National Park Service
U.S. Department of the Interior

Denali National Park and Preserve

Denali National Park and Preserve
Center for Resources, Science, and Learning


NPS Photo by Lucy Tyrrell

Summary of Current Resource Projects 2005

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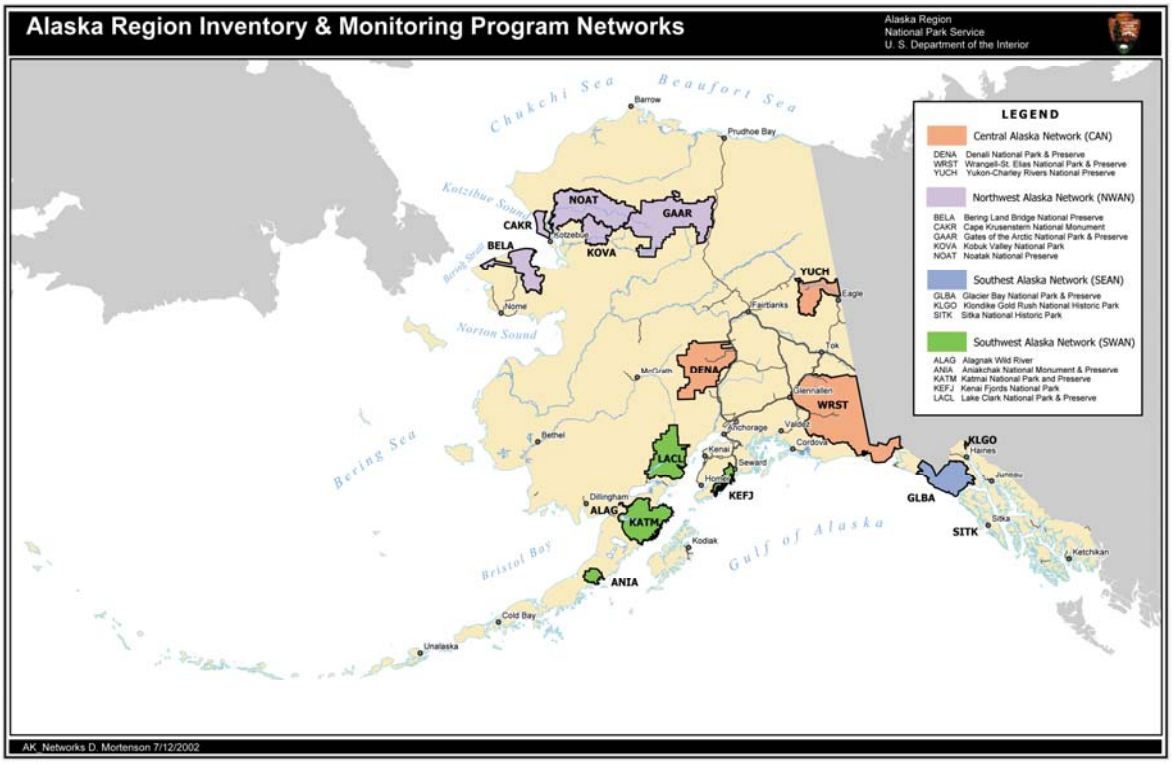
◂ Natural Resources ▸

Integrated Programs

Central Alaska Network (CAKN) and Inventory and Monitoring at Denali

In 1991, Denali National Park and Preserve was selected to serve as a prototype (one of 10 in the National Park System) to develop a Long-term Ecological Monitoring (LTEM) program. At Denali, the LTEM program's function was to help park managers protect park resources by providing the ecological context for resource preservation decisions. As a result of the prototype monitoring program, the National Park Service recognized the value of monitoring data and the need broaden the monitoring program to a national level. In 2000, the National Park Service created the "Vital Signs" monitoring program which grouped 270 park units into 32 'networks'. In this program, a "vital sign" is an indicator of the health of park ecosystems. Each network would develop an ecological monitoring program for its group of parks. Denali is one of three parks in the Central Alaska Network (CAKN), which also includes Yukon-Charley Rivers National Preserve and Wrangell-St. Elias National Park and Preserve.



From 1991 to 2000, the LTEM program focused on an intensive watershed sampling design in Rock Creek, in the eastern end of the park, but this approach did not allow park managers to infer information across all of Denali's 6 million acres. In 2000-2002, the LTEM staff explored a sampling design using a systematic grid that would allow inference of data across the entire Denali landscape (see Figure 1). The grid was tested to make sure it could adequately detect vegetation change and then the bird monitoring component was integrated into the grid as well. As the LTEM program broadened to this landscape view, the CAKN monitoring program was developing beginning in 2001. As a result, many of the LTEM monitoring protocols are being implemented beyond the boundaries of Denali in the other two Central Alaska Network (CAKN) parks.

In 2003, Denali staff completed an historical report on the Denali LTEM program, a report on the mini-grid sampling design (see Figure 1), and a synthesis and analysis of data for each monitoring component for the past 10 years. These reports fulfilled Denali's role as a national LTEM prototype park and allow other parks to learn from the prototype experience.

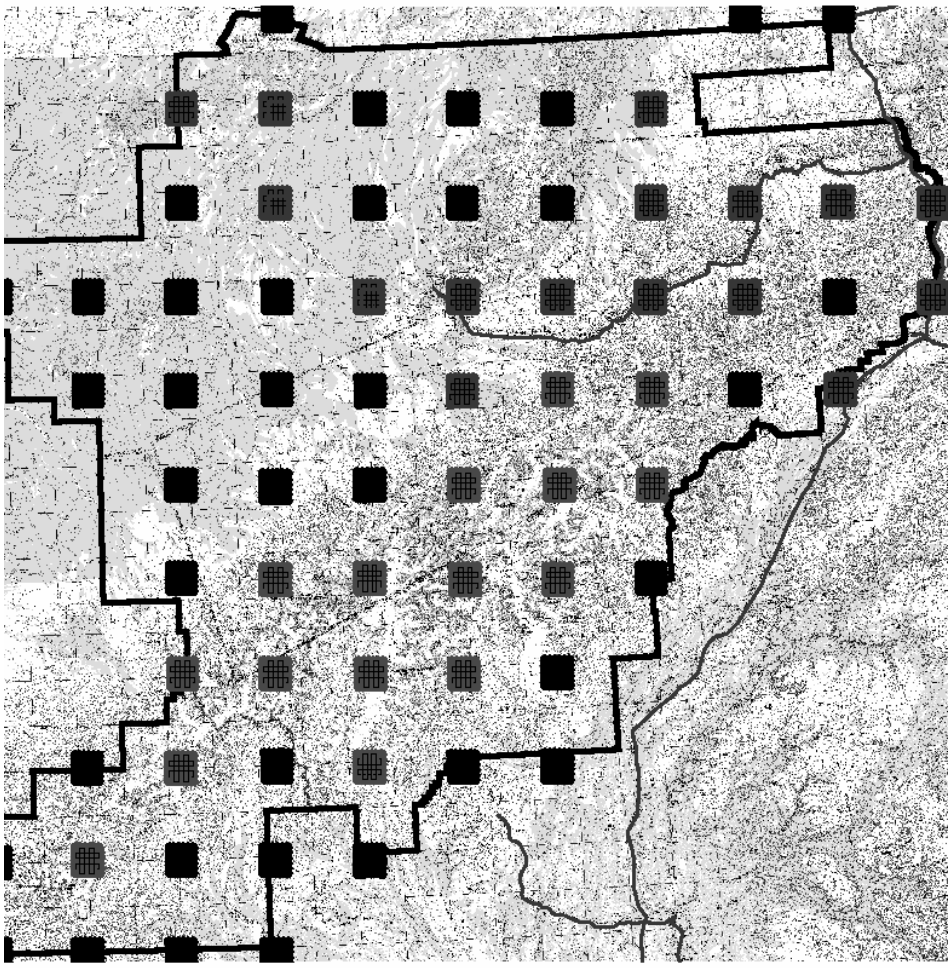


Figure 1. System of 20-km "minigrids" or sampling blocks for Denali National Park and Preserve. Each minigrid is 6.25 km^2, with the SE corner of each minigrid 20 km distant from the corners of adjacent minigrids. The minigrids are used to sample Denali's huge landscapes, and to integrate data about plants, animals, and physical features. Minigrids are: (1) accessible by road, (2) high elevation, and (3) low elevation, inaccessible by road.

By 2003, Denali park staff fully integrated the Denali's LTEM program with the vital signs monitoring for CAKN. Now, natural resource monitoring at Denali is under the auspices of the Inventory and Monitoring Program of the Central Alaska Network. Designing monitoring protocol began in 2003 across all three network parks, including many of the monitoring projects described here (vegetation, golden eagles, glaciers, climate, passerines, wolves, and caribou).

In December 2004, the *Vital Signs Monitoring Plan (Phase 3 Report)* for the Central Alaska Network was completed and submitted for scientific peer review to the national program. It lists the vital signs to be monitored in the network, and which ones will be monitored in each of the three parks. It also charts the schedule for developing and implementing the protocols for monitoring each of these vital sign (e.g., snow pack, ptarmigan, plant phenology).

During 2005, the monitoring plan will be revised and the final draft of the plan will be completed. Denali park staff are serving as Principal Investigators for several components of the program and they will be working closely with park staff of Wrangell-St. Elias National Park and Preserve and of Yukon-Charley Rivers National Preserve to finalize sample designs for the all aspects of the monitoring program. For more information, go to the website www.nature.nps.gov/im/monitoring/

Proactive Approach to Protecting the Toklat Basin

The goal of this three-year project is to identify the natural and physical features that define the Toklat Basin ecosystem, and to develop an information base that integrates data about many resource attributes so it can be used effectively by National Park Service managers.

The field portion of the study was completed in 2004; reporting and product preparation will occur in 2005. The study has six main components: reconnaissance of biological resources, development of computer models predicting where species of large vertebrates occur, inventories of selected species including anadromous fish and furbearers, mapping the surficial geology, characterization of the soundscape, and an assessment of the hydrology and aquatic resources. Each of these programs is described in their respective sections of this report.

The Toklat Basin is located north of the park road (downstream of where the road crosses the Toklat River). It is the broad basin that includes the Toklat and East Fork of the Toklat Rivers north of the Wyoming Hills, and south of where the East Fork flows into the Toklat. It is further defined as the area bounded by the Sushana River (to the east) and the Clearwater Fork of the Toklat (to the west).

Plants

Off-Road Vehicle (ORV) Impacts

We are beginning a study this year aimed at assessing and monitoring the impacts of Off-Road Vehicles (ORVs) on Park vegetation and soil resources in the Broad Pass area. This summer, we will be using GPS technology to map and characterize trails and other impacts from ORVs. The purpose of this project is to help manage ORV use on Park lands to minimize any damage to resources.

Long-term Monitoring

Field work continues this year for the vegetation component of the long-term monitoring of park resources, including landscape monitoring of vegetation and white cone spruce production.

- **Landscape-scale monitoring vegetation project**
  The goal of this project is to detect changes in fundamental properties of the vegetation cover of the park over long intervals of time. The design for this landscape-scale work is a systematic grid of sites at 20-km intervals laid out over the park landscape (see Figure 1). For vegetation monitoring, parameters measured at these mini-grid sites include species composition and structure, abundance, tree density, tree size, tree vigor, and evidence of pathogens. We also measure soil characteristics and landscape variables in these plots.

  During the 2005 season, the vegetation crew will be measuring plots in two study areas – the Rock Creek and Middle Teklanika River mini-grids. The focus of this work will be evaluating the reproducibility and observer variation inherent in the protocols that are used for monitoring vegetation during this long term study. Reproducibility and observer variation are crucial aspects of measurements expected to occur over decades, relying on many "generations" of field staff to record precise observations regarding the vegetation cover of the Park.

- **Repeat photography**
  A small project we are undertaking this year is making repeat photographs of some aerial photography taken in the mid-1970's by Dr. Fred Dean, a long-time researcher in Denali. These aerial photographs, which were taken while preparing the first vegetation map of the Park, are a treasure trove of ecological information. This exciting project will retake a small subset of these photos and make careful comparisons of the images to discern what changes are evident on the landscape over a 30-year span of time.

❖ **Monitoring of white spruce growth and reproductive effort (production of cones and seeds)**

The vegetation crew continues to monitor the permanent plots installed in 1992 within the Rock Creek drainage near park Headquarters, including observing the growth and seed production of selected white spruce trees. Spruce cone production has been quite variable among years during this study, with especially high productivity observed in the years 1998, 2000, and 2002 (see figure below).

On average, the trees in the forested sites produced more cones per tree than did trees in the treeline plots over the course of this study. However, 2004 was an exception to this pattern and there were more cones per tree in the higher elevation treeline sites. This is surprising because the trees at treeline are, on average, considerably smaller than the spruce trees in the low elevation forested site. Two factors may be involved: (1) increased drought stress in the low elevation trees due to the dry winter of 2003 (when the 2004 cone crop was initiated) and (2) there were several consecutive years of high cone productivity in the low elevation spruce trees, perhaps depleting the reserves of these trees. Cone formation and maturation in white spruce is a two-year process. Cones are initiated in one year, and grow, are fertilized and produce seeds in the following year. Thus we see a pattern of alternating high and low spruce cone crops in Denali, and we have never observed two consecutive years of high productivity.

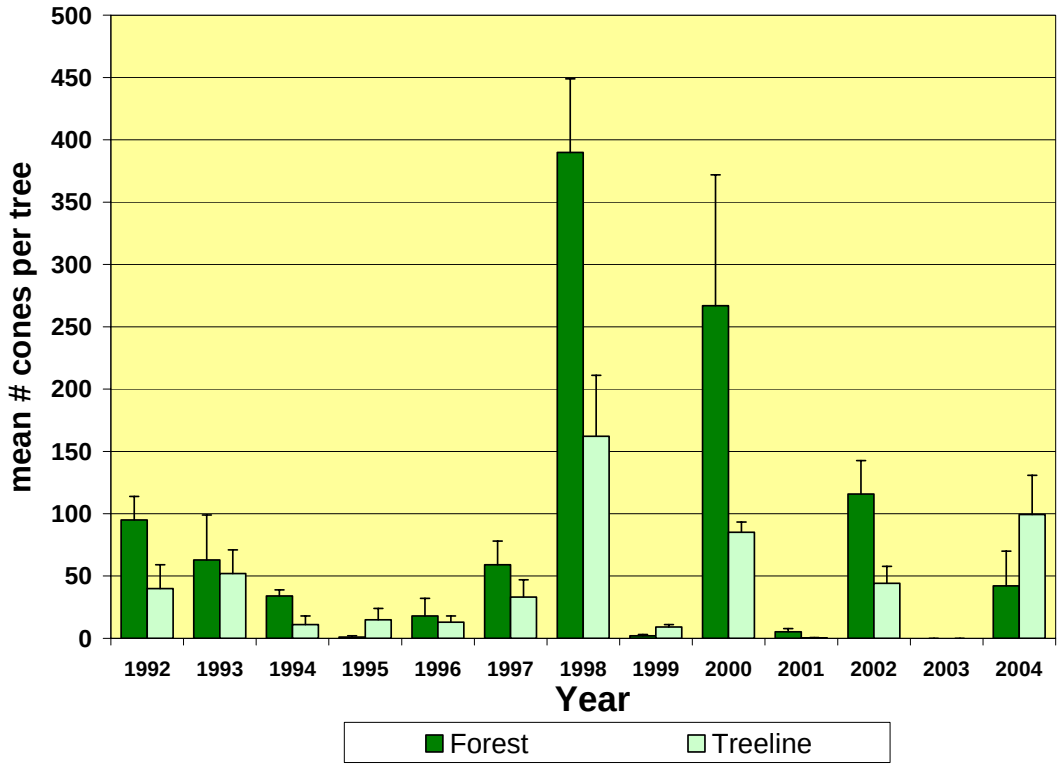


Figure 2. Mean number of cones observed per tree in low elevation forest and mid-elevation treeline sites in the Rock Creek drainage of Denali National Park and Preserve.

Removal of Exotic (Non-native) Plants

✧ **Dandelions**

In 2004, volunteers helped resource staff remove more than 270 pounds of non-native dandelions *(Taraxacum officinale)* from over thirty-five miles of the road corridor at the east and west ends of the park. The east-end portion focused on the park road from Igloo Ranger Station to Mile 8.5 on the park road. The west-end effort includes Wonder Lake Campground and the park road to the Kantishna Airstrip. In addition, on June 22, 2004, a group of 23 young people from a YMCA in Atlanta, Georgia removed over 160 pounds of dandelions in the Headquarters area.

In 2005, for the seventh year, volunteers in the Park will be enlisted to pull dandelions.

