



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



*Keeping an eye on park resources: Willow Ptarmigan, grizzly, wolf, snowshoe hare, Mew Gull*

## Summary of Current Resource Projects 2012

All photos courtesy of National Park Service, unless otherwise indicated.

# Table of Contents

## Natural Resources

### *Integrated Programs and Findings*

- Digitizing Research Files (1)
- Natural Resource Condition Assessment (1)
- Denali Park Road Capacity Study (1)
- Central Alaska Network (5)
- Wilderness and Backcountry Management and Monitoring (7)

### *Plants & Vegetation*

- Web-based Project: Ecological Atlas of Central Alaska's Flora, Repeat Photography (9)
- Habitat Study of an Endangered Lichen (9)
- Non-vascular Plant Collection and Identification (10)
- Aspen Phenology Monitoring (10)
- Rock Creek Vegetation Plots (11)
- Off-road Vehicle (ORV) Impacts (12)
- Temperature-Elevation Gradient Study (13)
- Muldrow Glacier Succession Plots (13)
- Landscape Patterns in Vascular Plant Diversity, Tree Species Abundance/Distribution (14)
- Eradication of Invasive Plant Species (15)
- Native Seed Collections (15)
- Monitoring Dust Palliatives on the Park Road (17)

### *Wildland Fire*

- Fire Highlights for 2011 (18)
- Monitoring Wildland Fires (19)
- Defensible Space Projects (19)
- Denali Fire Management and Fire Ecology Program (20)
- Effects of Shortened Fire Return Intervals on Vegetation (20)
- Monitoring Hazard Fuels Reduction Treatments (22)
- Staff Changes (22)
- Fire Education (22)

### *Wildlife*

- Wildlife Observations along the Park Road (23)
- Keep Wildlife Wild (24)
- Bear Monitoring (24)
- Bear Management (25)
- Moose (26)
- Dall's Sheep (26)
- Caribou (27)
- Wolves (29)
- Wolverines (31)
- Snowshoe Hare (and Willow Ptarmigan) (31)
- Small Mammals (31)
- Birds (32)

## *Physical Resources*

- Staff Changes (36)
- Parkwide Climate Monitoring (36)
- Weather Monitoring at Park Headquarters (37)
- Snow Surveys (39)
- Air Quality Monitoring (39)
- Visibility Web Camera (40)
- Monitoring Landslide at Mile 45 (40)
- Paleontological Survey of the Lower Canwell Formation (40)
- Toklat River Dynamics and Gravel Acquisition (41)
- Taking Digital Images of Cabin Peak Dinosaur Footprints (41)
- Soundscape Inventory and Monitoring Program (42)
- Overflights Committee (44)
- Glacier Monitoring (44)
- Glacier Research (46)
- Permafrost Monitoring (46)
- Long-term Stream Monitoring (47)

## **Visitor Characteristics and Social Science**

- Park Visitation (48)
- Improving Estimates of Visitors and their Activities (48)
- Counting Visitors who Use Trails (49)
- Social Norms about Soundscapes (49)
- Visitor Services Project (VSP) Survey (50)

## **Subsistence**

- Federal Subsistence Registration Permits (51)
- Subsistence Resource Commission (51)
- Updating the Denali Subsistence Management Plan (51)
- Understanding Change: How Communities Perceive Climate Change at the Local Level (51)

## **Cultural Resources**

- New Archeologist (52)
- Implementation of the Section 106 Programmatic Agreement (52)
- 1932 Lindley-Liek Movie (52)
- Archeology and Geomorphology of Ancient Lake Minchumina (52)
- Windy Creek Archeological Investigation (52)
- Archeology Survey (52)
- Archeological Site Condition Assessments (52)
- McKinley Flora Manuscript (53)
- Museum (53)
- Historic Research and Outreach (53)

## **Research Support**

Geographic Information System (56)

Research and Resource Communications (57)

Research Administration (59)

## **Researchers in Denali (2011)** (61)

## **Murie Science and Learning Center**

Background (63)

Programs (64)

## **E-Resources** (69)

## **Resources Staff 2012** (70)



# Natural Resources

## *Integrated Programs and Findings*

### Digitizing Research Files

The Resources Division is in the final year of a three-year project to convert to digital format many of the research records that currently reside in fireproof file cabinets in the Resources Building.

