million hectares (6 million acres) where wildness and wilderness still predominate. Because Denali ecosystems are among the few large landscapes left in the world that have had little direct alteration by human activities and land development, Denali science is of international importance. Scientists can study plants of the tundra and boreal forest, wildlife, geology, soils, air quality, glaciers, soundscapes, and streams in a largely pristine mountain and subarctic setting.

Despite the fact that Denali's ecosystems are relatively pristine, because Denali ecosystems have connections far beyond the park boundaries, what happens elsewhere influences park resources and vice versa. Scientists recognize the importance of understanding these linkages and of being alert to how changes at Denali may signal warnings about more global conditions. Air quality monitoring at Denali reveals air pollutants that are transported from other continents. The health and status of migratory and highly mobile species that spend only a portion of their lives at Denali may reveal factors affecting the animals during their travels and in their beyond-park habitats. For example, the chum and coho salmon that spawn in the Upper Kantishna River are miles and miles from where they lived their salty lives in the Bering Sea. Golden eagles soaring over Denali in the summer spend the winter as far south as northern Mexico.

Not only does park science satisfy the curiosity of visitors and researchers, and increase our basic understanding of subarctic ecosystems, but what we learn about Denali's ecosystems also helps park administrators make informed management decisions. Understanding Denali's resources through scientific studies is critical to knowing how to care for them as a lasting natural and cultural legacy.

DENA Archives. DENA 6816

Bear Flower (Boykinia richardsonii)

What is park science?

Research in the broad sense (also called science) is an approach to learning new facts or information that relies on careful study and investigation. Scientists uses rigorous sampling techniques to obtain unbiased results. Depending on the focus, park science is either inventory, monitoring, or research. Park managers rely on information from all three approaches to make informed decisions about the management of park resources and to resolve problems. Some projects use more than one type of science.

Inventory

Inventories are designed to assess the status of a resource at a given time. Inventories describe the resource in terms of presence (e.g., what plant species occur in the park?), abundance (e.g., how many glaciers are found on the north side of the Alaska Range?), distribution (e.g., where are the cabins used for winter patrols by dog-teams?), or condition (what is the percent body fat of bears emerging from dens?)

Monitoring

Monitoring tracks a resource over time. Scientists rely on repeated observations or measurements to detect changes or trends in presence, abundance, distribution, or condition of a resource. Examples of questions to be answered by monitoring would include: Has the number of wolves changed over the decades? Have non-native plants including dandelions spread westward from the Savage Checkpoint along the road corridor? In the last two days, has the Herron River fire expanded such that additional protection of structural resources is needed?

Research

Through carefully structured observations, researchers look for nature's patterns and try to explain them. Some researchers frame their questions as hypotheses or predictions that can be tested by collecting more data. Scientists also take advantage of natural experiments (e.g., variation in weather) and serendipitous opportunities that weren't imagined at first (e.g., using a newly developed technique to analyze previously collected samples). Examples of hypotheses being tested are:

(1) The natural variation in populations of wolves and their ungulate prey (moose, caribou, and sheep) is driven by winter severity. Specific hypotheses relate components of population dynamics (e.g., calf birth weights) to winter weather.

(2) The landscape characteristics described for known archeological sites can be used to predict locations of additional archeological sites.

Photo © Gordon Haber

Wolves

How long has science been a part of Denali?

Scientific studies have been important at Denali for decades. Even before the park was established, keen observations of wild-life and the mapping of geologic features laid the groundwork for later scientific studies. Since the park's inception, there have been more than 680 natural and cultural resource studies conducted in the park, counting those one hundred or so that are underway at present.

Contributions of early scientists

Any history of science in the park is likely to mention the contributions of these naturalists and scientists. The earliest pioneering work preceded the establishment of Mount McKinley National Park in 1917.

Alfred H. Brooks, geologist, led an 800-mile U.S. Geological Survey (USGS) expedition in 1902. Brooks, along with seven men and 20 pack horses, endured mosquitos and "roaring, turbulent bowlder-filled rivers" to describe and map the terrain along a transect in the Denali region. Imagine setting off to the part of the map that simply said "unexplored".