✧ **Other non-native species of plants**

Four non-native species other than dandelions were removed in 2004. These species, which will be targeted for removal in 2005 as well, are

- Vetch (*Vicia cracca*)—purple, flowering in July
  (7 lbs were removed near the visitor center sign at the park entrance and one plant outside the wash bay at the Auto Shop at Headquarters)
- White sweet clover (*Melilotus albus*)—white, flowering in July
  (8 lbs pulled from the Parks Highway near the McKinley Village)
- Hawk's-Beard *Crepis tectorum*—yellow, flowering in July
  (110 lbs pulled from sewage lagoon at the park entrance)
- Mustard *Erysimum cheiranthoides*—yellow, flowering in July
  (15 lbs pulled from East Fork of the Toklat cabin (Mile 43)

Revegetation of Construction/Disturbed Sites

Seed collections

In anticipation of the need for native seeds to revegetate areas of the Frontcountry after development and construction are completed, resource staff, volunteers, and the Denali trails crew conducted a major native plant "Need for Seed" collection in 2004. Collections were made near the park entrance and at Toklat, Eielson, and Kantishna of early successional species. These successional species are ones that will grow well on the newly-graded and bare soil sites being created by construction projects in the Frontcountry (e.g., near the new Visitor Center and Train Depot). The species include Eskimo potato (*Hedysarum* spp.), Oxytropis (*Oxytropis campestris*), Arnica (*Arnica* spp), and native grasses (*Elymus* spp).

Once the seeds are collected, they need to be cleaned (removing seeds from pods or leafy sheaths and removing plant stalks and stems). After cleaning, there were 7 lbs of Eskimo potato seed collected (Wendy did this cleaning here at the park). The other collections were sent for cleaning to the Alaska Native Plant Materials Center in the Palmer area.

In 2005 seeds will again be collected for revegetation of present and future construction projects.

Revegetation
Areas seeded in 2004 included the bare areas around the vegetation mats in the parking lot at the new Visitor Center, and the area in Kantishna called North Face Corner directly across from North Face Lodge. Annual rye was added on the slopes where erosion was a potential problem before the native seeds were fully established and could hold the soil in place.

Tundra mats harvested from the Matanuska Telephone Association (MTA) fiberoptic line were installed on the mounds at the parking area near the new Visitor Center.

In August or September 2004, staff revegetated several areas with tundra mats and seeds. The tundra mats are collected opportunistically from areas slated to be cleared (e.g., trail corridors associated with construction of the fiberoptic line and new bike trails). The areas that were revegetated include areas near the new visitor center and in Kantishna where gravel has been mined for the park road (i.e., the Northface Corner).

The best time for harvesting and transplanting mats is when the mats are almost dormant (so little damage occurs to plants) when more plant energy is directed at root production (in spring and fall) than in leaf and fruit production (summer). Seeding in the fall mimics the natural dispersal of seeds at a time when the seeds won't germinate but will overwinter on site and be ready to germinate the following spring.

The big projects for the 2005 season are revegetating the septic area around the new Eielson Visitor Center and the Toklat area, using vegetation mats and seeding in the fall.

Monitoring Dust Palliatives on the Park Road

To reduce road dust created by vehicular traffic, park maintenance crews apply an aqueous solution of calcium chloride (CaCl) to the surface of the park road. The application reduces both dust and the need for mining of additional fine materials to replace the material constantly lost from the road as dust. However, this dust palliative program also has the potential for adversely affecting ecosystems in areas adjacent to the park road. NPS has developed a monitoring plan to address this concern and to assess and monitor the possible effects on soil, water, and vegetation of applying calcium chloride as a dust palliative on the park road.

This summer an array of soil water samplers (called lysimeters) will be deployed along the park road in order to monitor the migration of chloride ions into the areas adjacent to the Park Road.

Wildland Fire

Monitoring Wildland Fires

Denali National Park and Preserve has 3,359,449 acres (out of a total of 6+ million) that are covered by burnable vegetation. Eighty-eight percent of the burnable vegetation acres (2,966,707 acres) lie within what is known as limited fire management options. Limited fire management options allow fire to play its natural role in the ecosystem. Although some wildland fires are suppressed because they threaten natural or cultural values, the emphasis of the fire management program at Denali is on actively monitoring wildland fires while they burn and on protecting individual isolated structures that lie in the fire's path. Monitoring includes observing a fire from aircraft, digitally photographing and mapping its progress, and keeping an updated narrative of the fire's status and behavior. Current and forecasted weather over the fire area is also monitored to ensure that the fire will continue to burn only where allowed. Protecting isolated structures that lie in the fire's path is generally accomplished by setting up a water pump and sprinkler system on or around the structure as most structures tend to be located adjacent to water sources.

Pertinent fire information and fire perimeter maps are posted for public consumption at www.nps.gov/fire under public/fire news and for internal audiences at http://165.83.62.205/epr/fire/fire.htm . Current fire information is also posted on wildland fire bulletin boards at headquarters and the Resource building at Denali Headquarters and for the bus drivers on the NPS bulletin board.

Table 1. Fires in or near Denali National Park and Preserve in 2004.

Fire Name	Burn Period	Acres	Action Taken	Comments
FY 2005 Sewage Lagoon Slash Burn	November 15-19	0.1	Prescribed Fire	Objective to burn biomass debris

Denali Public Affairs office sent out a press release to internal and external audiences about the Sewage Lagoon slash burn that occurred November 15 – 19, 2004.

Creating Defensible Space Around Structures

History has shown the devastating effects when wildland fire combines with a buildup of vegetation around structures. Hazardous fuels around structures in the developed and backcountry areas of Denali National Park and Preserve have or are being reduced to create a "defensible space" around the structures. Much of the built environment in Denali was constructed during the 1920s and 1930s. Structures were often built close to the forest edge or the forest has since grown back into the areas disturbed during construction.

Creating a defensible space includes clearing all flammable vegetation within 30', and thinning the vegetation that lies within 30' to 100' of the structure (cutting some trees, other

vegetation; removing lower branches of trees). The defensible space reduces the risk of property damage in the event of a wildland fire and improves safety for visitors, residents, and firefighters. Once all the defensible spaces have been created, a maintenance and educational program will continue the benefits of this program.

- **Developed areas**. In fall of 2004, defensible space totaling approximately 30 acres was created in Denali developed areas (Wilderness Access Center, new Visitor Center Water Supply, C-Camp, C-Camp and Headquarters Water supply control facilities, Headquarters Historical District and the Headquarters Residential Areas). The contract for mechanical reduction (cutting trees or limbing lower branches) was set up with Ancor Inc. The Headquarters Historical District was treated for hazard fuels within a historical cultural landscape context. Care was taken to trim branches to varying heights from the ground so the appearance was more natural. The biomass (logs, branches, etc.) generated from thinning and limbing was delivered to Usibelli Coal Mine in Healy to be utilized as reclamation material. The front country area to be treated in 2005 includes the Toklat Work Center.

- **Cultural resource sites**. In 2004 the Lower East Fork Cabin and much of the Stampede Mine were treated with FIREWISE treatments. Of the sites to be cleared in 2005, the ones most visible from the park road are those near the Toklat Patrol Cabin, the Pearson Cabin, and the East Fork Research and Patrol Cabins.

In 2005 the Fire Management Staff will revisit 24 of the 26 plots that were installed in 2003 as pre-treatment vegetation plots. The goal is to measure how the vegetation in the defensible space (treated areas) changes over time. Tracking the plots is intended to identify recurring maintenance treatments needed to minimize the threat of wildfire.

Throughout the hazard fuels project, Denali employees received information through bulletin boards, web sites, emails, and brochures about the fire history of the area, wildland fire risk to this area, Firewise concepts and updates about the project, including a presentation on "Why Are We Doing This Project?" Two Hazard Fuel Project Success Stories are posted at www.nps.gov/fire

Utilizing Satellite Imagery to Estimate Burn Severity

To more efficiently and safely monitor the severity and associated effects of wildland fire on the vegetation within Denali National Park and Preserve, an exciting new technology that utilizes satellite imagery is being developed. If it proves to be accurate, precise, and reliable, this technology will substantially increase firefighter safety by reducing the amount of time spent in aircraft flying over fires to collect data about fire severity.

Fire specialists have compared pre- and post-fire Landsat (satellite) imagery to develop this new index of burn severity called the Normalized Burn Ratio (NBR). This continuous index relies on the fact that vegetation reflects light in different ways if it is unburned or burned to various degrees. [For any satellite image "techies", NBR is calculated in a manner similar to the Normalized Difference Vegetation Index (NDVI), but uses Landsat bands 4 and 7 (not 3 and 4 as NDVI does).]

To be confident that the NBR system works for Denali or elsewhere, the satellite image NBR index has to agree consistently with ground observations. The NBR method has been applied to Landsat imagery for Denali and other Western Area parks to produce GIS maps showing the mosaic of fire effects (NBR index).

Fire Management staff did not install any plots in Denali during 2004 and will not install any plots in 2005. If fires greater than 300 acres occur in 2005, plots could be installed in 2006.

Videography Landcover Reclassification and Moose Browse Utilization

The current landscape level fuels map for Denali is based on LANDSAT imagery compiled from scenes over a period of years. The analysis and imagery used to develop the landcover classes used in the fuels map development is unable to detect vegetation on historical fires for up to 15 years. For lack of a more accurate landcover classification the areas that have burned in the last 3 to 15 years are classified as "burn". Though the classification of "burn" is accurate the classification does not differentiate between what year(s) the areas were burned or give any indication of what vegetation has recovered/colonized the site.

Approximately 12.9% of the park, which is prone to natural ignitions, is classified as "burn" or has burned since the Landcover Classification map. In the short term, these "burn" areas need to be reclassified into another Landcover classification other than "burn" for fuel model maps so fire behavior predictions can be made with some confidence by fire managers. In the long term, coupled with evidence from ongoing and historical fire successional studies, successional models need to be developed on a landscape scale and applied to fuels model map products.

Post-fire plant succession of an area depends on fire severity, climate, surviving flora and seed sources, proximity to early successional colonizing seed sources, and substrate (rock, soil). Fire severity is the degree of ecological change (setback) to an area due to the presence of fire. In general, the greater the fire severity, the further the plant succession is reduced to it earlier stages, hence the longer it will take for the area to return to its pre-fire condition. In a forested or shrub dominated area, like much of the natural fire-prone portion of Denali, if the area has burned under sufficient fire severity to encourage shrub development, browsing by moose (moose browse utilization) may increase. Extremely high fire severity may delay the onset of the shrub stage of successional development; extremely low fire severity may induce little change in the species composition and

structure of an area. Moose play a major role in the dynamics of boreal forest ecosystems and are an important resource for subsistence users. Fire is a major disturbance of boreal forests in Denali and interior Alaska, but how the age and fire severity of fires affects the density and distribution of moose on a landscape scale is poorly understood.

The purposes of this pilot study are to reclassify the "burn" portions of the Landcover Classification, test the use of videography as a method for landcover reclassification, validate predictive fire models used by fire managers, validate successional patterns compared to burn severity, and identify fire effects on the level of moose browse observed under varying burn severity levels and age of burn. Understanding the natural variability related to fire is necessary in order to identify potential abnormal effects associated with long-term climate change or management activities.

In the fall of 2004, two approximate 100-km transects were flown with videography equipment over the northwestern (most fire-prone) portion of the park. The two transects cross "burn" areas ranging from 3 to 50 years old and with maps of burn severity dating back to 2000. This product includes an unbroken line of high resolution video with time/date and latitude/longitude stamped imagery.

In 2005 field crews will ground truth areas along the two transects (up to 40 plots) to record information about the degree of browsing by moose (low, moderate, high). Data from this portion of the study will (1) provide ground-verified data to reclassify the "burn" landcover classification to a vegetated class, and (2) establish baseline information on the extent of shrubs (browse) utilized by moose for areas where fire age and satellite-derived (Normalized Burn Ratio) burn severity are known.

Fire Education

- **Denali Digital Storytelling Camp.** In June 2004, a group of students were equipped with digital cameras, PDA's, and other electronic gadgets to be able to tell the ecological story of fire at the site of the Horseshoe Lake fire of 2002. As part of the first ever Denali Digital Storytelling Camp, students learned about fire and fire ecology and measured forest plots in a recent burn. NPS fire staff at Denali demonstrated field techniques to measure fire effects and succession.

- **Firewise Workshops.** Firewise is a multi-agency effort designed to reach beyond the fire service by involving homeowners, community leaders, planners, developers, and others in the effort to protect people and property from the risk of wildland fire—before a fire starts.

  The Alaska NPS Fire Management staff teamed up with the Chugachmuit and Matanuska-Susitna Borough Department of Emergency Services to co-present a Firewise workshop at the Susitna Valley High School on April 23. The Fire Management staff and the Division of Forestry presented a Firewise workshop at the Murie Science and Learning Center on April 30. These interactive workshops

have been newly created for local communities adjacent to the park. Participants learn about local fire history, wildland fire and fire management in Alaska, homeowner protection, wildland fire prevention in wildland/urban, rural or remote areas, and where homeowners can seek out further assistance. At the conclusion of the program, participants have the knowledge to become Firewise.

Wildlife

Keep Wildlife Wild

In 2005, for the fourth year, Denali National Park and Preserve resource staff will educate people with the basic message: "Keep wildlife wild - do not approach or feed wildlife". Though no hard data have been collected, anecdotal observations indicate that the program has been successful. Fewer reports of human-wildlife conflict due to food conditioning have been reported each year the program has been in effect. The program includes bookmarks, buttons, brochures, and signs bearing a universal symbol "Do not feed the animals" with text explaining why this is important. In 2005, staff will continue to distribute more of these materials around the park. Signs appear on trash cans, picnic tables, and toilet stall doors.

The message has also become part of every interpretive program. The "Keep Wildlife Wild" program serves as a model for other parks. We ask that everyone working at the park take every opportunity to discourage the feeding and subsequent habituation of wildlife.

Bears

- **Grizzly bear monitoring:** This long-term study on the north side of the Alaska Range focuses on a sample of grizzly bears between the Muldrow Glacier and the Herron River. Marked females are tracked to determine production and survival of cubs.

  Bear capture was conducted on 26 May 2004. Due to bad weather, not all planned work was completed. Captures were conducted from the helicopter without fixed wing support. Four female grizzly bears were captured to replace collars and one new female grizzly bear was collared. One dropped collar was retrieved. We were not able to catch three other females that were due for collar replacement nor were we able to investigate 3 mortality signals which are either mortalities or dropped collars.

  At den emergence, 4 sows had a total of 8 two year olds, one had a litter of 2 yearlings, and 7 sows had a total of 15 spring cubs. One-quarter of the followed two year olds

had died (mortality was 0.25), and no yearlings died. Mortality of spring cubs was 0.67, similar to the mean mortality of 0.70 for the study. There were no 3 year olds in the sample at this time due to a cub recruitment failure in 2001.

The number of collared bears followed in the study is now 17, all female. This decrease is due to mortalities, dropped collars, and possible collar failures. Of the 17 collared bears, the oldest is 33 years old and the oldest breeding female is 26 years old.

Plans for 2005 are to replace radio collars where necessary, increase the sample size by collaring some new bears or locating those with failed collars, and investigate mortalities/dropped collars.

✧ **Population estimates:** On the south side of the Alaska Range, the park is cooperating with the Alaska Department of Fish and Game to estimate population numbers for both black and grizzly bears. 2003 was the third field season of this three-year study.

A final report on this study has not yet been received; preliminary results indicate that for the entire study area, the density for brown bears is approximately 28 bears/ 1000 km^2. This density is slightly higher than that documented on the north side.

Density for black bears is predicted to be about 80 bears/ 1000 km^2.

Bear Management

Bear problems at Denali escalated in the 1970's and 1980's. By 1982, Denali had the highest rate of backcountry bear incidents of any U.S. national park with a significant grizzly population and high backcountry use. Bears were getting food from backpackers and poorly-handled garbage, causing property damage, and injuring people. Between 1946 and 1983, 48 bears were relocated or destroyed in the park. Denali's Bear Management Plan (BMP) was developed to address bear problems and reduce bear-human conflicts.

By educating staff and visitors about bears and providing bear-resistant storage for food and trash, the park has dramatically reduced conflicts with bears and other wildlife. In 1984, Bear Resistant Food Containers became mandatory for backcountry users. By 1985, incidents with bears in the backcountry had dropped nearly 90%. The last problem with a food-conditioned bear in one of the Denali campgrounds was in 1994. Since 1983, only four bears have been destroyed, one sent to a wildlife park, and two relocated by the National Park Service.

The success of the Bear Management Plan is largely dependent on the cooperation of all NPS employees. Within the BMP, it states that all employees are responsible for reporting or correcting possible bear problems as they develop. Supervisors and liaisons are responsible for ensuring that their staff or crews get bear safety training and are aware of Denali's policy regarding bears and other wildlife. To get further information or to schedule bear training, contact Pat Owen (Wildlife Biologist) at 683-9547. Information and some equipment can also be provided for bear-proofing camps and worksites.

Between May 19 and September 21, 2004, 283 bear-human interactions were documented. These were classified as 230 encounters, 37 incidents and 16 observations. Incidents, defined in Table 2, included 9 cases of property damage, 2 reported injuries that were mild, 15 close charges and 11 general incidents. There were 236 interactions in the backcountry and 31 in the front country. Twenty eight of the incidents were in the back country and 9 were in the front country. There were 50 more bear-human interactions reported in 2004 than in 2003 (233) even though the backcountry desk, where reports are received, was open fewer hours.

Table 2. Number of bear-human interactions* and location in 2004, Denali National Park and Preserve.

	Frontcountry	Backcountry	TOTAL
Encounters	22	208	230
Incidents (General)	9	28	37
TOTAL	**31**	**236**	**267**

*Note: An interaction is classified as either an encounter or an incident.