In the first year, approximately 1600 of the Resource Technical Library's "reports" were converted to PDF format files. This scanning included many of the library's holdings of technical reports and grey literature, but did not include documents that were too difficult to dismantle for scanning purposes. As new documents are added to the technical library, a digital version is added as well.

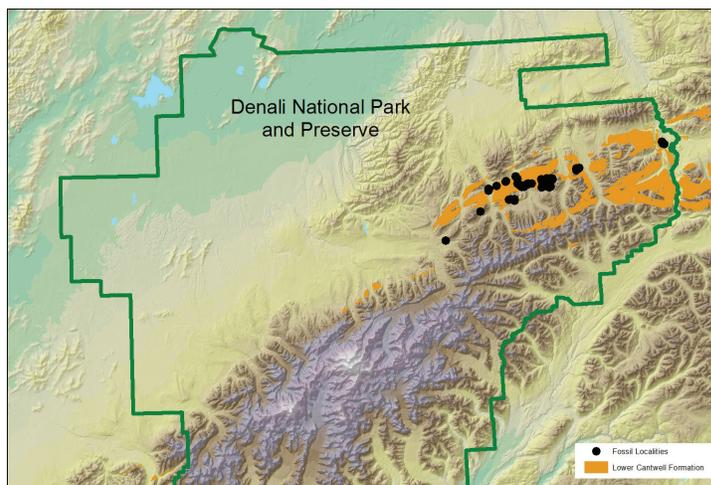
The second phase of the project focuses on the files pertaining to the numerous research projects that have taken place in the park since it was established. This collection of files currently comprises approximately 37 linear feet of records. In winter (late 2010), a graduate student from St. Mary's University of Minnesota documented file content and digitized records from a number of high-priority projects. During that phase, many large format maps and drawings were also digitized, and the scanned maps were geo-referenced for use with the park's GIS database.

In the final phase of the project, the rest of the records are being scanned. A filing and folder framework has been developed for processing and including records from future research projects.

### Natural Resource Condition Assessment

What are current conditions for important park resources? To address this question, Natural Resource Condition Assessments are being developed for each national park, as part of the National Park Service's Natural Resource Challenge.

In 2011, Denali received the products from the Natural Resource Condition Assessment (NRCA) accomplished through a Cooperative Ecosystem Studies Unit agreement with St. Mary's University of Minnesota. These final products include: (1) a 400+ report that includes compiled graphs, tables, charts, and maps and other spatial analyses of existing data on the condition of the park's natural resources, (2) six appendices, with additional analyses of subsistence; Kantishna water quality; administrative flights and soundscape; habitat use by soil type for caribou, Dall's sheep, and moose; influence of humans; and lichen species, and (3) GIS layers of spatially-analyzed datasets.



*An example of a map included in the Resources Condition Assessment is the distribution of fossil sites (dots) within the Cantwell Formation (areas that are mustard-colored) as reported in Reitman and deMoore 2010.*

A copy of the Natural Resources Condition Assessment for Denali (32 MB file) is posted at these sites, which are available to the public.

<http://irma.nps.gov>  
(enter DENA NRCA in the search parameters)

<http://www.nature.nps.gov/water/nrca/reports.cfm>  
(scroll down the list of completed reports to the Denali document)

### Denali Park Road Capacity Study

Provided here are a summary of the road study (2006-2011) and a brief description of what is planned for 2012.

## Overview

In 2006, Denali began a multidisciplinary study designed to optimize visitor experience along the park road while protecting wildlife. Since 1972, traffic on the park road has been limited mostly to buses. Since 1986, a use limit of 10,512 vehicle trips annually has been in effect. Faced with increasing visitation and pressure to defend or change the limits to road traffic,



park managers designed a study to better understand the impacts of traffic volume and traffic patterns on the physical, biological, and social environment of the park. Biologists studied wildlife movements in 2006 (20 collared bears) and 2007 (20 collared sheep). Traffic counters monitored road traffic at several locations from 2006 to 2011. In 2011 a new traffic counter was installed near a sheep migration corridor in the Tattler Creek area. A “quiet night” (no traffic from 10 p.m. Sunday to 6 a.m. Monday) was instituted in 2007 and continued in 2008.