DENA Archives. DENA 6816

Wandering tattler and young at nest

Charles Sheldon was a business entrepreneur and sheep hunter turned naturalist-preservationist. In the summer of 1906 he surveyed for Dall sheep starting at the foot of the Peters Glacier moraine. As he wandered and learned the habits and habitat of Dall sheep, he was awestruck by the "stupendous immensity" of Denali among the "ragged snowy line" of other peaks. Sheldon returned the next summer for a year's stay systematically observing wildlife with his guide Harry Karstens. What Sheldon learned about wildlife movements in the "vast extent of the wild areas" grew into his idea for a park-refuge that resulted in the protection of Mount McKinley National Park in 1917.

Stephen Capps led several USGS mapping expeditions in Alaska. In 1916, he studied mineral deposits in Kantishna, but also recorded wildlife observations.

Olaus Murie was a biologist for the U.S. Biological Survey in Alaska. In 1920-1923, he made reconnaissance surveys in and around the park, where he could study caribou in unhunted populations. While studying caribou, he described the park's fauna and flora – the first records of Denali's biological resources.

Adolph Murie's earliest trip to the McKinley Park region was in the summer and fall of 1922. Adolph was 22 and took a steamer to Alaska to assist his older brother Olaus, who was studying caribou. The next summer, they were still making "continuous observations of the birds and mammals" for the U.S. Biological Survey. They documented the first known nest of the wandering tattler (tundra-nesting shorebird). In 1939, Adolph returned to Alaska to conduct wolf-sheep research in the park. Over the years, he conducted numerous studies of mammals, birds, and their ecological connections. His works include Wolves of Mount McKinley and Grizzlies of Mount McKinley.

Joseph Dixon and George Wright conducted what might be considered the first inventory of birds and mammals in Denali in 1926. They logged approximately 500 miles on foot. During their travels, according to the custom of the day, they shot and prepared skins for 168 specimens of birds and 83 study skins of mammals, in addition to gathering 2 birds' nests, 350 photographs and 280 pages of notes. Dixon returned to Denali in 1932 to complete his study of animal life. His journals are filled with notes about the habits of "living animals in the field" (e.g., "…caribou standing and lying down on the snow to keep away from flies and mosquitoes…", "…several old rams started down the talus slopes to feed in the meadows…").

Bradford Washburn spearheaded a 90-day expedition for weather observations on Mount McKinley in 1947. Well-known for his black and white photographs of the mountain, he also made extensive survey measurements to produce a detailed map of "the roof of North America" that is still in use today.

Photo courtesy of U.S. Geological Survey

Alfred H. Brooks

Photo © Rick McIntyre

Dall sheep

Stephen R. Capps Collection, 83-149-2167, Archives, University of Alaska Fairbanks

Stephen Capps

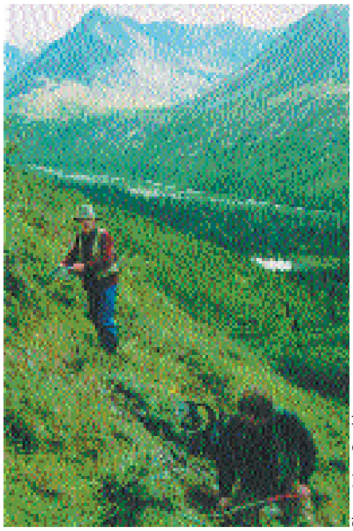


Photo © Jess Grunblatt

Scientists survey soil and vegetation near Riley Creek

What current scientific studies are there?

Recent and on-going projects probe questions in the natural and social sciences, and about Denali's cultural and subsistence resources. Some studies are completed in one to several years while some monitoring projects will continue indefinitely. Some scientific projects are conducted by park staff (~50%), others have been planned or funded by the park but contracted out to cooperating researchers (~20%). The remainder of projects are carried out by investigators from universities, organizations, and other agencies, or independently with other funding.

The list of selected recent or on-going projects illustrates the variety and scope of Denali science. Studies are categorized into natural sciences, social sciences, and cultural and subsistence, then listed by inventory, monitoring, and research depending on the focus.