Encounter-- any time an animal is aware of a human's presence and therefore the animal's behavior is altered because of the human.
Incident--when an animal is involved in near (close charge) or actual contact, or causes damage to persons or property.

Back-country incidents involved close charges, bears invading campsites while people were present, bears investigating Bear Resistant Food Containers (BRFC's) and cooking gear, and two personal contacts. The personal contact incidents took place in separate locations more than one week apart but were very similar in nature. Each involved a solo hiker surprising a sow with cubs. In each incident the hiker dropped to the ground while the sow was still some distance away at which point the sow contacted the individual and inflicted scratches on the forearm. Front-country incidents included bluff charges, getting into a pack, damage to a vehicle, and damage to tents.

Aerial Moose Survey

To estimate the number of moose (Alces alces) in a 10,004 km² (3862 mi²) area on the north side of the Alaska Range mountains, an aerial survey was conducted November 15 - 27, 2004. Snow conditions were good for viewing moose throughout the survey area. The survey area is bounded by the park boundary on the east and north, and the north slopes of the Alaska Range Mountains on the south (Figure 3). To the west the area is bounded by the park boundary and a line running roughly from the confluence of the Herron and Foraker Rivers southeast to the Birch Creek Hills. This project is part of the Central Alaska Network (CAKN) monitoring program at Denali National Park and Preserve and follows program protocols.

We surveyed 38% of the study area (covering 240 units). Of the units surveyed, 123 were high moose density units and 117 were low moose density units. (Sample units were stratified as either high or low moose density based on past survey results and known habitat characteristics.)

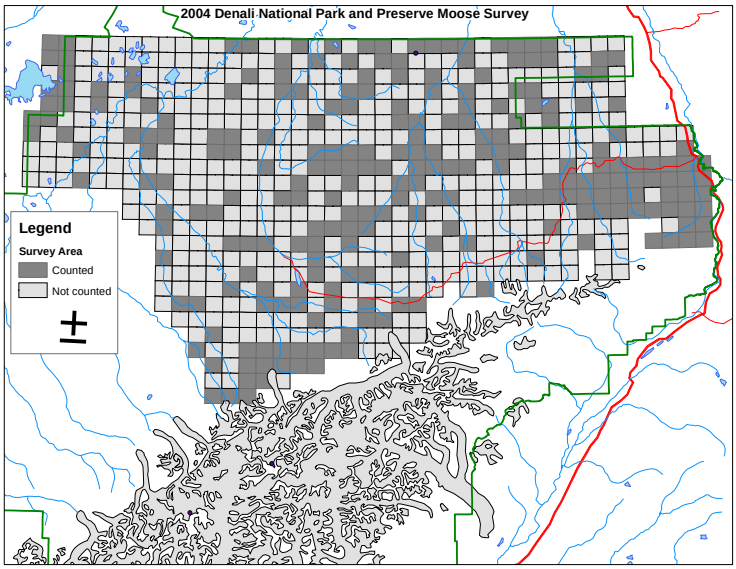


Figure 3. Denali National Park and Preserve Moose Survey units (2004).

We observed 592 moose during the survey and estimated 1104 ± 219 moose for the entire survey area (Table 3). Overall estimated moose density was 0.11/km² (0.29 moose/mi²), while the observed density was 0.21/km² (0.55 moose/mi²) in high density units and 0.02/km² (0.05 moose/mi²) in low density units. Since 1986, estimates for density of moose in this same area have ranged from 0.12 to 0.24 moose/ km². Thus, overall estimates for moose from the fall of 2004 (0.11 moose/km²) are lower than in any other previously estimated year (Table 3).

The calf:bull:cow ratio was 39:88:100. Calves, bulls, and cows represented 17%, 39%, and 44% of the estimated population, respectively. We estimated that 69% of cows were without calves, 27% of cows had 1 calf, and 6% of cows had 2 calves with them. The

calf:cow ratio and bull:cow ratio in this survey were higher than those reported from past surveys (i.e., fewer cows compared to either calves or bulls, see Table 3).

Summarizing results of two subunits (East and Kantishna South) separately from the entire survey provides additional information specific to these areas of special concern to managers. Results were compared to past surveys. The East subunit (354 square miles) is east of the Teklanika River roughly between the Outer Range and the Alaska Range. The Kantishna South subunit (668 square miles) includes the bulk of the Kantishna Hills and is bounded by the Toklat River, Stony Creek, the McKinley River Bar, and Glacier Creek.

Estimated moose density for the East subunit was 0.26 moose/ km^2 (0.66 moose/mi^2) and for the Kantishna South subunit were 0.08 moose/ km^2 (0.20 moose/mi^2). Moose numbers have declined significantly in the Kantishna South subunit. An unusually high bull:cow ratio in Kantishna South suggests that moose numbers were influenced by breeding-season aggregation and differential migration of bulls and cows.

Table 3. Population estimates from moose surveys, North side, Denali National Park and Preserve, 1986-2004.

Year	Calves/ 100 cows[a]	Bulls/ 100 cows	Estimated population	Density Estimate (moose/ km^2)	Source
1986	23	75	1,650 ± 347	0.19	Meier (1987)
1991	23	81	1,564 ± 123	0.22	Meier et al. (1991)
1996	30	56	2,000 ± 402	0.13	Fox (1997)
1997	22	63	1,630 ± 204	0.23	Belant and Stahlnecker (1997)
1999	22	69	1,866 ± 244	0.24	Belant et al. (1999)
2004	39	88	1,104 ± 219	0.11	This study

Road Wildlife Study

This study relies on those bus drivers who volunteer to help monitor wildlife along the park road and will continue in 2005 . Drivers record the numbers of bears, moose, sheep, caribou, and wolves they see on their trips (westbound only). These numbers are summarized and compared to previous years to detect substantial changes. So far, differences in numbers from year-to-year are within the range expected due to natural variation.

Though data have not been analyzed for the past few years this project is considered worthwhile and will continue. It will become part of a much larger road/wildlife study due to begin in full in 2006. A biologist will be hired this season to work on the preliminary stages of that project. One of the duties assigned to this person will be the analysis of past data collected by bus drivers.

Until more analyses are available, here are the past summaries once again: Based on the groups and individuals observed per bus trip in 1999, 2000, and 2001, a visitor taking one bus trip into the park could expect (based only on averages) to see 15 caribou (in 3-4 groups), 3 or 4 grizzlies, 18-19 Dall sheep (in 1 or 2 groups). A visitor taking 10 trips into the park would be expected to see a moose on 8 out of 10 trips, and a wolf on 2 out of 10 trips. In other words, the odds of seeing the big mammals are: Caribou (very close to 100%), Grizzly bear (very close to 100%), Dall sheep (very close to 100%), moose (80%), and wolf (20%).

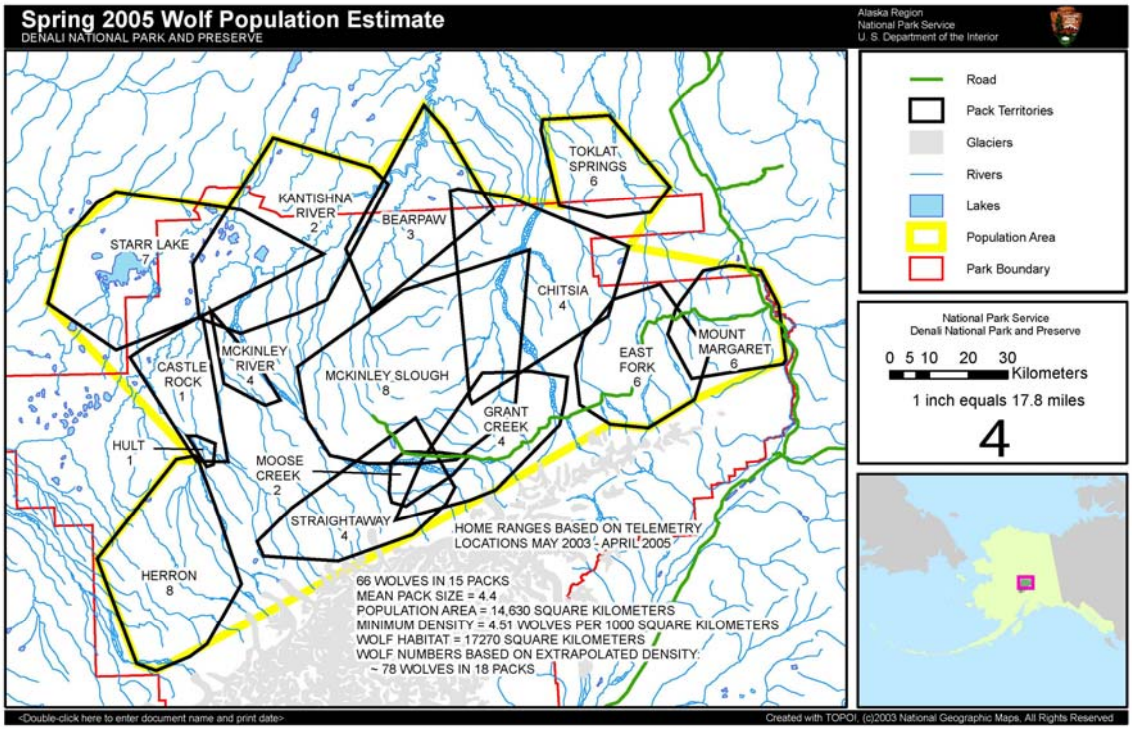
Wolves

Denali National Park and Preserve's wolves have been studied by researchers since 1939. Population estimates were not very accurate until 1986 when a large-scale wolf research project was initiated by David Mech and others. This project provided basic information necessary for effective wolf management. While the intensive research program was concluded in 1993, research and monitoring efforts have continued.

The current study consists of maintaining 2-3 radio-collared wolves in each known pack inhabiting the park north of the Alaska Range. Radio collared wolves are located every 2 weeks, with additional locations during late September-early October to determine fall pack sizes and to count pups, and locations during mid-March to determine late winter pack sizes.

Telemetry locations acquired over two biological years (a biological year runs May 1 – April 30) are used to determine the area of each pack territory. Areas of the combined pack territories and pack counts are used to estimate abundance and density of wolves. In addition, monitoring data have been used to determine wolf movements, mortality factors, behavior, and population dynamics.

In October 2002, John Burch of Yukon-Charley Rivers National Preserve/Gates of the Arctic National Park began monitoring the wolves in Denali when Layne Adams of the U.S. Geological Service, Alaska Biological Sciences Center was no longer able to continue the wolf studies. Starting in April 2004, new Denali wildlife biologist Tom Meier assumed the project. Layne Adams has continued to work on the caribou portion of the predator-prey project.



In March 2005, approximately 66 wolves in 15 packs inhabited Denali north of the Alaska Range. This is a slight decrease from the 2004 estimate of about 78 wolves in 15 packs. The actual number of wolves in the park can never be precisely determined, as packs move in and out of the park and vary in size as wolves come and go from them. The winter of 2004-2005 was more severe than other recent winters, which should have made it easier for wolves to get food. We expect an increase in the wolf population in 2005.

Small Mammal Inventory

At this time all 25 species of *small* mammals expected to occur in Denali have been documented (observed in the park and specimens collected) (Table 3). One goal of the Central Alaska Network inventory of parks is to document as high a percentage of expected species as possible (it is now 100% for Denali's small mammals). The inventory of small mammals at Denali was completed in 2002 by a field crew from the Idaho State University, in cooperation with the University of Alaska Museum. The inventory was part of the Central Alaska Network's efforts to inventory and monitor park resources. Researchers discovered two mammals not previously documented at Denali: the tiny shrew *Sorex yukonicus* and the meadow jumping *Zapus hudsonicus*. The inveotyr also collected study specimens for 16 other species of small mammals (voles, shrews, hares,

mice, squirrels, and pika). By far, Denali's three most common species (based on collections) are northern red-backed voles, tundra voles, and the cinereus shrews.

Table 4. Checklist of the small mammals of Denali National Park and Preserve, Alaska. All species listed have been substantiated with a vouchered specimen.

INSECTIVORA - Shrews

Family **Soricidae**
- *Sorex cinereus*, cinereus shrew
- *S. hoyi*, pygmy shrew
- *S. monticolus*, montane shrew
- *S. palustris*, water shrew
- *S. tundrensis*, tundra shrew
- ** *S. yukonicus*, tiny shrew

CHIROPTERA - Bats

Family **Vespertilionidae**
- *Myotis lucifugus*, little brown bat

CARNIVORA - Carnivores

Family **Mustelidae**
- *Mustela erminea*, ermine
- *M. nivalis*, least weasel

RODENTIA - Rodents

Family **Sciuridae**
- ** *Glaucomys sabrinus*, northern flying squirrel
- ** *Marmota caligata*, hoary marmot
- *Spermophilus parryii*, arctic ground squirrel
- *Tamiasciurus hudsonicus*, red squirrel

Family **Dipodidae**
- ** *Zapus hudsonius*, meadow jumping mouse

Family **Muridae**
- *Clethrionomys rutilus*, northern red-backed vole
- *Lemmus trimucronatus*, brown lemming
- *Microtus miurus*, singing vole
- *M. oeconomus*, tundra vole
- *M. pennsylvanicus*, meadow vole
- *M. xanthognathus*, taiga vole
- *Ondatra zibethicus*, muskrat
- *Synaptomys borealis*, northern bog lemming

Family **Erethizontidae**
- *Erethizon dorsatum*, North American porcupine

LAGOMORPHA - Pikas & Hares

Family **Ochotonidae**
- *Ochotona collaris*, collared pika

Family **Leporidae**
- *Lepus americanus*, snowshoe hare

Small Mammal Monitoring

Scientists from the Institute of Arctic Biology, University of Alaska, Fairbanks, continue to study population dynamics of small mammals (mice, voles, and shrews) in Denali National Park and Preserve. In 2004, Dr. Eric Rexstad and Ed Debevec of the Institute of Arctic Biology, University of Alaska, Fairbanks, along with a crew of hardy biological technicians, sampled the Rock Creek minigrid and collected the 13th year of data in the Rock Creek watershed (legacy plots), in order to study variation in numbers of small mammals within a year and from year-to-year during the snow-free period of "summer".

A new trapping configuration, chevrons, was used to perform the spatially extensive sampling. A chevron consists of 40 traps placed in an L-shaped configuration. Traps around the perimeter of the plot were placed 10 m apart making the legs of the plot 20 m wide and 100 m long. This design was created to facilitate the task of checking traps by a two-person crew.

A remarkably low number of red-backed voles were captured, leading to some of the lowest population estimates in the 13 years of this project and a very low conformance index for this species (a 1 in a 100 year event). Conformance reflects how aberrant the population estimates from the current year are when compared with estimates from past years. A small conformance indicates that the current estimate is different (either high or low) compared to other years.

The 2004 field season was remarkable for its lack of precipitation, resulting in very parched conditions. Despite winter and spring conditions favorable to large fall populations of small mammals, these populations failed to materialize. Thus, summer meteorological factors (at least those as extreme as witnessed in 2004) also exert influence upon fall populations of small mammals. Anecdotally, we observed larger than normal abundances of singing voles on our legacy plots, possibly because this high-elevation animal was displaced to lower elevations in search of free water.

To learn more about this project, visit the web site:
http://mercury.bio.uaf.edu/~eric_rexstad/denali04/annual2004.pdf

Birds

Wildlife biologists are conducting short-term and long-term studies focusing on different ecological aspects of bird life in Denali National Park and Preserve. Several projects are aimed at protecting avian resources (birds, bird habitat, and prey sources) in and outside of Denali. Other projects such as the Breeding Bird Survey provide information for national monitoring programs. There are also several Citizen Science projects focusing on birds in the local area. For more information about Denali birds, check out the article "Birds, Bird Studies, and Bird Conservation in Denali National Park and Preserve" in the Fall/Winter 2002 issue of *Arctic Research of the United States* published by the Interagency Arctic Research Policy Committee or visit the website
http://www.nps.gov/dena/home/resources/wildlife/birdweb/index/homebirdpage.htm

- **Assessing the spatial and temporal variation in passerines (songbirds)**: The objective of this project is to assess changes in songbird populations at Denali in both space and time. A primary objective of the passerine monitoring is to assess how bird communities (composition, distribution, and abundance) respond to changes in landscape structure and vegetation. Therefore, the passerine monitoring program uses the same spatial sampling design as the vegetation monitoring program in Denali. Carl Roland (NPS), Karen Oakley (USGS) and Trent MacDonald (Western Ecosystems Technology (WEST) developed this probabilistic sampling design,

commonly referred to as the minigrid design, in 2000. Each 2.5 km x 2.5 km minigrid includes 25 sampling points located 500-m apart. By co-locating our sampling points with those sampled by the vegetation crew, we eliminated the need for the bird crew to collect data on vegetation and/or habitat and generated an integrated data set containing measurements of vegetation and passerine birds across the landscape in Denali.

We sample for birds at each minigrid point using a 10-minute point-transect with data grouped by distance interval. All birds seen or heard at each plot are recorded during a 10-minute sampling period. Detections of birds are separated into four time segments: 0-3 minutes, 3-5 minutes, 5-8 minutes, and 8-10 minutes. All birds detected within 150-m of the observer are recorded at 10-m intervals up to 100 m, then at 25 m intervals to 150-m.