Over several years, social scientists conducted surveys of park visitors about their park road experience: In 2006, they gathered qualitative information about visitor experiences, and used this information to ask specific questions in 2007, in order to select indicators and standards of an “acceptable” park road experience. Researchers returned to Denali in summer 2010 to administer additional surveys designed to further define visitor preferences regarding park road management. A final report on that study is posted at <http://www.nps.gov/dena/naturescience/denali-park-road-capacity-study.htm>.

Traffic patterns were monitored in 2006 by installing 130 GPS units on buses and 40 units in NPS vehicles traveling the park road. From 2007 to 2011, bus drivers on up to 20 buses used touch screen panels to record information about stops along the park road

(e.g., wildlife, passenger drop off and pick up). In 2010 and 2011, bus driver wildlife observations were complemented with a new program that involves park staff riding buses with hand-held computers with GPS capability. This program collected data on wildlife stops, including species, number of animals, distance from the road, behavior, and numbers and types of vehicles at each stop. Staff also noted numbers of vehicles at rest stop and at the Eielson Visitor Center which is a proposed indicator in the Vehicle Management Plan. Researchers gathered information about dust (2007 to 2009) and sound (2008 to 2010) along the park road. A comprehensive model of park road traffic has been developed to predict the effects of changes in traffic volume and timing on visitor experience and wildlife movements.

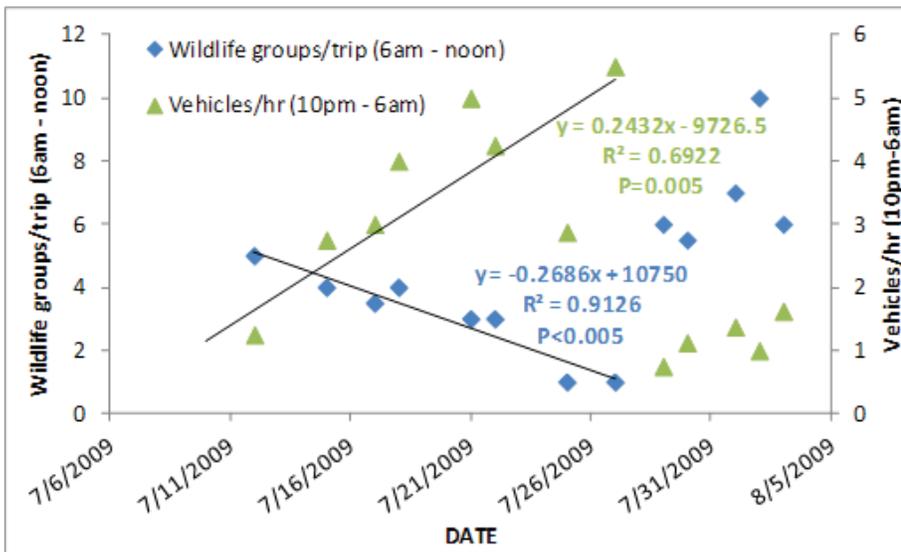
## Plans for Summer 2012

Researchers will continue to collect observational data about sheep and bear behavior along the park road, including riding buses to note wildlife on hand-held computers. New GPS units will be installed on all concessioner buses and NPS vehicles. The new system provides real-time location data via satellite and is being developed as part of the monitoring plan for the Vehicle Management Plan. Each bus will also be equipped with a device that drivers will use to note when they are at wildlife stops. These data will not be used for monitoring wildlife, but as part of the monitoring strategy for compliance with the standard limiting the number of vehicles at wildlife stops.



Vehicles in viewsheds, at rest stops, and gaps in traffic will be monitored automatically with the new system. Because wildlife stops can happen anywhere along the road, driver cooperation is needed to identify these stops. Road study staff will continue observations along the road to ground-truth the GPS data.

Also planned for 2012 is an experiment on the impacts of night-time construction traffic on morning wildlife sightings. As part of a Toklat construction project, trucks will haul material east out of the park, and west to the Mile 70 pit.