Natural Sciences (biological and physical)

Inventory

- Floristic inventory of Denali National Park and Preserve
  —to find and make voucher specimens for plant species not previously documented in the park

- Lepidoptera (butterflies and moths) and Bombidae (bees) of Denali National Park and Preserve
  —to list what species of butterflies, moths, and bees live in the park

- Spiders of Denali National Park and Preserve
  —to list what species of spiders live in the park

- Denali soils inventory
  —to describe soil layers by digging pits at numerous locations, and to map the park's soil types

- Denali landcover mapping
  —to map the park's vegetation using a combination of satellite images and field sampling

- Brown and black bear surveys in south central Alaska
  —to determine the density of brown and black bears in the park south of the Alaska Range

- Insect diversity and habitat types
  —to identify possible associations of insects with certain plant communities

- Assessment of the status and threats of exotic plants
  —to evaluate the distribution of the park's exotic plants and their threat to native species

Monitoring

- Monitoring wildfires in the park
  —to maintain the indigenous wildland fire regime while protecting natural and cultural resource values

- Trumpeter swan surveys
  —to determine if the number of trumpeter swans is increasing, decreasing, or stable

NPS photo by Western Area Fire Management staff

Moose Lake Fire, July 2002

- **Wildlife observations and monitoring by busdrivers**
  —to record changes in numbers and distribution of wildlife species observed along the park road

- **Denali's Long-term Ecological Monitoring Program**
  —to monitor and detect changes and trends in such attributes as…

  Location of treeline
  Inter-annual variation in growth and reproduction of white spruce
  Wolf, caribou, grizzly bear, and moose populations
  Abundance, productivity, and survivorship of songbirds
  Raptor populations (eagles, gyrfalcon, merlin)
  Golden eagle nesting productivity
  Small mammal community dynamics in different habitats
  Aquatic invertebrates
  Water quality and flow, erosion, and sediment size of reference stream channels
  Snow depth, density, and water equivalent
  Weather
  UVB
  Air quality
  Glacier movement and mass balance

- **Seismic monitoring**
  —to document seismic activity (earthquakes) in the park

- **Soundscape inventory and monitoring in the park**
  —to document any changes in the level of sounds heard in high- and low-use areas of the park

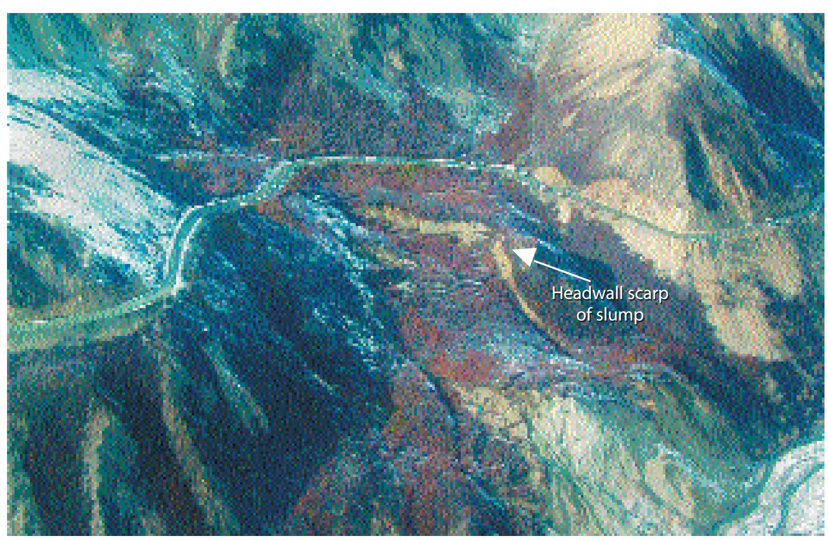
- **Soil-slump mudflows along the park road**
  —to measure how fast the slump-mudflows are moving and assess what risk they pose to the road

Photo © Rick McIntyre

Caribou escaping mosquitos and flies on a patch of snow

Photo © Sandy Milner

A Surber sampler is used to collect stream invertebrates



National Park Service photo

The landslide or slump at Milepost 45 threatens the park road

Moose

Research

- Snowmobile trail effects on wildlife
  —to determine whether wildlife avoid, prefer, or are neutral to snowmobile trails

- Impacts of snow compaction from snowmobiles on soil temperature and vegetation
  —to test the relationship among compaction from snowmobiles, spring soil temperatures, and vegetation growth

- Comparison of ectomycorrhizal fungi in early successional sites across a latitudinal gradient
  —to compare for different latitudes how fungi associated with plant roots help plants colonize disturbed areas such as glacial moraines

- Population dynamics of wolves and their prey
  —to determine wolf density and population trends in relation to mortality, availability of prey items, and the number of young