In 2004, we conducted surveys for passerine birds on four minigrids in Denali. We sampled all points on the Teklanika and Savage minigrids one time in June and all sample points on two minigrids, Rock Creek and Primrose Ridge, three times (early, mid-, and late) during June to assess within-season variation of count results across an elevation gradient. Experienced bird surveyors, who completed a two-week distance sampling training course before the field season, conducted the surveys. We conducted all surveys between 0300 and 0930 daily from June 1 to June 28, 2004.

Similar to our results in the past four years, we detected 19 to 25 species per grid and passerine birds were the most common group of birds detected on the counts. We detected most birds (• 70%) in the first five minutes of the count and detected most birds (• 80%) by their calls or songs. Our preliminary results from the multiple sampling events on the Rock Creek and Primrose Ridge minigrids in June 2004 suggest that we should conduct future surveys in alpine areas before June 15; the number of species and number of individual birds detected on points at higher elevation on both grids decreased after June 15.

Highlights of the 2004 season included many observations of White-winged Crossbills on the middle Teklanika minigrid that is dominated by large white spruce, the first documentation of a Baird's Sandpiper nest in over 40 years in Denali on the Primrose Ridge minigrid, and many observations of Surfbirds on the Primrose Ridge minigrid.

We are awaiting the results of a formal peer-review of our monitoring plan and standard operating procedures. In 2005, we plan to sample eight to 12 minigrids, with most sampling focused on minigrids within 5 km of the Denali park road and in the wetlands in the northwest region of Denali. In autumn 2005, we plan to generate a report summarizing our findings from 2002-2005.

✧ **Breeding Bird Survey (BBS):** The North American Breeding Bird Survey (BBS) is a large-scale survey of North American birds. Denali has two of the approximately 3,700 active BBS routes across the continental U.S. and Canada (about 2,900 are

surveyed annually). The BBS has accumulated over 30 years of data on the abundance, distribution, and population trends of more than 400 species. These data can reveal whether major population changes of a species in certain states are related to a continental decline or merely represent population shifts within their breeding range. We conduct two standardized Breeding Bird Survey (BBS) routes in Denali. Both routes are located along the Denali Park Road.

The Savage BBS route was completed on June 16, 2004. The surveyed started at the west end of Savage River bridge at 0301 and ended near Sable Pass at 0815. All 50 points were surveyed in 2004. The starting temperature was 12° C and the ending temperature was 16° C. The wind at ground level ranged from a slight breeze to intermittent gusts > 15 mph. This was the second year that Blackpoll Warblers were detected on the Savage BBS route and the first year that Semipalmated Plover and Belted Kingfisher were detected on the route. The Belted Kingfisher was detected by its call and one week later, the nest was discovered along the Teklankia River within 0.25 miles of the BBS point where it was first detected.

The Savage BBS route has been surveyed 16 times since 1986, and every year since 1993. Of the 53 species detected on the Savage BBS route in at least one year, less than half (22) were detected in 50% of the survey years (8 or more years). Eight species were detected every year including Black-billed Magpie, American Robin, Orange-crowned Warbler, Wilson's Warbler, American Tree Sparrow, Savannah Sparrow, White-crowned Sparrow, and Common Redpoll. Of these species, White-crowned Sparrow, American Tree Sparrow, and Wilson's Warblers are the most abundant, averaging more than 40 individuals per survey year. Fourteen species were detected in 8 to 15 of the survey years (number of years are in parenthesis) including Willow Ptarmigan (15), Mew Gull (15), Gray Jay (15), Boreal Chickadee (15), Arctic Warbler (15), Swainsons Thrush (15), Varied Thrush (15), Fox Sparrow (15), Dark-eyed Junco (15), Hermit Thrush (11), Myrtle Warbler (11), Ruby-crowned Kinglet (9), Harlequin Duck (8), and Golden-crowned Sparrow (8).

The Toklat BBS route was completed on 17 June 2004. The survey started in front of the Toklat Ranger Station at 0322 and ended at 0924. All 50 points were surveyed in 2004. The starting temperature was 9° C and the ending temperature was 12° C. The wind at ground level ranged from a slight breeze to intermittent gusts > 15 mph. This was the first year that Upland Sandpiper, Barn Swallow, and Townsend's Solitaire were detected on the Toklat BBS route. The Barn Swallow was observed flying over beaver ponds just west of Grassy Pass (Mile 70, Denali Park road).

The Toklat BBS route was been surveyed 16 times since 1982 and every year since 1993. Of the 69 species detected on the Toklat BBS route in at least one year since 1993, less than half (25) were detected in 50% of the survey years (6 or more years). Ten species were detected every year including Alder Flycatcher, American Robin, Orange-crowned Warbler, Wilson's Warbler, American Tree Sparrow, Savannah Sparrow, Fox Sparrow, White-crowned Sparrow, Golden-crowned Sparrow, and Common

Redpoll, . Of these species, White-crowned Sparrow, American Tree Sparrow, Savannah Sparrow, and Wilson's Warblers were the most abundant, averaging more than 40 individuals per survey year.

Results from the Denali BBS routes are available at:
http://www.mbr-pwrc.usgs.gov/bbs.

- **Developing indices of trends in willow ptarmigan (and snowshoe hare):** Indices of population size of snowshoe hare and willow ptarmigan on a broad scale are obtained by recording the number of each species observed during routine field activities. These data allow the tracking of changes in the abundance of both species over time. The abundance of snowshoe hare and willow ptarmigan was higher in 2004 than in the past three years. Populations of both species are expected to increase in the next couple of years as they enter the increasing stage of their 8-11 year population cycles.

- **Reproductive success of Golden Eagles and Gyrfalcons:** This was the 17th consecutive year for conducting standardized aerial surveys to determine occupancy of nesting territories and document reproductive activities and nesting success for Golden Eagles and Gyrfalcons in Denali. Both species are of conservation concern — Golden Eagles because of habitat changes and persecution on their lower 48 wintering grounds, and Gyrfalcons because Alaska is the only place they breed in the United States—and this study provides critical information for their conservation. Denali contains the highest reported nesting density of Golden Eagles in North America and our monitoring program and associated research projects have made significant contributions to Golden Eagle ecology in North America.

  The occupancy and breeding activity survey was conducted from April 28 through May 2, 2004. This survey is conducted after most pairs complete their clutches but before most nest failures to determine occupancy and breeding activities. The productivity survey was completed July 20, 2004. The productivity survey is conducted late in the nestling period to determine nesting success and productivity. All the surveys were conducted from a Robinson R-44 helicopter.

  We surveyed 82 known Golden Eagle nesting territories during the occupancy survey. We documented 71 territorial pairs, resulting in an occupancy rate of 87%. The number of pairs breeding and successfully raising fledglings was lower than most years. We documented 30 of the 71 territorial pairs as breeding pairs (42%) and determined that 17 of the 30 breeding pairs (57%) successfully raised at least one fledgling. The 17 successful pairs produced 19 fledglings. Overall productivity, measured as the number of fledglings per territorial pair, was 0.27 and mean brood size was 1.12.

  We surveyed 13 known Gyrfalcon nesting territories and found a new Gyrfalcon nesting territory during the occupancy survey. The occupancy of nesting territories

was lower than most years; we documented 9 territorial pairs resulting in an occupancy rate of 64%. We could not estimate the number of breeding pairs with eggs because we could not find the nest sites of two territorial Gyrfalcons. The number of successful pairs and productivity was lower than most years. We determined that 4 of the 9 territorial pairs (44%) successfully raised at least one fledgling. The 4 successful pairs produced 8 fledglings; overall productivity was 0.89 and mean brood size was 2.00.

The nesting phenology of Golden Eagles and Gyrfalcons was similar to other years. Most clutches were completed by mid-April, most hatching occurred by early June, and most fledglings left their nests by early August.

2004 Highlights: Gyrfalcons once again successfully nested on the east side of Marmot Rock, about 100 meters from the Denali Park road. Tens of thousands of park visitors had a chance to observe both adult Gyrfalcons throughout the summer and the fledgling Gyrfalcons from late July through August. To the best of our knowledge, this appears to be one of the most visible Gyrfalcon nesting territories in Alaska and provides park visitors with truly unique opportunities to observe the world's largest falcon during the nesting season. Gyrfalcons and Golden Eagles often nest on Marmot Rock. The temporary wildlife closure that is established in late May and maintained throughout the nesting season on Marmot Rock and around the valley and ridge immediately to the east of Marmot Rock appears to minimize disturbances by keeping park visitors from approaching too close to the nest.

Proposed activities for 2005 include (1) continuation of Golden Eagle and Gyrfalcon monitoring in the historic study area in Denali, (2) continuation of genetic studies of golden eagles in Denali, and (3) continued public education and outreach efforts.

- **Examining fidelity of Golden Eagles to nesting areas**: Results from our genetic study on Golden Eagles conducted in conjunction with the USGS-Alaska Science Center Wildlife Genetics Laboratory show that we can identify individual eagles using DNA collected in their shed feathers. This is a non-invasive, cost-effective method for obtaining data to assess the population trends of breeding eagles in Denali. We will continue to collect shed feathers from nesting territories to determine if we can assess fidelity to nesting areas. Feather collections for this research are conducted under the auspices of a U.S. Fish and Wildlife Service Eagle Scientific Collecting Permit and a State of Alaska Scientific Permit. After the DNA material is removed from the feather shafts, all feathers are transferred to the National Eagle Repository in Colorado.

- **Monitoring Trumpeter Swan populations:** The U.S. Fish and Wildlife Service (FWS) will conduct their five-year statewide Trumpeter Swan surveys in 2005. FWS personnel will used standardized aerial surveys from a fixed-wing aircraft to count the number of adult swans and cygnets from early to mid- August in the northwestern region of the Denali. Survey results from 2000 in this region indicate that well over 200 pairs of swans nest in the area.

- **Christmas Bird Count:** The National Audubon Society organizes the Christmas Bird Count (CBC) and each year more than 50,000 observers participate each year in this all-day census of early-winter bird populations. The results of their efforts are compiled into the longest running database in ornithology, representing over a century of unbroken data on trends of early-winter bird populations across the Americas. The primary objective of the Christmas Bird Count is to monitor the status and distribution of bird populations across the Western Hemisphere. The count period is from December 14th to January 5th. When data with Christmas Bird Counts and other surveys such as the Breeding Bird Survey are combined, scientists begin to see a clearer picture of how the continent's bird populations have changed in time and space over the past hundred years.

  Local naturalist Nan Eagleson organizes and compiles the results of the Denali CBC. Eleven species including Ruffed Grouse, Spruce Grouse, Willow Ptarmigan, Gray Jay, Gray Jay, Black-billed Magpie, Common Raven, Black-capped Chickadee, Boreal Chickadee, Pine Grosbeak, White-winged Crossbill, and Redpoll were observed on the 2004 Denali CBC.

  Between 1992 and 2004, participants tallied 26 species on the Denali CBC. The number of species tallied annually ranged from nine to 18. The eight species observed in most years included Spruce Grouse, Gray Jay, Black-billed Magpie, Common Raven, Black-capped and Boreal Chickadee, Pine Grosbeak, and Redpoll. The number of individual birds counted annually ranged from 71 to 935. During the years with the highest counts, Redpolls and White-winged Crossbills accounted for 64 to 76% of all birds detected on the Denali CBC. The counts of these two seed-eating finches were high only in years when viable seeds of White Spruce were abundant. Further, Golden Eagles were detected only in years when snowshoe hares were abundant. Not a surprising result given that some Golden Eagles may overwinter in years when snowshoe hare, one of their primary prey species, are abundant.

- **Denali Institute Migration Station:** The Denali Institute Migration Station (DIMS) is located near Moose Creek and is operated from early August to early September. The station is maintained on private land, owned by Denali National Park Wilderness Centers. The station was started in 1998 and has operated annually since then, generally from late July through early September. The station was established with two main goals: 1) learn about the migration and abundance of birds migrating through the Moose Creek valley in autumn, and 2) educating the general public about birds and bird conservation using banding demonstrations and evening lectures to the guests of Camp Denali, North Face Lodge, and other visitors. The station will operate in 2005; a full analysis of the eight-year data set and a peer-review of the DIMS will follow in autumn 2005 and winter 2006.

  In 2004, DIMS was operated from July 30 to September 7. Ten standard mist nets (2.6 m x 12 m, 30-mm mesh) were opened daily for up to 7 hours, beginning at sunrise,

weather permitting. Nets were open on 37 days, with 3 days cancelled due to rain. Net locations along Moose Creek were consistent with those used for the last five seasons. All captured birds were banded with U.S. Fish and Wildlife Service aluminum leg bands and processed according the protocol established by the Alaska Bird Observatory (ABO). Data recorded for each captured bird included date and time of capture, net number, species, age, sex, amount of skull ossification, length of wing and tail, size of fat deposits, breeding condition (presence of brood patch or cloacal protuberance), molt condition, proportion of juvenal plumage, and mass.

In 2004, 1558 birds of 31 species were captured in 2633.4 net hours at DIMS. Wilson's Warbler was the most abundant species captured (30% of all individuals captured), followed by Ruby-crowned Kinglet (14%) and White-crowned Sparrow (13%). Nearly 80% of the captured birds were hatched in 2004. The busiest day for captures was the first day of operation, July 30, when 79 birds were captured in 67.5 net hours. The peak migratory movements occurred from August 20 to September 4. The slowest days for captures were August 18 and September 8, both with 21 captures during 70 net hours.

Wood Frog Surveys

The wood frog is the only amphibian that occurs (or is expected to occur) in Denali National Park and Preserve. Information on the presence and habitat associations of the wood frog continues to be collected concurrently with many of the ongoing bird and vegetation projects. In 2003, Dr. Grant Hokit, Carroll College, Helena, Montana, conducted pilot field work in the Wonder Lake area that indicated that further study was merited because wood frogs are relatively widespread across Denali and that populations are relatively dense across the landscape.

Early last summer (June 5 to June 30, 2004), Hokit and his crew conducted extensive surveys for wood frogs from Grassy Pass to the south end of Wonder Lake. They looked for frogs in all still-water sites inside randomly-located 1-km circular plots. By describing habitat information and recording where they found frogs, they learned what features are positively or negatively correlated with use by wood frogs. Of the 41 plots, 22 were within 5 km of the Wonder Lake Campground and 19 plots were within 2 km of the road between Wonder Lake and Grassy Pass. Researchers surveyed a total of 219 still-water sites within the 1-km sampling plots. Wood frogs were observed at 106 sites (48%), breeding activity (the presence of eggs and/or larvae) was observed at 98 sites (45%), and adults and/or juveniles were observed at 17 sites (8%).

A series of statistical analyses revealed that breeding activity occurred more frequently than expected at larger sites that were not isolated from other sites with: 1) maximum water depth between 1 to 2 meters, 2) no connection to moving water, 3) 51-75% of the site less than 50 cm deep, 4) 76-100% of the riparian zone covered with woody vegetation, 4) from one quarter to three-quarters (26 to 75%) of the site covered with emergent vegetation, 6) alder or spruce present in the riparian zone, and 7) no sign of beaver

activity. Sites with signs of beaver activity were negatively associated with breeding activity probably because they were generally deeper, with less emergent vegetation and less woody vegetation in the riparian zone, than other sites. No breeding activity was observed at bog sites dominated by sphagnum mats. Breeding activity of wood frogs was *not* associated with elevation or the distance of a site from contiguous boreal forest. In fact, the majority of the sites where wood frogs were present were in shrubby tundra more than 5 km from boreal forest.

Freshwater Fish Inventory

Freshwater fish inventories were conducted in 2003, but not in 2004, and none are planned for 2005. The only fish that was "expected" but not sampled in 2003 was the inconnu. This brings the total number of species documented in Denali to 14 (Table 5).

Table 5. Denali fish species list including the results of inventory sampling in 2003.