- Dynamics of wolf-prey systems and wolf societies in the Denali region
  —to better understand wolf ecology, behavior, and wolf-prey systems

- Ecology of moose
  —to learn about the ecology of moose behaviors associated with calving (spring) and the rut (fall)

- Productivity of moose in Interior Alaska
  —to determine the relationship between the nutritious proteins or non-nutritious tannin compounds in the plants they eat (mainly willows) and the number of moose calves they produce

- Breeding biology and dietary analysis of northern hawk owls in interior Alaska taiga forests
  —to learn what northern hawk owls eat, and what nesting habitat they select

- Assessing breeding habitat, movements, and survivorship of golden eagles in and from Denali
  —to study where golden eagles nest from year to year and how this affects the success of raising young for each pair of eagles

- Assessing the presence and potential impacts of polyaromatic hydrocarbons from snowmobiles
  —to assess how products from snowmobile exhaust affect stream water quality and organisms

- Monitoring freeze-thaw transition on a regional scale in boreal forests
  —to determine how latitude in Alaska affects the process of soil freezing and thawing

- Use of pulsed radar to determine characteristics of snow
  —to predict avalanche hazards using pulsed radar from aircraft to check snow properties

- Tectonic studies of the Alaska Range using temporary seismometers
  —to describe the mountain building associated with tectonic plates in the Denali area

- Developing a geologic cross-section through Denali NP—Analysis of the Kahiltna Formation
  —to make a map of the geology of the park showing a cross-section of the Alaska Range

Social Sciences

Monitoring

- Subsistence use community profile
  —to interview subsistence users about their resource use and to identify any trends over time

- Backcountry visitor use
  —to record and assess trends in the number of park visitors in the backcountry

- Concession statistics
  —to record and assess trends in the number of users of concession programs (buses, flightseeing, guides)

- Aircraft use monitoring
  —to record and assess trends in aircraft use over the park and landings in the park

- Visitor satisfaction with the bus system
  —to assess how the visitor viewed and valued the Denali bus experience

Photo © Kennan Ward

Buses transport park visitors

Research

- Relationship between acute mountain sickness and rating of perceived exertion in climbers
  —to determine how exertion by climbers and the mountain sickness they experience may be related

- Studies of traditional ecological knowledge of fish resources
  —to interview Native Alaskans and others involved in subsistence fishing to learn about customs, harvests, and trends related to fisheries

- Removing human waste associated with mountaineering expeditions
  —to test pack-out bags to address the problem of human waste while mountaineering

Photo © Bill Ruth

Mountain climbers on Denali

Cultural and Subsistence

Photo © C. Craft Lefebre

Preparing fish for drying, Telida, 1949

Photo © C. Craft Lefebre

Mary Seseui of Telida, 1949

National Park Service photo

Fish Lake Cabin

Photo © Percy Duyck

Fishwheel on the Tanana River

Alexia Family Collection

Camp along Antone Pitka's trapline, c.1950

Inventory

- Parkwide ethnographic study
  —to determine the Native Alaskan history and culture in the Denali vicinity
- Native place names mapping
  —to map the Native Alaskan names for the natural features in the Denali vicinity
- Mountaineering history jukebox
  —to document and present oral history of Denali mountaineering through short digital audio recordings of interviews with climbers

Monitoring

- Condition assessments of all cultural sites (mining camps, backcountry cabins, buildings, etc.)
  —to determine what work is needed to maintain or restore cultural sites
- Assessment of salmon in the Tanana and Kantishna Rivers
  —to use fishwheels to recapture marked fish to learn how many salmon return upstream in the two major watersheds of the Tanana River

Research

- Effects of hunting and trapping on population dynamics of large mammal populations
  —to determine if bag limits or seasons for trapping and hunting should be changed based on population trends

What are the logistics of park science?

Park science has many tools. Some projects rely on satellite images or maps, while others use fieldwork or personal interviews. Every project has its own methods. Some studies deploy specialized instrumentation and gadgets, technical contraptions that record information about temperature or sound, or more commonplace items such as compass, binoculars, and shovels. Other projects might use rock hammers, vials, fish wheels, increment borers, plant presses, radio-collars, binoculars, bird bands, seismometers, needles, and probes. Some methods have changed over the years, while others have changed little.