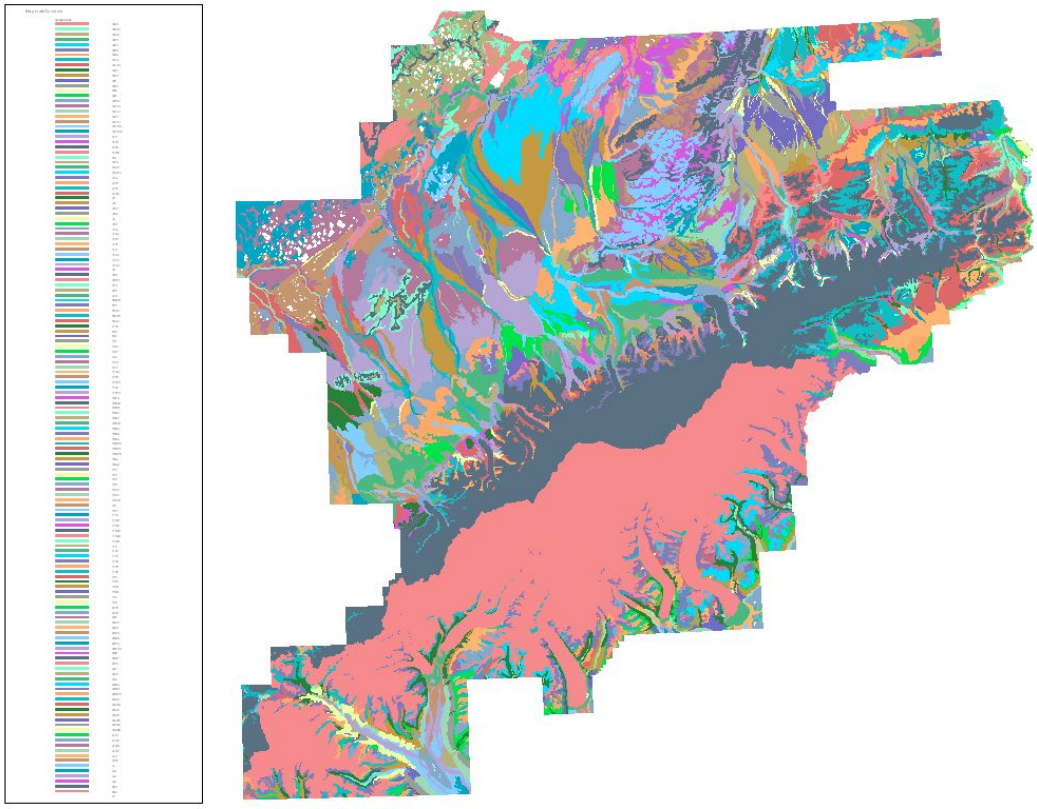
Species Category	Common Name	Scientific Name	Status *
Lampreys	Arctic lamprey	*Lampetra japonica*	2003
Pikes	northern pike	*Esox lucius*	E, 2003
Suckers	longnose sucker	*Catastomus catastomus*	E, 2003
Mudminnows	Alaska blackfish	*Dallia pectoralis*	2003
Whitefishes	inconnu	*Stenodus leucichthys*	E
Whitefishes	round whitefish	*Prosopium cylindraceum*	P
Whitefishes	humpback whitefish	*Coregonus pidschian*	2003
Trouts and Salmon	lake trout	*Salvelinus namaycush*	P
Trouts and Salmon	Dolly varden	*Salvelinus malma*	P
Trouts and Salmon	Chinook salmon	*Oncorhynchus tshawytscha*	P
Trouts and Salmon	chum salmon	*Oncorhynchus keta*	P
Trouts and Salmon	coho salmon	*Oncorhynchus kisutch*	P
Grayling	Arctic grayling	*Thymallus arcticus*	P
Codfishes	burbot	*Lota lota*	P
Sculpins	slimy sculpin	*Cottus cognatus*	P

* P - Present or previously documented
E - Expected but not previously documented
2003 - Newly Documented in 2003 E, 2003 – Expected and documented in 2003

◂ Physical Resources ▸

Soils Mapping

A soils map for Denali National Park and Preserve has been produced after researchers from the Natural Resource Conservation Service (NRCS) spent six years (1997-2002) interpreting air photos, digging soil pits, and collecting field data on soils and vegetation. In 2004, the NRCS researchers produced a final report, map, and a database from their six years of field work. Detailed maps of soil types, ecological subsections, potential natural vegetation, permafrost, soil and geomorphic processes, and landforms are available for the park at a 1:63,360 scale. This data set is the most comprehensive of its kind in Alaskan parks. One version of the Denali soils map can be found at http://www1.nature.nps.gov/im/units/cakn/Documents/DENA_SoilSubMap.pdf

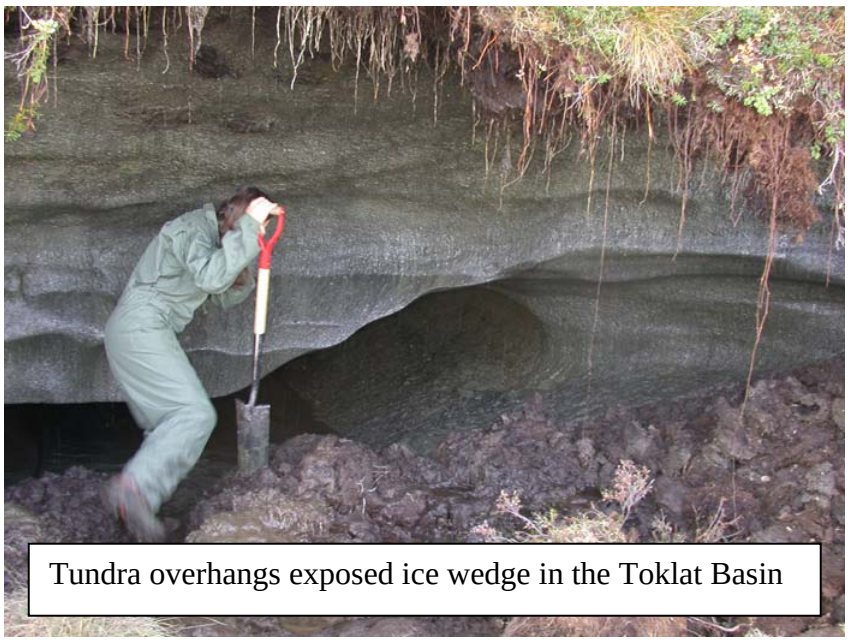


Toklat Basin Surficial Geology

These investigations are part of the larger project that is a proactive approach to protecting the Toklat Basin by documenting its special features. Hydrologic characterization of the Toklat Basin began in 2004 and will continue through 2005. Stream chemistry, geometry and flow, along with flood zone analysis and chemistry of the

Toklat Springs (a few miles north of the park boundary), will give us better insight to this region of the park.

Work during 2003 identified large areas of extensive permafrost that appear to be rather fragile (near 32°F). In 2004, surficial geology mapping in the Toklat Basin focused on glacial extents and permafrost delineations. Resource personnel used interpretations of air photos and satellite images, along with field investigations, to map the surficial geology including landforms, permafrost extent, and extents of past glaciations.



Tundra overhangs exposed ice wedge in the Toklat Basin

Using the Denali soils map, staff also identified different types of permafrost and classified each type in detail. There are significant areas of thermokarst development and formation of surface features in the Toklat Basin, a large alluvial basin that currently has very poor drainage. A regional change in the permafrost regime would significantly change the surface hydrology and the vegetation that is largely controlled by the shallow, moist soil conditions.

Permafrost Monitoring

As part of the Central Alaska Network program design process, two permafrost monitoring pilot projects are being conducted to understand the relation of permafrost trends to climate trends. Air and satellite photo interpretation will be used to identify the general rates and nature of landscape change due to permafrost changes in the park. A second quantitative study will complement the remote sensing effort. Annual measurements of borehole temperatures for, and detailed analysis of, a developing thermokarst began in 1991. These data will be analyzed during 2005 to provide a detailed picture of the rate of change that has occurred there.

Weather Monitoring at Park Headquarters

For nearly 80 years, weather information has been collected at park Headquarters. Beginning in 1922, Alaska Railroad personnel collected weather information in their camp near Riley Creek. In 1924, the National Park Service took over operation of the weather station. In 1925, the station was moved from the old headquarters site near the confluence of Hines and Riley Creek to the current Headquarters area (near the

Kennels). This station is one of over 12,000 in the National Weather Service's Cooperative Weather Observation Program. Long-term weather (climate) datasets provide valuable information for detecting and predicting changes or trends in both temperature and precipitation, both factors that play a critical role in the ecology of Denali.

Below is a summary of the 2004 climate data collected at park headquarters and compared with averages from the long-term database.

Temperature

- maximum temperature 30.5°C (June 20)
- minimum temperature −41.0°C (January 19)
- mean annual air temperature −0.8°C (warmer than historical average of −2.7°C)

Denali Headquarters
Average Monthly Temperatures (°C)

	2004	80-Year Historic Average
January	-20.8	-16.7
February	-8.4	-14.3
March	-12.9	-10.6
April	0.2	-2.8
May	8.8	5.3
June	15.0	11.2
July	15.2	12.7
August	14.4	10.4
September	1.4	5.0
October	-1.3	-4.2
November	-7.6	-12.3
December	-13.0	-16.2
Yearly Average	***-0.8***	***-2.7***

The summer of 2004 was the warmest on record for Denali National Park headquarters. Most other areas of the state also experienced the warmest summers on record. Nine daily maximum temperature records were set at Denali Park Headquarters, including an impressive 5 consecutive days of record breaking temperatures in mid-August. There were 60 days of temperatures above 70° and 16 days above 80° during the 3 month period. The summer was also considerably drier than normal. There were only 4 days of precipitation during the entire month of August. May however, was wet, with more than twice the normal precipitation. Monthly snowfall totals for Winter – Spring 2004 were below normal, with no snowfall in May compared to an expected average of 2.7 inches. In the fall of 2004 we had more snow than normal for September and November, but significantly less than the average snowfall in October.

Precipitation

Denali Headquarters Monthly Precipitation (cm)		
	2004	Historic Average
January	0.79	1.82
February	0.66	1.47
March	1.35	1.26
April	0.38	1.34
May	5.44	2.12
June	3.15	5.77
July	7.04	8.54
August	3.05	6.89
September	2.77	4.36
October	0.69	2.56
November	2.41	2.14
December	5.77	2.42
Yearly Total	***33.48***	***39.02***

Spring Weather 2005

As of May 1, 2005, there have been several record temperatures at Headquarters this spring:
April 28 – 65° F - Tied with record high set in 2003
April 29 –65° F - Previous record 60° in 1958
April 30 – 65°F - Previous record 62° in 1953
May 1 – 68° F - Tied with record high set in 1979

The snowfall accumulation on April 19 of 10.7 inches is a record for that day and the third largest snowfall in a single day for the month of April. The total snowfall for April 2005 was 17.4 inches. To put this snowfall in perspective, the snowfall in April 1948 totaled 89.3 inches!

Snowfall for April 1948 The 89.3 inches of snow that fell in April 1948 was distributed (in part) as follows:
April 1 – 10.7 inches
April 2 - 17 inches
April 10 – 6.4 inches
April 11 – 8.7 inches
April 13 – 6.5 inches
April 15 – 5.9 inches
April 26 – 13.8 inches
April 27 – 8.8 inches

Parkwide Climate Monitoring

Climate monitoring continued at established locations around the park. These data are especially useful for weather forecasting related to fires and detecting trends by long-term monitoring. There are a total of 15 climate stations distributed throughout the park. Most of these stations record air temperature, relative humidity, wind speed and direction, solar radiation, precipitation, and soil temperatures. From these stations, resource staff gain a park-wide perspective on the physical factors affecting Denali's ecosystems, while providing timely information on snow and weather conditions to park managers, the National Weather Service (NWS), the Natural Resources Conservation Service (NRCS), researchers, and the public.

In 2004, climate monitoring entered the second year of its development phase for the Central Alaska Network (CAKN), which included some initial station deployments and protocol development. The climate stations were added to the existing array of stations operating under various federal and state programs that are within and around the three parks (Denali, Yukon-Charley Rivers, and Wrangell-St. Elias). The main objective of the program is to monitor and record weather conditions at representative locations in order to quantify one of the drivers in Alaskan ecosystems, identify long and short-term trends, provide reliable climate data to other researchers, and to participate in larger scale climate monitoring and modeling efforts.

In 2003–2004, more than 30 sites were visited at the three parks to obtain specific information on the suitability of each site for climate monitoring. A panel of knowledgeable climate experts from the National Weather Service (NWS), the Natural Resources Conservation Service (NRCS), and the Western Regional Climate Center (WRCC) was solicited to review a detailed, technical site evaluation completed in the winter of 2004. Through this review, the National Park Service formed partnerships with each of these agencies culminating in interagency agreements and Cooperative Ecosystem Studies Unit (CESU) agreements that will provide a means for data archiving and general support and technical assistance from regional climatologists. The near real-time data generated by these stations will be used in unlimited ways to incorporate local climate variations with individual research projects and other network monitoring components, as well as to inform visitors and park managers on current conditions.

The sites that were deployed in the three CAKN parks were:

- Wrangell - St. Elias: Chititu and Chicken Creek
- Yukon-Charley Rivers: Coal Creek
- Denali: Stampede, Dunkle Hills (Stations upgraded and sensors added as part of design development phase).

The data from the climate stations will be available starting this summer in near real-time at http://www.wrcc.dri.edu/NPS.

Weather Station on Mt. McKinley

Denali Park staff, the International Arctic Research Center (IARC), and the Japanese Alpine Club have continued to work jointly planning the transmission of data from a weather station on Mt. McKinley. One objective of the project is to make near-summit weather information available in "real time" to the hundreds of climbers who attempt the summit each year, as well as to park rangers, who must plan and perform search-and-rescue operations in the vicinity of the South Summit. Researchers also find the data useful for their studies of the high-elevation environment. The National Weather Service, which has in the past issued a specific climbing forecast for Mt. McKinley from its Fairbanks forecast office, will be able to utilize the data to monitor and forecast weather at high altitude.

Originally, the Japanese Mountain Club installed a weather station in 1990 in memory of four Japanese climbers (including the famous mountaineer and adventurer Naomi Uemura) who, in independent climbing events, are all believed to have been literally blown off the mountain by gusts of wind. The Club donated the weather instrumentation to the International Arctic Research Center at the time of its opening ceremony in 1999. In 2002, an expedition of eight (climbers from the Japan Alpine Club and one person from University of Alaska Fairbanks) climbed the mountain and on June 18 installed a new weather station at 19,200' (1120 feet from the summit). The weather station was designed to transmit temperature, wind speed, and wind direction. To avoid moving parts that could be destroyed by windy or icy conditions, an ultrasonic sensor was used to measure wind speed. The station relayed data until January 7, 2003. In June 2003 an attempt was made to upgrade the station with new sensors and different programming in hopes of acquiring year round data. The electronics failed shortly after installation.

Because of the difficulties encountered so far with the weather station operations, a new approach was taken in 2004 using multiple ("redundant") systems similar to precautions taken in spaceflight.

Here is the 2004 Expedition Log (taken from the International Arctic Research Center Mt. McKinley project page at http://www.iarc.uaf.edu/mt_mckinley/mt_mckinley_2004_diary.php)

2004

June 30 - *Kahiltna Glacier Base Camp* - The team safely descended from the summit and are waiting for good flying conditions so they may return. The weather station seems to be working well as far as they can tell.
June 28-*High Camp* - The team will be listening for a signal from the weather station scanner at High Camp on their return from the summit.
June 27- *Weather Station ~18,735 ft* - All equipment has been assembled and seems to be working. The team continued to the summit, expecting to reach it in about 3 hours. The weather was clear. On their descent, they will test the weather equipment and check back from Medical Camp where one of the team stayed behind.
June 22 - *Medical Camp, 14,000 ft.* - Weather station equipment has been assembled and is functioning properly. Weather is good although winds and cloud cover are expected to pick up. The expedition expects to reach the weather station location in about 4-5 days.
June 21- *Medical Camp, 14,000 ft.* - All have arrived safely at the Medical Camp. The weather station equipment was flown in and arrived safely. They plan to commence assembly of the station and all is going well.
June 17- *Base Camp, 8,000 ft.* - With two feet of new snow, the expedition is waiting for the weather to clear before climbing to the

Upon return from the expedition, the team discovered that the satellite transmission was not working as planned. Data being received via radio telemetry also degraded for unknown reasons during the month of October. Temperature readings became increasingly erratic. Transmission from the station has ceased. When the station is again operational, you can go to http://www.denali.gi.alaska.edu to obtain Mt. McKinley weather data.

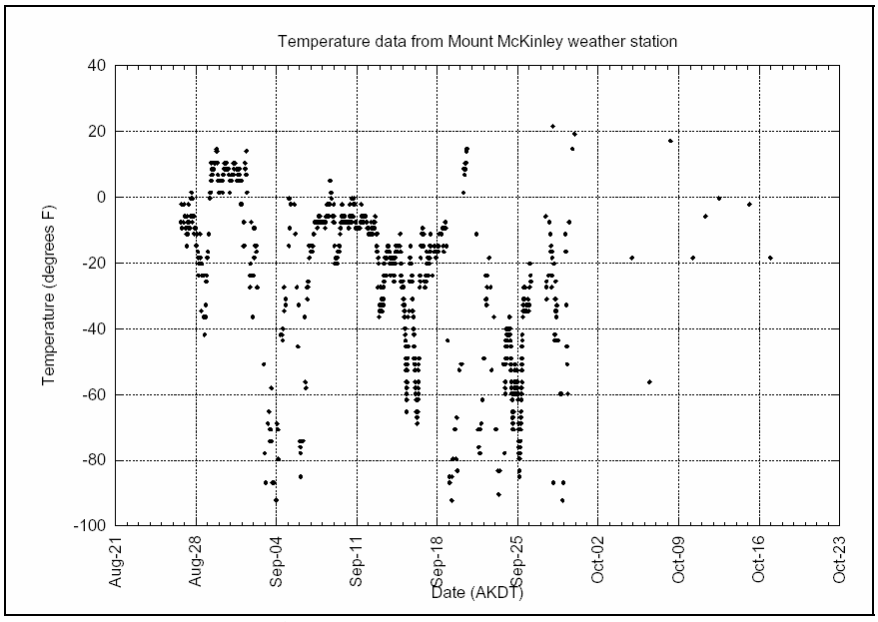


Figure 4. Temperature recorded from the Mount McKinley weather station from August 21- October 17, 2004 as recorded for Alaska Daylight Time.
(Taken from http://www.iarc.uaf.edu/mt_mckinley/mt_mckinley_weather.php)

The plan for 2005 is to install two completely separate sub-stations, a primary and a backup, at the existing platform. Both stations will rely on a radio link rather than satellite telemetry. One station will have more robust instrumentation including a direct measure of turbulence, wind speed, wind direction, solar radiation, air pressure, and air temperature. This station will log data as well as transmit data. The backup station will measure only air temperature and wind speed and direction and will not have the ability to log the data.

UV-B Monitoring

An ultraviolet-B (UV-B)/ozone monitor was installed at Denali in 1997 as part of the Park Research and Intensive Monitoring of Ecosystems Network (PRIMENet) to monitor changes in UV-B incidence at the earth's surface that may be affecting human health and ecosystem processes. PRIMENet represents an interagency effort between the Environmental Protection Agency (EPA) and the National Park Service (NPS) to

cooperate on a program of long-term monitoring and research of environmental stressors.

The summer of 2004 marked the end of UV Monitoring in Denali National Park and Preserve. The Brewer spectrophotometer was removed from the site on September 20, 2004. PRIMENet funding was discontinued last year and the program was completely phased out by the end of 2004. Final testing and diagnostics were done on site before the instruments were shipped to the data contractor. Continuous monitoring of daily irradiance occurred in 2004 until the instrument was removed. Data and graphs from the PRIMENet monitoring program can be obtained at the National UV Monitoring Center: http:///oz.phyast.uga.edu/ or from the EPA's UV-Net monitoring center: http://www.epa.gov/uvnet/.

Air Quality Monitoring

Long-term monitoring of air quality continues at the stations near park headquarters and Trapper Creek. In June 2005, Denali will reach the milestone of 25 years of uninterrupted air quality monitoring through the National Atmospheric Deposition Program. Other parameters measured at the headquarters station include ground-level ozone, sulfur and nitrogen oxides, fine particles and aerosols, and associated meteorological parameters. The Trapper Creek station measures fine particles and aerosols through the nationwide IMPROVE monitoring network (Interagency Monitoring of Protected Visual Environments).

Results have shown that, while Denali has some of the cleanest air measured in the United States, small amounts of industrial and agricultural contaminants from other continents make their way to the park each year in a strongly seasonal pattern. On average, the peak concentrations of international contaminants occur in the late winter and spring, and naturally-occurring wildfire smoke is the primary contributor to air quality degradation in the summer. It is reasonable to expect that as the human population grows in source areas such as Europe and Asia, unless international control measures are put into place, pollution will increase over time in Denali and other remote Alaska parks.

More information about the National Park Service nationwide air quality monitoring program can be found at the following web site: http://www2.nature.nps.gov/air.

Regional Assessment of Toxic Airborne Contaminants

Although Denali seems an unlikely place to find Persistent Organic Pollutants (POPs) and other toxic airborne contaminants, these pollutants are a growing concern throughout the arctic and subarctic.

In 2004, the NPS Western Airborne Contaminants Assessment Project (WACAP) sampled fish (see photo at right), lake sediments, lake water, snow, lichens, willows, and

spruce trees at Wonder Lake and McLeod Lake as part of a multi-park assessment of contaminants in park ecosystems. Subsistence hunters also donated samples from moose harvested near the park. In March 2005, the third and final year of snow sampling occurred at the two Denali study lakes. Most of the Denali samples are still undergoing chemical analysis, but WACAP researchers have released a few preliminary project results from samples collected during the first year of the study (see Figure 5).

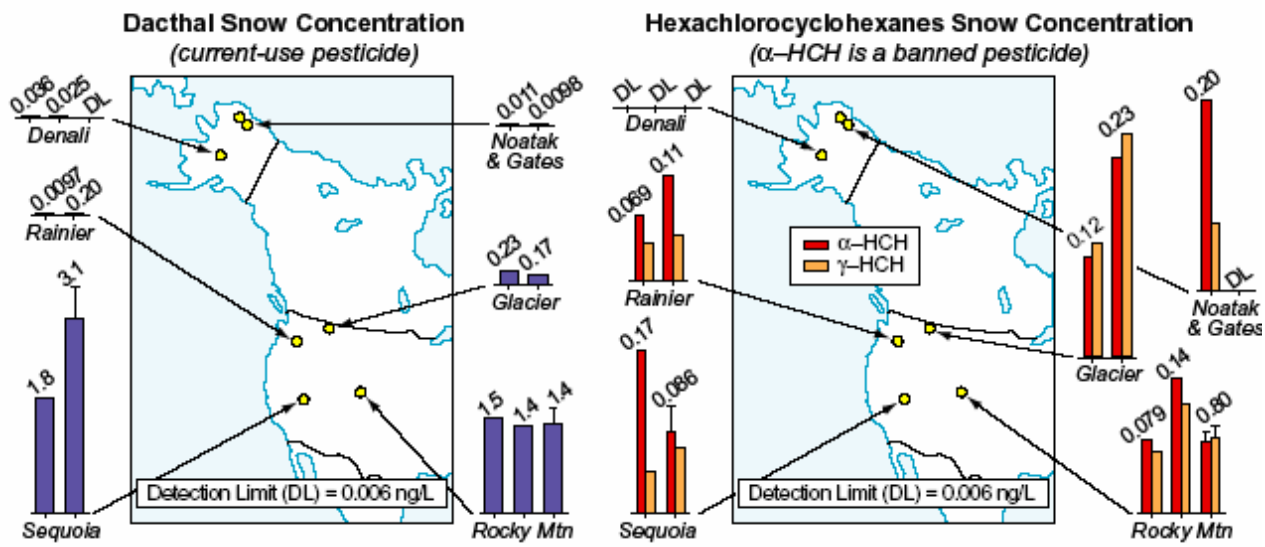


Figure 5. Two examples of (preliminary) results from WACAP sampling (in this case, two pesticides in snow samples, March 2003). WACAP is collecting contaminant data for multiple sites (different bars) at several parks. Height of each bar indicates concentration of the contaminant. Concentrations of current-use and banned pesticides found in Denali snow were at or near the analytical detection limits (DL on the graphs). The three Denali sample sites in 2003 were Wonder Lake, McLeod Lake, and the mountaineering base camp at 7,000 ft on the Kahiltna Glacier.

Information about toxic airborne contaminants and the WACAP project can be found at http://www2.nature.nps.gov/air/studies/air_toxics/wacap.cfm.

Eielson Web Camera

A web camera was installed at Eielson Visitor Center in July 2004 to document summer visibility conditions in the park. The Eielson camera is part of a nationwide network of visibility webcams operated by the NPS Air Resources Division. During summer, the camera updates once every 15 minutes, and the image is transmitted to the web via satellite. Current ozone and weather data from the air quality monitoring station near park headquarters are also displayed on the webcam home page and updated hourly. All

images are archived throughout the summer for a long-term visual record of visibility, one of the air quality related values protected under the Clean Air Act.

The first summer of operation provided ample opportunity for the webcam to document wildfire smoke in the park, a naturally occurring form of haze that cannot be avoided in regions such as Alaska where the natural fire cycle predominates. The camera currently operates during summer only, due to funding and logistical constraints.

Web camera photos of Mt. McKinley on a clear day (8/3/04) and a smoky day (8/23/04).
http://www2.nature.nps.gov/air/webcams/parks/denacam/denacam.cfm

Water Resource Management Plan Development

The park's existing Resource Management Plan (1998) calls for the development of a Water Resources Management Plan to protect and preserve the high quality of surface and ground water resources, and correct current water quality degradation problems. The evaluation of existing baseline data is insufficient to support monitoring and research programs proposed in the project statement. Planning and development efforts within and adjacent to Denali National Park and Preserve have been occurring at an accelerated pace for the past five years. The potential for large projects with resource-impact potential continues to exist (e.g., North Access and South Side development). As a result of development pressures, a need exists to identify the significant unprotected water resources of Denali National Park and Preserve, and to initiate protection measures for them. To develop a comprehensive water resources plan that relies on professional experience, includes ample public involvement, and meets management needs, this project will include public meetings and scoping sessions, professional analysis, and park planning processes.

The Denali National Park and Preserve Water Resource Management Plan will provide an adequate conceptual framework to address the identified issues in a realistic manner for the next 10 years. The plan was started in 2004 and is expected to be completed in 2006. It will provide the framework for park management decisions regarding water resources.

Seismic Monitoring

In 2002, Denali staff completed writing the Environmental Assessment (EA) evaluating the environmental effects of an upgrade and a new installation of seismic monitoring equipment in the park. Researchers at the Geophysical Institute at the University of Alaska Fairbanks have maintained seismic monitoring stations within Denali at Wickersham Dome, Thorofare Mountain, and Mt. Healy for over thirty years. Their proposal to upgrade these sites to allow for digital, multi-signal transmission, and to install a new site on Double Mountain, was given the go-ahead, as long as they follow some mitigating measures. The installations occurred in 2003. Real-time earthquake data and maps showing recent seismic activity are available through the Alaska Earthquake Information Center. The data now include the upgraded Denali sites, with real-time, digital, multi-component data. The new equipment allows for much more precise location of earthquakes and therefore better interpretation of the fault plane and cause. The old equipment only recorded vertical movement, the new equipment records movement all three directions.

In 2005, a new installation is proposed for Castle Rocks in order to better characterize activity on the western portion of the Denali Fault and the "Kantishna Swarm" of earthquakes (a cluster near Kantishna). The Kantishna Swarm is of interest to researchers working on the geologic evolution of the Alaska Range and the apparent volcanic gap that occurs between the eastern and western portion of the Alaska Range (all of Denali Park).

Monitoring Landslide at Mile Post 45

At Milepost 45 on the park road, survey stations were established in 1993 to monitor the rate of movement of the surface area of a mass movement (landslide)--a classic rotational slump with a headwall scarp, subsiding basins, pressure ridges and fractures, and flow features. The apex of the headwall scarp is within 35 horizontal feet of the park road, and park management and Federal Highways personnel are concerned about the threat that this movement poses to the road.

Both horizontal and vertical movement has been monitored since 1993. Approximately 50 stations have been established over the entire period. Some have been lost to surface fracturing, squeeze-out, or animal damage, and some are added each year. Results of the horizontal component are shown in Table 6.

Stations above the scarp, which are both above and below the road (Zones 1 and 2), show little to no movement (±0.3 ft) since the origin of the survey network, suggesting the ground immediately above and below the road remains relatively stable at this time. Zones 3 and 4 represent the actively subsiding basin, which demonstrated large displacements in the 93-94 survey. Generally, the degree of displacement has diminished in recent years of survey. However, increased rates of precipitation or concentrated periods of precipitation could re-activate the landslide.

Landslide surveys were accomplished in the 2003 and 2004 field seasons, but the data have not yet been analyzed. However, cursory observations indicate that there have been no increased rates of movement on any of the stations during these two years.

Annual monitoring of the landslide will continue, so staff can watch for sustained or increased rates of movement, with particular attention paid to Zones 1 and 2, because these most immediately threaten the park road.

Table 6. Surveyed Horizontal Movement of Landslide at Mile Post 45, Denali National Park

Survey Year	93-94	94-95	95-96	96-97	97-98	98-99	99-02	02-05
Approximate Elapsed Time	1 yr	1 yr	1 yr	1 yr	1 yr	1 yr	3 yrs	3 yrs
Zone 1 – Above Scarp (Above Road)								
Number of Stations Surveyed	0	0	0	0	0	0	4	
Average Movement of Stations (ft)*							**0.3**	
Zone 2 - Above Scarp (Below Road)								
Number of Stations Surveyed	6	6	3	5	5	7	4	
Average Movement of Stations (ft)*	**0.3**	**0.3**	**0.4**	**0.3**	**0.3**	**0.2**	**0.5**	
Zone 3 - Below Scarp (Upper Basin)								
Number of Stations Surveyed	9	8	9	9	9	12	9	
Average Movement of Stations (ft)*	**6.8**	**2.3**	**2.7**	**1.2**	**3.4**	**0.9**	**1.9**	
Zone 4 -Below Scarp (Lower Basin)								
Number of Stations Surveyed	11	11	15	13	11	13	12	
Average Movement of Stations (ft)*	**8.4**	**2.8**	**3.4**	**1.6**	**4.7**	**1.2**	**2.1**	

***Survey values represent average horizontal movement (in feet) for one year (in the columns for years 1993 to 1999) or three years (in the last column)**

Paleontological Survey of the Lower Cantwell Formation

Work will begin this field season surveying the plant and animal fossil materials (potentially including large and small vertebrate and invertebrate fauna). Preliminary results confirm that a diverse terrestrial fossil assemblage is likely preserved in the lower part of the Cantwell Formation in siltstones, sandstones, and conglomerates, as well as in numerous fossil soil horizons. This rock unit, largely unmapped and uninvestigated, correlates with other dinosaur-bearing rocks of the North Slope of Alaska and with dinosaur-bearing rocks of Aniakchak National Monument and Preserve in Alaska. The survey will include classic geologic mapping of Cantwell exposures throughout the park.

McKinley Quad Mapping

In 2004, field work by retired USGS geologists updated portions of the McKinley Geologic Quadrangle (scale at 1:250,000). The field work (in the western portion of the park) included mapping of geologic contacts, limited paleontology, and evaluation of data published since the original quadrangle map was published John C. Reed, Jr. in 1961. The cadre of geologists had worked in the same area during their USGS tenure. It is hoped the updated geologic interpretation of the area will be completed during the next two years. The work was supported by NPS's Geologic Resource Evaluation funding.

Field Class for Geologic Mapping

The University of Alaska Fairbanks will conduct part of its Field Geology class in Denali Park from June 25 to July 7, 2005 (excluding the weekend). The class objectives are: (1) to teach advanced undergraduate geology students how to use field geologic information in creating a geologic map and cross section and (2) to better understand the well-exposed, but geologically complex region that sits between two major strands of the Denali fault system.

In 2005, the class will be based out of the Murie Science and Learning Center's Field Camp at Igloo Creek. Each day, twelve University of Alaska geology students, assisted by four UA faculty members and a graduate Teaching Assistant, will depart from the Field Camp to conduct field traverses for geologic mapping. Field traverses will be done in four 3-person teams, each mapping a different, but overlapping, 10 square km area identified for work in 2005 (see map). The area of work for 2005 lies between the Field Camp, Sable Mountain, and Cathedral Mountain, exclusive of the Sable Pass closed area. Some visual observations of bedrock and rock deformations may be made from afar, thus extending what can be mapped beyond the area traversed on foot (and thus mapped areas may include parts the Sable Closure).

The group will be augmenting their geologic observations with non-invasive geophysical techniques (including magnetics, electromagnetics, and gravity) to better define geologic structures and rock types in areas of sedimentary cover. Individual student maps will be compiled and added to the map prepared in summer 2003. The objective is to complete a

detailed geologic map in the vicinity of the Park Road between Teklanika Campground and the Toklat River by 2011, by conducting the field class at Denali in alternate (odd) years. The field class was also held in 2003. We invite a limited number of Denali staff and associated persons (with advance warning) to join us a day's traverse mapping geology. Interested persons should contact Bill Witte, fnwkw@uaf.edu by 15 June 2005.

Snow Surveys

The Long-term Ecological Monitoring (LTEM) snow surveys were fully integrated with the Central Alaska Network (CAKN) in 2004. The development of the snowpack monitoring program within the CAKN took place in 2004 with the assistance of the data collection officer and hydrologist from the Natural Resources Conservation Service (NRCS). Two new aerial marker sites were added to Wrangell -St. Elias in this developmental phase; these markers will be surveyed starting in fall 2004. Additionally, an agreement was established with the NRCS to install a SNOw TELemetry (SNOTEL) site in Kantishna within Denali National Park and Preserve in 2005. The purpose of this agreement was to establish a robust site to record year-round precipitation measurements.

In the winter of 2003-2004, snow surveys in the three CAKN parks occurred as they have been prior to the formation of the network. The surveys were conducted by park staff during the survey window during the last 4 days of each month during the winter season. A highlight of the Denali data is presented below.

Thirteen snow courses and aerial snow markers were surveyed in 2003-2004. The snow started about a month later in 2003, with little snow falling in September or October. In November, Denali Park headquarters received twice the normal amount of snowfall for the month and slightly more than normal for December. In general, January had some good winds in the interior, and snow courses that may be susceptible to drifting were generally drifted. The late winter early spring months of 2004 had monthly snowfall totals below normal, but not nearly as low as the previous winter. The park wide snow surveys indicated quite a bit of variation on the north side between the eastern sites and the far west sites, and between those sites nearer the Alaska Range as opposed to farther away at lower elevations. For example the Rock Creek snow courses, located near headquarters, were 80 percent of normal for February while the Lake Minchumina site was 47 percent of normal. The Purkeypile site, west of Mt. Foraker at the base of the range was 113 percent of normal. By the May 1 snow survey there was no snow on the ground at the Rock Creek sites, Stampede, and Kantishna. Purkeypile and Minchumina were not surveyed on May 1 due to poor flying weather.