Science happens along the road corridor and in remote locations of the park. Scientists haul gear and themselves around by helicopter or fixed wing aircraft, or travel on foot, by boat, or in vehicles along the park road. The high cost of travel and the time it takes to travel to remote locations have to be taken into account when decisions are made about what research can be accomplished in a given field season.

Any scientist wanting to conduct research must submit a study proposal and fill out an application. Usually the project has been discussed with a park liaison who makes sure the project fits in with the overall science goals of the park. Appropriate research gathers information while making minimal impacts to park resources. Permits are granted for some limited collecting of objects, whole organisms, or parts of organisms. In past projects, collections have been made of plant roots or leaves, or the entire plant, voles, moose pellets, feathers, rocks, or soils. Some of these samples are destroyed while being analyzed. Some animals are collected and released after they have been measured or tagged. Data and records are kept in fireproof file cabinets. Reports, dissertations, and publications resulting from scientific studies become part of the Denali resources technical library. Computer databases are maintained about the research studies and the library volumes. Archived documents and collections are housed in Denali's museum or are loaned to other institutions.

National Park Service photo

Vole collection

National Park Service photo

Downloading acoustical data from the Pika Glacier sound monitoring site


National Park Service photo

Studying snow depth and density at Broad Pass

How has science benefited the park?

At Denali, managers have applied science findings in several ways. For one, science has helped park staff develop efficient methods to inventory and monitor the natural and cultural resources the National Park Service is mandated to protect. In addition, park administrators use information from scientific studies to make management decisions that minimize impacts on resources.

Managers also apply scientific knowledge to mitigate impacts of past disturbances or to resolve park problems. For example, research may give insight into the most effective treatments for restoring lands that have been altered by mining or construction.

Which way of applying park science is illustrated in each of the examples listed below?

Hunting for new plant species in a 6 million-acre park

The location of searches for plants species expected to occur but not yet documented in the park have been chosen based on an analysis of the expected species list. Each species was classified into expected habitat(s), landscape position (elevation), and geographic regions of the park. The combinations of habitat type, elevation, and region that were expected to yield the most "new" plants (e.g., low-elevation wetlands in the Kuskokwim-Minchumina Basin) were targeted for further exploration.

Assessing when there's adequate snow

Studies of seasonal snow depth and density help develop guidelines for adequate snow cover for snowmobile use in the new park additions and preserve. Managers can use reports of snow conditions in certain areas to help determine if these areas should be opened to snowmobile use. The goal is to prevent damage to park vegetation.
See photo above.

Assessing impacts of subsistence harvests

Results of wildlife research provide managers with information on what kind of natural population fluctuations are to be expected. These results can then be used to modify harvest limits if needed to minimize any biological problems, and maintain natural and healthy populations.

Protecting cultural resources

To reduce the risk of wildfire damage to cultural features, such as administrative, historic, or subsistence cabins, fire management personnel remove trees and brush, referred to as hazardous fuels, around these features. How much of an area is cleared is based on past studies of fuels and fire behavior.

Locating new facilities

New visitor facilities on the south side of the park will be located with the knowledge of where development would have the least impact to natural resources. To map potential nesting habitat for waterfowl and raptors, habitat variables measured in known nest locations were included in a predictive computer model.

Restoring Caribou Creek Watershed

Several methods of reconstructing the stream bank were compared, and the one that was most effective at restoring the vegetation was selected for use in the Caribou Creek watershed where mining in the 1930's and more recently in 1984 - 1985 had channelized the stream and disturbed the area. See photo at right.

Acquiring river gravel for park roads

Gravel to maintain Denali's 90-mile access road is excavated from the braided Toklat River using scrapes that have been determined to best mimic natural meanders. Some scrape patterns are not used because they were slower to refill with gravel and slower to recover a natural appearance. See photo below.

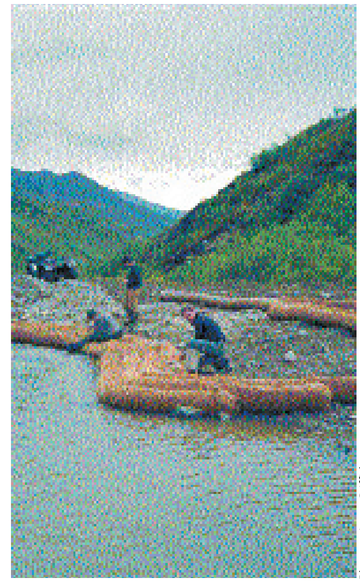
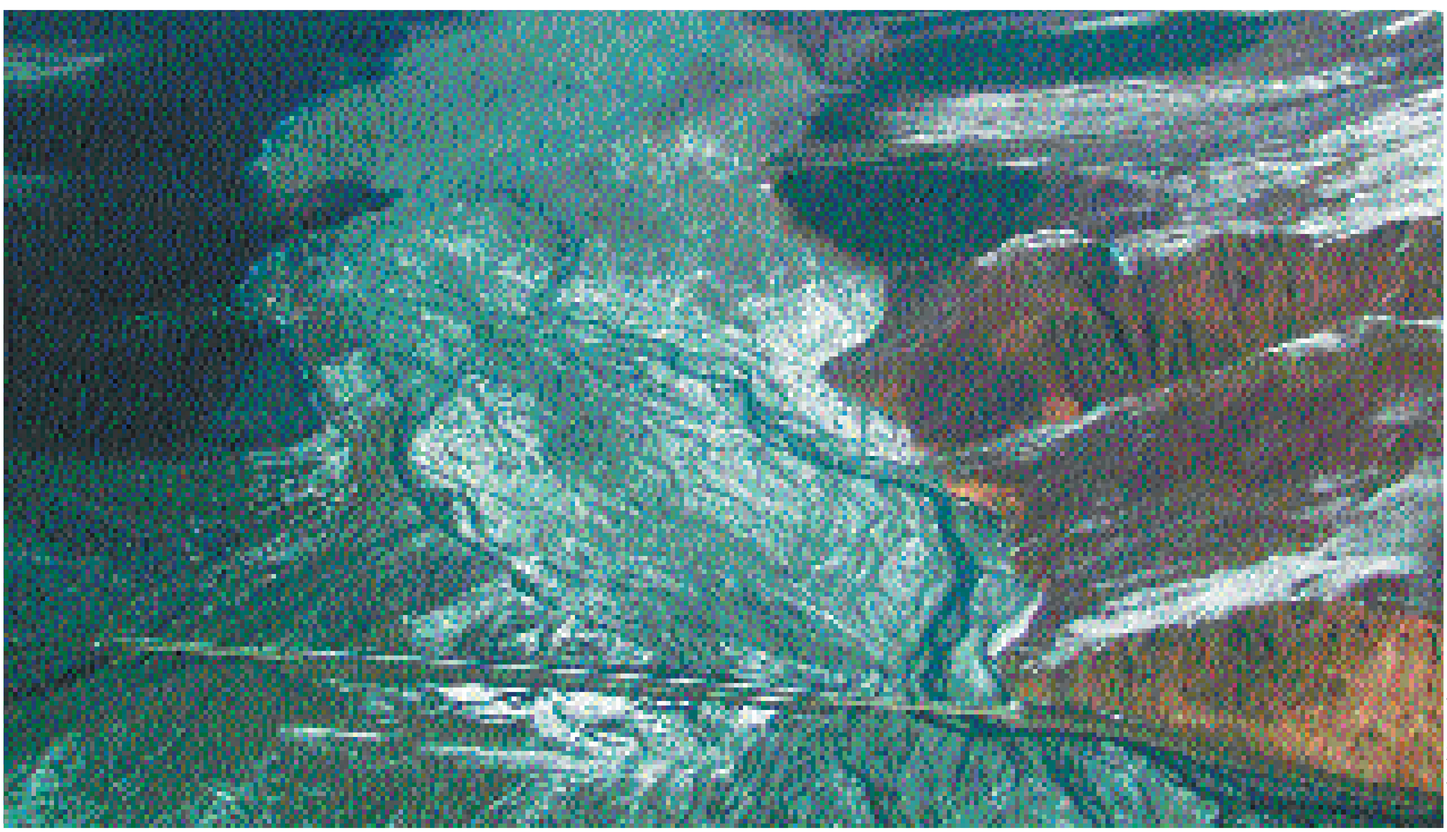


Photo © Lynn Griffiths

Coconut fiber logs are positioned to stabilize the banks of Caribou Creek

During your visit to the park, you are encouraged to ask, how does or could science help resource management at Denali?

What questions do you think should be answered by scientific studies at Denali National Park and Preserve?



National Park Service photo

Aerial view of the natural meanders of the braided Toklat River (note park road at bottom of photo)