The Peters Hills snow sites on the south side of the Alaska Range were 66 percent of normal on February 1 and 80 percent of normal on April 1. By the May 1 snow survey most of the snow had melted. The lower elevation sites on the south side had 10-13 inches of snow on May 1 and historically they have 33-43 inches on May 1. The snow depth at the upper elevation site above 2700' was close to normal at 71" on May.

Snowmobile-related Research Projects

A number of projects that measure the effects of snowmobiles on various resources at Denali National Park and Preserve were continued from previous winters.

- **Snowpack characterization:** This study focuses on what measuring the characteristics of the snowpack that allow adequate support of snowmobile travel without causing adverse impacts to vegetation and soils. This project provides depth and density information to park managers who are faced with the decision to open or close areas of the park and preserve to snowmobile use based on the current snow conditions.
  - Snow depth and density were monitored at several fixed survey sites throughout the winter season (December through May). The park additions (park areas added in 1980 through the Alaska National Interest Lands Conservation Act or ANILCA) that are south of the crest of the Alaska Range were open to traditional snowmobile use on November 19, 2004. On January 4, 2005 the areas north of the range were opened.
  - Survey sites were located in different vegetation types as well as in areas of special concern to park management.
  - Data were collected in an effort to define the development of an adequate snowpack for snowmobiles, and to monitor the change of that snowpack throughout the season.
  - The information will also indicate how changes in the measured variables affect the level of support provided by the snowpack.

- **Snowmobile activity patterns and route maps:** This study uses aerial and ground surveys, Global Positioning System (GPS) units and Geographical Information Systems (GIS) to produce maps that show where winter visitors use snowmobiles the most on parklands. The highest concentration of use occurs on the south side of the Alaska Range. One popular area for use is the Broad pass area south of Cantwell, and another is the Tokositna Valley and Peters and Dutch Hills. The Stampede Corridor also receives moderate use.

Muldrow Glacier Monitoring

Denali Park and Preserve staff members have monitored ice elevations and flow rates of the Muldrow Glacier since 1992. The Muldrow last surged in 1956-57 extending its terminus some 2.5 miles (four kilometers). Surges may occur at 50-year intervals; thus, another surge is anticipated within a few years of 2007. Monitoring efforts will continue in 2005 in order to describe the quiescent glacier between surges so that the data can be compared to information collected during and after the next surge.

Ice surface flow rate markers will be surveyed on various points of the Muldrow Glacier, as well as its two largest tributary glaciers (Traleika and Brooks), to detect

flow rate changes that might signal the start of a surge. The following items will be measured or sampled:

- Elevations of the main ice streams and moraine crests, using longitudinal and cross-section surveys
- Levels of the water table in moulins (stream caverns in glaciers) and other slow-flow subsurface ice pools
- Surface ablation (melting and evaporation) and the position of the terminus ice front
- Temperature and stage of water flowing at the terminus

Long-term Glacier Monitoring

Long term glacier monitoring sites were installed on the Traleika and Kahiltna Glaciers in 1991 to monitor the long-term mass balance changes and flow of these two glaciers. These glaciers were selected to compare glaciers on the north (Traleika) and south (Kahlitna) sides of the Alaska Range (dryer and wetter climates, respectively). The measuring sites for both glaciers are located at approximately 6000' (1830 m). The Kahiltna Glacier flows ~660 feet (200 meters) per year, while the Traleika Glacier moves ~165 feet (50 m) per year. The Traleika glacier has lost approximately 13 feet (4 m) of water-equivalent (if the change in ice/snow were water) in 11 years of monitoring (a negative mass balance), while the Kahiltna has gained ~7 feet (2 m) of water-equivalent. Interestingly, the Traleika Glacier, though experiencing negative mass balance, has been thickening consistently, illustrating the complexity of glacier flow. The glacier surface at our measurement site has risen approximately 82 feet (25 m) in the past 11 years.

During 2003, radar soundings to estimate glacier thickness were made on the Traleika, Muldrow and Kahiltna Glaciers. When these measurements are processed, they will indicate the dynamics of glaciers by documenting any changes in thickness of ice. Radar measurements in 2002 indicated that the East Fork of the Toklat Glacier is 660 feet (200 meters) thick; and the Muldrow Glacier is 1640 feet thick (500 meters) and 50 feet (15 meters) thicker near McGonnagall Pass. Basecamp (on the Southeast Fork of the Kahiltna Glacier) sits on ~985 feet (300 meters) of glacial ice.

Monitoring on the Southeast Fork of the Kahiltna Glacier began in 2004 and will continue in 2005. Movement rates, winter accumulation, and summer ablation rates will be determined. Magnets are also placed in outhouse holes for determination of their movement rates.

Historic Photos of Glaciers

During 2004, over 200 historical photos of park glaciers were obtained. These are ground-based images made in the early 1900's by survey and research expeditions to the Denali area, including Cathcart, Capps, Washburn, Post, and others. Many of these sites were "reoccupied" to repeat the images using modern digital cameras. New photo stations were established at locations lacking historical coverage. The

photo-comparisons of the glaciers are often dramatic, showing significant changes in the ice extents – including over 700 vertical feet of ice loss on a glacier in the Teklanika valley.

The GIS data and photographic media will be available to researchers, park management, park natural resource and interpretive staff, park visitors, educators, and the general public through the accompanying website.

Soundscape Inventory and Monitoring Program

A soundscape research program has been underway at Denali National Park and Preserve since 2001. Natural and human-generated sounds have been inventories and monitored at numerous locations around the park including along the park road, near Cantwell south of Broad Pass, at the Stampede Airstrip, in the Ruth Amphitheater, at base camp on the Kahiltna Glacier, on the Pika Glacier, and at the toe of the Tokositna Glacier. This summer's focus (2005) is collecting information from within the Wilderness zone and to measure representative areas with high aircraft traffic and compare them to areas we predict have little aircraft traffic.

From the 3500+ hours of digital recordings and sound levels that have been documented in the park's three acoustical zones (alpine, sub-alpine, and scrub/forest), we can calculate for each audible sound the percent time and the number of times per day that it is audible. We then use the sound level data to compare the levels of human-made sounds to the natural ambient levels. Wind is the most widespread natural sound in all areas and aircraft overflights are the most common human-made sound. For those with interest in natural soundscapes in national parks (and the National Park Service role in their protection), the National Park Service Natural Sounds Program Center website is http://www1.nrintra.nps.gov/naturalsounds/index.htm

The data collected with sound stations can be used to characterize the soundscape and make informed management decisions. The relative abundances of human-made sounds, geophony, and biophony are shown for two locations, Ruth Airstrip (Figure 6A) and Stampede Airstrip (Figure 6B), during the month of June, 2002. From these two figures we can see that human-made sounds dominated the soundscape on the Ruth Glacier, whereas natural sounds were dominant at the Stampede Airstrip. Most of the human sounds on the Ruth Glacier were made by aircraft. Notice the lower abundance of human made sounds on June 19, 2002 at the Ruth Airstrip. June 19 was windy and cloudy so no planes were able to land on the airstrip, but other human sounds that day include people talking. Interestingly, the next day is the only day on which biophony was heard (a white-crowned sparrow). The wind storm may have blown the bird onto the Ruth Glacier.

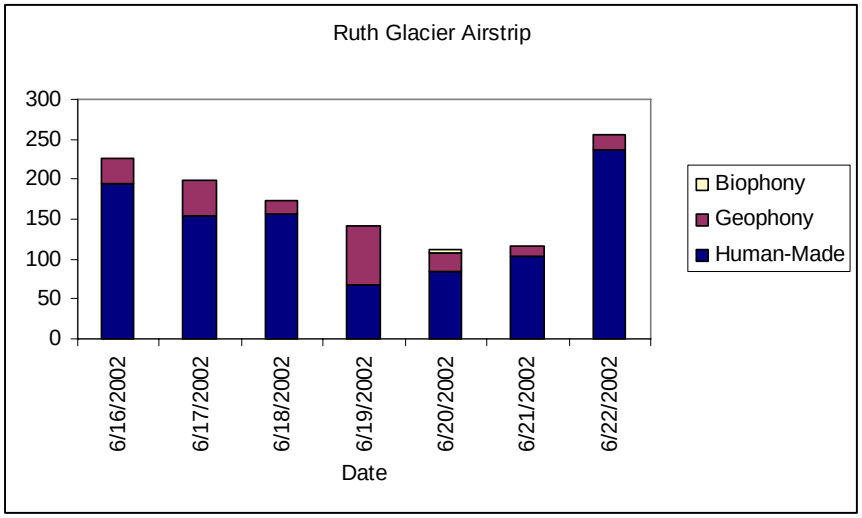


Figure 6A. Relative abundance of sounds identified from a sound station set up at the Ruth Glacier, Denali National Park and Preserve during one week in June 2002. Sounds were identified as human (dark lower bar), physical or geophony (middle medium colored bar), and biological or biophony (highest light bar only on 6/20).

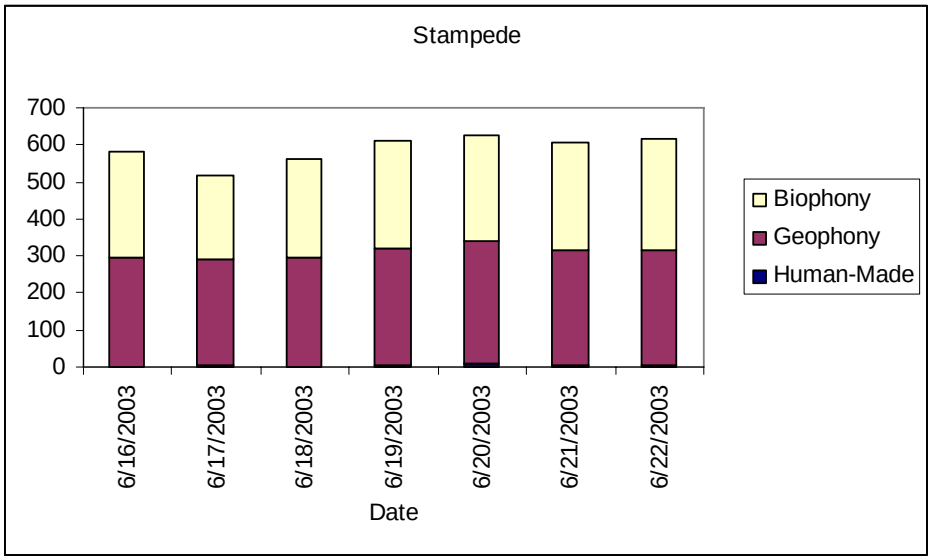


Figure 6B. Relative abundance of sounds identified from a sound station set up in the Stampede area, Denali National Park and Preserve during one week in June 2002. Sounds were identified as human (dark lower part thin part of bars), physical or geophony (medium bottom half of the bars), and biological or biophony (light upper half of bars). Aircraft were identified at the Stampede Airstrip on the first five days shown but the relative abundance is so low they are barely represented on the graph.

Mining Issues (Minerals Management)

Mining claims within Denali National Park and Preserve are significantly reduced (in number) after several years of acquisition, legal contest, and administrative extinction. Only 19 unpatented* mining claims are left, mostly on Quigley Ridge and along Eldorado Creek, and better than half of those are pending contest or under null and void appeal. Some 15 patented* claims, or subdivision parcels, still exist on Spruce and Rainy Creeks, Quigley Ridge, and along Moose Creek, between the Kantishna Roadhouse and Denali Backcountry Lodge.

*There are "patented" mining claims" (privately owned surface and mineral estates) and "unpatented" mining claims (federally held and managed surface and privately held mineral estates).

Reclamation of Disturbed Areas

The mandate of the National Park Service (NPS) and the Mining in the Parks Act of 1976 requires reclamation by a mining operator to "restore natural conditions and processes" and to "return the area to a condition equivalent to its pristine beauty." Historically, mining and access activities in Denali National Park and Preserve have resulted in major surface disturbance and environmental damage, with minimal or no reclamation being done to restore disturbed area to their natural state. The result is approximately 1500 acres of barren gravel tailings in riparian zones from placer and lode mines, 75 miles of trails and roads, and miles of disrupted stream channels and floodplains.

- **Glen Creek Restoration**: Restoration work on the lower portion of Glen Creek, initiated in 1988, has been the flagship for NPS floodplain restoration techniques for 10 years. In the 2004 field season, the upper portion of Glen Creek (formerly 15 placer claims) was the site of trash removal, equipment inventory, and floodplain reconstruction. An NPS crew consisting of a project lead, an equipment operator, three laborers, and one volunteer redistributed and recontoured 4.5 acres of tailings and floodplain, re-established over 1500 feet of stream channel in a more natural functioning configuration, inventoried 26 equipment or supply sites, and hauled 15 tons (two 30-yard dumpsters) of scrap steel and trash to a landfill.

  In the 2005 field season, a major clean-up effort is planned, in which an environmental contractor will remove all remaining mining equipment, debris, and contaminated soils. The contractor will be stationed at Glen Creek for about a month, making frequent haul trips on the park road in all sizes of vehicles.

Social Sciences

Visitor-related Projects

Two ongoing projects monitor visitation to Denali National Park and Preserve. One of these projects also focuses on park use by park staff.

- **Monthly public use report:** This project documents visits to the park including Talkeetna Ranger Station, mountaineering, aircraft landings, railroad passengers, Park Road traffic, bus passengers, and backcountry users, for both recreational and non-recreational purposes. According to this report, recreational visitors to the park were 404,234 in 2004, compared to 359,840 in 2003 and 353,560 in 2002. However, there have been some glitches in the program that formulates the representative numbers for Denali and reexamination of the formulas and input method is forecast for some time in 2005.

- **Road traffic monitoring:** Because the road corridor is a man-made feature within a pristine natural area, monitoring the direct and indirect effects of park road use on the natural resources is critical. Vehicle use of the park road by both visitors and park staff is being documented. Six automated traffic counters are located along the park road from the entrance to the park boundary in Kantishna. However, only the entrance counter will be maintained in 2005 to assist with the Monthly Public Use Report. Vehicles are also counted at the Savage Check Station. Approximately eighteen hundred vehicles entered the park on July 4, 2004 (compared to 14 on December 25, 2004).

Winter Road Users and their Perceptions of the Aufeis Removal Project

In 2002, park management decided to conduct the Aufeis Removal Project on a trial basis for several years. The objective of this project is to remove overflow water as it freezes on the park road throughout the winter. As a result, during spring road opening, aufeis removal is less time-consuming, more fuel-efficient, and safer for equipment operators. To accomplish the task of aufeis maintenance during the winter, Denali crews use heavy equipment, front-end loaders, steam trucks, and road graders to channel, peel, and remove overflow water as it freezes on the road. To be able to access the problem areas at Miles 3.6, 4.7, and 6.9 all winter, crews maintain the lane on the south side of the road to Mile 7. This lane is packed and groomed to a depth of 6", and plowed if snow falls in excess of this depth. The north lane of the road remains unplowed for the duration of the winter until spring road opening.

In February and March of 2004, a social science study was conducted to determine if the Aufeis Removal Project is affecting recreational users and how to mitigate for possible negative impacts. Park staff were enlisted to conduct the survey from February 18 through March 6. Visitors who recreated on the park road beyond Headquarters were asked if they would be willing to complete a 20-question survey about their experience on the park road in relation to the Aufeis Removal Project.

The survey, approved by the Office of Management and Budget, consisted of 20 questions, including

- What activities were you engaged in today?
- In what way was the quality of your experience in the park affected by the Aufeis Removal Project?
- Did you use the plowed/groomed lane, the unplowed lane, or both equally?

Forty winter road users (about equal males and females) completed the survey. Most (70%) of the 40 respondents used the plowed/groomed lane, while some (28%) used the plowed and unplowed lanes equally. Nearly half (48%) thought that the quality of their experience was positively affected by the Aufeis Removal Project (groomed trail and the removal of unsafe domes of aufeis), 42% thought it was not affected, and 10% thought it was negatively affected (detracted from wilderness experience). Most respondents (25-28 respondents) were neutral about hearing, seeing, or smelling equipment, because the equipment was not operating when they used the road.

Most (58%) said "yes" they favored continuing to plow the road all winter to remove aufeis, 10% said "no", and 28% said "don't know". These responses were not statistically significantly different (Chi-square test) by residence (local resident, out-of-town, out-of-state) or by recreational activity. Respondents thought safety of recreationists and safety of equipment operators were the most important aspects of the Aufeis Removal Project for park managers to consider in deciding whether to continue the project or not.

Other findings were:

- Of the 40 survey respondents, 17 (42.5%) were local residents, 15 (38%) were from out of town, and 8 (20%) were from out of state.
- Of the forty respondents, 11 were park employees.
- Out-of-town respondents were from Fairbanks, Ester, Trapper Creek, and Anchorage.
- Out-of-state respondents were from Massachusetts, Washington, California, Spain, and France.
- Most park road users were over 40 (63%) and highly educated (73% with at least 4 years of college).
- For 25 winter visitors (63%), the trip was the first one on the park road during the winter (2003-2004).
- Twenty-five respondents (63%) said they read the description of the Aufeis Removal Project posted at the trailhead.
- More survey respondents used the road on Sundays (11 visitors) and Wednesdays (13 visitors) than on other days.
- The most popular times to recreate on the park road were between 10 and 11 am (9 respondents), and between 3 and 4 pm (11 respondents).
- Most winter road users spent either 1-2 hours (11 respondents) or 2-3 hours (10 respondents) on the park road.
- The most popular activities were cross-country skiing (20) and walking (13).
- Many respondents thought that their recreational experience was positively affected because there was a groomed trail (23) or because unsafe domes of aufeis had been removed (17).
- Road users suggested that the park widen or improve the by-pass trail, remove more of the chopped ice, and keep fully one-half of the road unplowed.

To address the possibility that some road users have stopped using the park road because of the Aufeis Removal Project, a survey would need to be conducted during a year when the Aufeis Removal Project is not occurring.

≺ Cultural and Subsistence ≻

Updates of Subsistence Community Use Profiles

The Park is awaiting the final report for the Nikolai and Lake Minchumina projects. By hiring local people to help with logistics and interviews within the communities of Nikolai and Lake Minchumina, researchers gathered field notes, interviews, and survey data during 2002 and 2003. This research was done in cooperation with the local Tribal Councils, the Alaska Department of Fish and Game, the Denali Subsistence Resource Commission, and park staff.

The objectives of the community use profiles and harvest assessments were to:
1) update and expand information about subsistence uses and needs, and areas traditionally utilized for subsistence by residents of Lake Minchumina and Nikolai.
2) document knowledge of fish populations, fish life histories, geographic distribution, fishing techniques, practices, and equipment
3) build community involvement and support by working cooperatively with the communities that fall within Denali's subsistence resident zones to incorporate traditional ecological knowledge into management programs
4) gather additional qualitative information regarding the eight criteria factors used in making "customary and traditional use" determinations by the Federal Subsistence Board.

Kantishna River Fall Chum Salmon Stock Assessment

This cooperative fall chum salmon fishery study will continue in 2005 for both the Tanana and Kantishna Rivers. Denali's participation will focus on the operation of the two upper Kantishna recapture fish wheels under a contract with a local resident. This will be the sixth year of a cooperative study between the National Park Service and the Alaska Department of Fish and Game to assess abundance and timing of the fall chum salmon runs.

In 2004, mark-recapture studies on fall chum salmon *Oncorhynchus keta*, were conducted for the tenth consecutive year on the Tanana River and for the sixth year on the Kantishna River. In the Tanana River, chum salmon were captured and tagged using a fish wheel located on the right bank of the river, immediately upstream of the Kantishna River mouth, and recaptured in a fish wheel located approximately 76 km upriver on the right bank. In the Kantishna River, chum salmon were captured in a fish wheel on the left bank of the river, approximately 9-km upstream of its terminus on the Tanana River, and recaptured through the use of four fish wheels; two fish wheels were located approximately 113 km upstream in the Toklat River (one on each bank) and the two fish wheels were located 139 km upstream on the Kantishna River. These studies were conducted from August 16 through October 5.

There were an estimated 119,900 fall chum salmon reaching the upper Tanana River (using the Bailey model abundance estimate), and about 64,950 fall chum salmon reaching the Kantishna and Toklat Rivers, the second highest estimate since the project began. The Toklat River in the Kantishna River drainage has a Biological Escapement Goal of 15,000 to 33,000 fall chum salmon. The Toklat River abundance was 35,480 fall chum salmon based on ground surveys and count expansion using a migratory time-density curve. This is the first time that the Toklat River drainage has exceeded its Biological Escapement Goal since the collapse of the salmon runs in the Yukon River drainage, and the largest numbers of fall chum salmon observed on the Toklat River spawning grounds since the Kantishna River drainage salmon stock assessment project began six years ago. This fishery has been identified by the State Board of Fisheries as a Stock of Concern.

Subsistence Reports to be Reprinted

In response to numerous requests, Denali staff are planning to revised and reprint two reports:

- "Denali National Park: Ethnographic overview and assessment" by Terry Haynes, David Anderson, and William Simeone (first printed in February 2001)
- "Native place names mapping in Denali National Park and Preserve" by James Kari (first printed in August 1999)

These reports were initially funded by the National Park Service through cooperative agreements with the University of Alaska, Fairbanks, Oral History Program and the Alaska Department of Fish and Game, Subsistence Division.

Traditional Subsistence Access Review for the Cantwell Area

In response to requests from Cantwell residents and the Denali Subsistence Resource Commission, Denali National Park is conducting a review about the traditional use of Off Road Vehicles (ORVs) for subsistence purposes in the Cantwell area. The Alaska National Interest Lands Conservation Act, Section 811, specifies that rural residents engaged in subsistence uses shall have reasonable access to subsistence resources and that the Secretary of the Interior shall permit on public lands, for subsistence purposes, the appropriate use of snowmachines, motorboats, and other means of surface transportation traditionally employed by local rural residents subject to reasonable regulations.

Existing information at the time of Denali's General Management Plan indicated that ORVs have not been regularly used for subsistence purposes and they have not been allowed on a park-wide basis. However, the General Management Plan also states that any additional information about traditional means of subsistence access will be reviewed on a case-by-case basis. It is this additional information about traditional access means for the Cantwell area that National Park Service is now considering. The information has been gathered from the Subsistence Resource Commission, Public Hearings in Cantwell,

past and current research, oral histories, and other agencies databases. If found to be a traditional means of access for subsistence activities for the Cantwell area, subsistence use of ORVs could be allowed on traditionally used trails and routes, but would be restricted or closed where the terrain and topography cannot support such use without causing an unacceptable level of adverse impact on natural and cultural resources.

Denali's Historic Resources and National Register

Research continues to determine whether historic sites in the park are eligible for listing on the National Register of Historic Places. To date, only two historic resources are listed on the National Register: the Headquarters Historic District and the Patrol Cabins of Mt. McKinley. Historical sources of information (correspondence, archival material, oral history, photography, and architectural information) are collected and evaluated to develop Determinations of Eligibility to the National Register. Draft nominations include the Kantishna Mining District, Caribou Creek (part of Kantishna District), McKinley Park Station, CCC Camp, and the Stampede Mine Historic District. Work continues in 2005 on these drafts that are now in the stage of gathering documentation to support the nominations (generating maps and diagrams and reproducing photographs). As an outgrowth of this National Register work, information is being compiled about mining in the Kantishna Hills for the park website. Park staff are continuing to research what sites are eligible for the National Register but have shifted their evaluations from mining sites to the numerous trapping cabins in the park.

Historical Research and Oral History

Cultural resource staff continue to participate in planning for interpretive exhibits and films for the new visitor center and for interpretive trails in the frontcountry. Interpretive panels with historical information and photographs of the Morino Roadhouse and sites in McKinley Park Station (a community) will be posted on trails in the vicinity of those locations. Interpretive posters were also developed for the C-Camp recreation hall to show current residents what the camp was like when it was built and occupied by the Civilian Conservation Corps (CCC) in the late 1930s. C-Camp is named for the CCC.

During 2004 ten individual informants were interviewed for a total of 10 hours of oral history recording.

- On January 22, 2004, Healy residents Berle and Clare Mercer were interviewed for 2 hours regarding their use and observations of the Stampede Corridor, horse packing in Mt. McKinley National Park, packing for mountain climbers from Wonder Lake to the Muldrow Glacier, and the cultural resources observed during those travels. An audio tape and a digital video were recorded.
- On April 15, a 90-minute audio recording was made of an interview with Bill Nancarrow regarding many specific questions, including topics such as place name locations, the history of the Toklat Road Camp buildings, and information about several historic park structures. Much of this interview focused on answering specific questions posed by Frank Norris as part of his research on park administrative history.
- On May 18, Ginny Hill Wood and Florence Collins gathered at Ginny's home in Fairbanks for a 45-minute interview by Jane Bryant regarding their participation in the 1954 Thayer Expedition and the 1954 Northwest Buttress Expedition, both to Mt. McKinley. Ginny and Florence were both pilots

who assisted those climbing expeditions with airdrops and both knew the stories of these expeditions.

- During the week of June 25, Camp Denali hosted the 50th Reunion of the 1954 Thayer Expedition, a climbing expedition that made the first ascent of the South Buttress and the first traverse of Mt. McKinley. This was the first time since 1954 (50 years) that the 3 surviving climbers had been together. The three surviving climbers, Les Viereck, Morton 'Woody' Wood and George Argus, and the wife of Elton Thayer, who was killed on the climb, attended. Jane Bryant hosted an opening two hour interview/discussion on June 22 regarding preparations for the climb. This discussion was held in the Camp Denali Lodge and was recorded by audio tape and digital video. On June 23 Les Viereck presented his powerpoint slide show and spoke about the climb, assisted by George Argus and 'Woody' Wood. This 90-minute presentation was recorded by audio tape and digital video. On June 24 Jane Bryant made an audio and digital video recording of an oral history interview conducted by Jeri Cole in the Camp Denali Lodge with Ginny Hill Wood and Morton 'Woody' Wood regarding their activities establishing Camp Denali.
- On September 8, a 1-hour oral interview was recorded with James W. Corson, Wonder Lake Ranger from 1956 to 1958. He discussed conditions at park headquarters, his jobs at Wonder Lake and burying Johnny Busia. This Park Oral History study has been in progress since 1994 and is a continuing research study, with numerous informants identified as needing to be interviewed.

Archeology

Preparations have been made to initiate two archeology projects. One is the stabilization of the Teklanika Archeological District which has been eroding since being excavated in the 1960s. The other project is a five-year project to survey the areas of the park that have a high probability of being archeological sites. The full survey will begin in 2006.

In 2005, the cultural staff will continue oral history interviews with park staff, former employees, local residents, and others who have knowledge of park history. Historian Frank Norris (Alaska Regional Support Office) continues to conduct research toward writing an Administrative History for Denali National Park and Preserve. Cultural staff will continue to seek out historic park-related photographs to enhance Denali's historic photograph collection.

◂ Research Support ▸

Geographic Information System

A Geographic Information System (GIS) is a computer-based system for storing, analyzing, and displaying spatial information. Anything that can be depicted on a map can be incorporated into a GIS. The Denali National Park and Preserve GIS is used by all functions in the park for preparing maps for planning purposes, public displays, and analysis of park resources. Engineering drawings for construction, mining site rehabilitation, and design work are also produced by the GIS. Denali's GIS includes several hundred layers or themes of information (hydrology, elevations, buildings, roads, etc.) that can be overlain by the computer to form composite maps. In addition to

producing maps and other visual products, the associated databases can be queried in a variety of ways to analyze the features appearing in the maps. The system is managed on a central workstation and used by park staff on their desktop computers.

There have been several notable additions to the park's GIS dataset in the past year. A soils mapping project, which has been on-going for the last 6 years, was completed resulting in a complete soils layer and associated database for the park. A project to collect high-resolution (1 meter) satellite imagery of the park was begun and to date the portion encompassing the road corridor has been collected. It is anticipated that the entire park will be collected over the next 2 to 3 years resulting in a base map far more accurate than the existing USGS Topo Quads.

The park maintains the entire NPS GIS dataset for the state of Alaska locally (over 100gb of data and over 18,000 coverages). Many additional layers of information have been added. The dataset is kept current through updates that are conducted nightly over the internet.

GPS (Geographical Positioning System) has become a valuable tool for park managers in all disciplines. As receivers have become smaller, cheaper, and more precise, the number of units in use in the park has grown dramatically. The park glaciologist uses Survey-Grade GPS to measure movements of glaciers within 0.5 meters. Biologists use GPS to document sample site and observation locations within 2 to 5 meters. The backcountry staff uses small, recreation-grade GPSs to document patrol routes, campsite locations and for search and rescue. The maintenance Division uses GPS to document infrastructure such as culvert locations and for laying out construction projects. In the future this tool will increasingly be useful for precisely locating park infrastructure and documenting management activities.

Denali National Park and Preserve Museum

Denali National Park and Preserve's museum collection is an assemblage of objects, works of art, historic documents, photographs, and natural history specimens documenting the human and natural history of Denali.

During 2004, over 200 research requests for information and access were handled and 10 linear feet of archival material were cataloged. The museum collection includes over 6700 individual objects and 68 linear feet of archival material and collections. Natural history specimens, mostly plants and mammal bone samples, number 5059 items bringing the total object count to 245,379. The majority of the collection is maintained in a storage facility in the Headquarters area.

In 2004, work space was further reconfigured and upgrading vault storage continued in the museum. In addition, 2004 was the first year of a four-year project to organize and catalog culturally significant archival collections. Two staff from the regional office conducted an archival survey at Denali to identify what is in the museum archives as well

as to identify other documents that should be added to the archives. In 2005, container lists and finding aids are being developed so the information can be searched and retrieved more easily for research purposes.

For an appointment to access the collection, please call Ann Kain at 683-9607 or 644-3615.

Research Administration

As of May 15, 2005, 718 study numbers have been assigned to scientific and scholarly studies. Some studies are in progress, some in review for 2005, and some have taken place in the park over the years. Each year there are approximately 50-75 studies that are ongoing or recently completed. These projects are either conducted by Denali staff (described in this document) and park cooperators (e.g., U.S. Geological Survey, Biological Resources Division, and the Alaska State Department of Fish and Game), or by other investigators (e.g., from other agencies and institutions). Appropriate research gathers information while making minimal impacts to park resources. Scientific research on arctic and subarctic ecosystems has been integral to the understanding, management, and protection of resources at Denali National Park and Preserve since the early 1900's.

Any scientist wanting to conduct research must submit a study proposal and fill out an application. To expedite this process, the National Park Service developed a Research Permit and Reporting System (RPRS). Beginning in 2001, scientists file an application using the RPRS website (http://science.nature.nps.gov/research). Denali Park staff review the application and study plan for any administrative, scientific, or compliance concerns, assess how the proposed project fits in with the overall science goals of the park, and set the conditions of the research permit, if approved and issued. Collecting permits may be granted for limited collecting of objects, whole organisms, or parts of organisms (e.g., leaves). Some samples may be destroyed while being analyzed. Some animals may be collected and released after they have been measured or tagged.

Each researcher reports his/her results in an Investigator Annual Report (IAR). Anyone can access and read the Investigator Annual Reports for projects conducted in Denali and all national parks by going to the website http://science.nature.nps.gov/research. Beginning in 2002, each researcher at Denali is expected to include an educational component to their project, in addition to filing an IAR.

Study files about each research project are kept in fireproof file cabinets in the resources building. Reports, dissertations, and publications resulting from scientific studies become part of Denali's resources technical library. Arrangements can be made to use these materials by contacting the Lucy Tyrrell, Research Administrator at (907) 683-6352. Computer databases are maintained about the research studies and the library volumes. Archived documents and collections are housed in the Denali National Park Museum or are loaned temporarily to other institutions.

Recent Resource Milestones

The Murie Science and Learning Center (MSLC) continued to grow its fee-based and educational programs to carry out its mission of "provide research, discovery, and learning opportunities within northern Alaska National Parks, and to promote understanding and appreciation of our natural and cultural heritage". The MSLC is one of 32 centers planned as part of the National Park Service's Natural Resource Challenge.

Because of Denali's role as a Long-term Ecological Monitoring prototype park, Denali was able to play an important leadership role in the **development of an ecosystem and landscape approach to monitoring across all three parks in the Central Alaska Inventory and Monitoring Network (CAKN)**. CAKN's *Vital Signs Monitoring Plan Phase 3 Report* was reviewed by a national panel in 2005.

- The CAKN ***Vital Signs* report** was regarded as one of the best in the National Park Service by the national Inventory and Monitoring Program director!

- Specifically, the CAKN **climate monitoring program** received accolades for its in-depth site evaluation during program development for the *Vital Signs* report, as well as for its draft climate monitoring protocols. This approach to how to establish climate monitoring in parks is now being recommended by the national Vital Signs Monitoring Program to other networks across the nation.

- **Large mammal monitoring in Denali** was substantially enhanced this year by the hiring of Tom Meier (Wildlife Biologist), and by the integration of Denali's large mammal monitoring program with those of the other two CAKN parks—Yukon-Charley Rivers National Preserve and Wrangel-St. Elias National Park and Preserve. Monitoring protocols for wolves and moose were written and approved in 2004; protocols for monitoring caribou, Dall sheep, and grizzly bears are in preparation.

A new **Road Capacity Study** is underway to model the park road's capacity. The model will integrate information from biological, social experience, and logistical constraint studies. If the model shows road use is under capacity, increases in traffic would be staggered over several years. An adaptive management approach using Before-After-Control-Impact (BACI) research would be able to adjust traffic levels to prevent damage to resources or visitor experience.

The feature film and the exhibits in the new Denali Visitor Center are the result of an extended collaboration among Denali's natural and cultural resources staff; Denali's interpretive staff; and the contractors for exhibit design and for fabrication and installation. From the selection of topics in planning exhibits to the final review of exhibit text, graphics, plant and animal sculptures, and artificial landforms for content and accuracy, the collaborative process was highly successful in that it enables high-quality scientific information to be shared in an accurate but fun and exciting way.

LOOK FOR THESE IN 2006:	* Denali issue of Alaska Park Science (Spring 2006)
	* Alaska Park Science Symposium to be held at Denali (mid-September 2006)