*In 2009, as the number of construction vehicles per hour (triangles) increased, the wildlife groups recorded per trip (diamonds) decreased.*

It is hypothesized that the negative impacts to morning wildlife sightings that have been observed during past construction traffic will be mitigated by limiting construction traffic speed, and spacing vehicles to just a few per hour. Road study staff will monitor morning wildlife sightings from buses.

### *Development of the Monitoring Plan for the Vehicle Management Plan*

Results of the Road Study have led to the development of an approach to adaptively manage traffic along the park road based on seven measurable indicators, with associated standards. The comprehensive monitoring program is designed to ensure that any changes in traffic are not having a negative impact on resources and to ensure compliance with the standards.

#### **Indicators for Monitoring Impacts of Traffic for the Vehicle Management Plan**

- (1) Number of vehicles at a wildlife stop**
- (2) Number of vehicles at rest stops and the Eielson Visitor Center**
- (3) Number of vehicles in established viewscapes**
- (4) Gaps in traffic at locations where Dall's sheep are known to cross the road**
- (5) Large vehicle (contractor) traffic**
- (6) Hourly nighttime traffic**
- (7) Hiker wait times**

Six of the indicators (1) through (6) see list above (and their associated standards) are designed primarily to regulate the numbers of vehicles on the park road such that natural resources are protected and the visitor experience is preserved. The first four indicators impact the number of concessioner buses allowed on the park road. Two indicators (5) and (6) limit traffic that has been shown to negatively impact wildlife sightings.

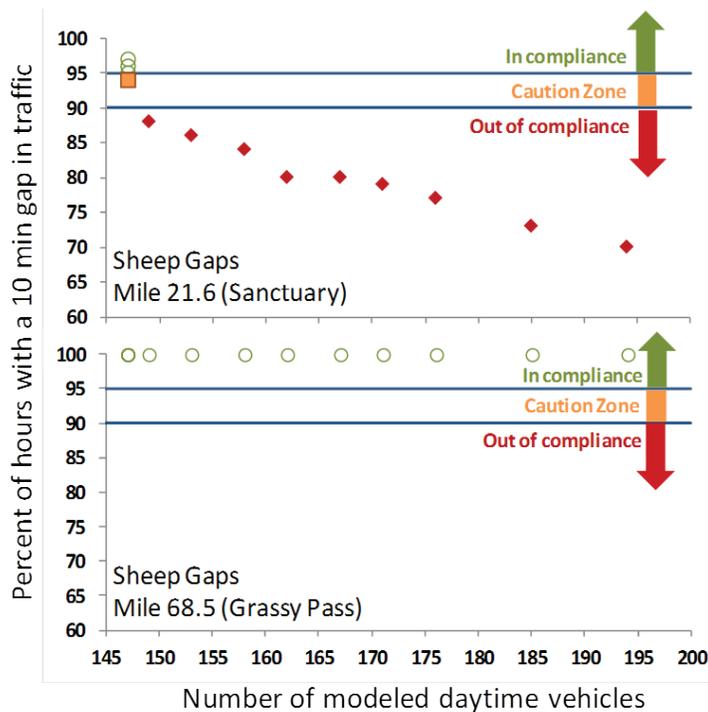
One additional indicator (7), hiker wait times, does not limit traffic volume, but is designed to ensure adequate visitor access via the transit system.

A previous part of the Road Capacity Study involved equipping all concessioner buses and many other vehicles traveling the park road with GPS units to collect detailed information on their movements. From these data, a micro-simulation model was developed that will allow the park to test how different schedules may meet the standards set for the indicators. This traffic simulation model was used to test sample schedules for compliance with the standards set for indicators (1) through (4). The purpose was to give park managers an idea of how many vehicles could use the park road daily while meeting the standards for these indicators.

In general, based on model results, increases in concessioner buses above baseline (usage in 2007) resulted in a lack of compliance with the standards for vehicles at a wildlife stop and sheep gaps. While viewsheds showed little change in compliance until

concessioner bus numbers were increased by more than 30 percent, sheep gap and number of vehicles at a wildlife stop showed rapid declines in compliance with increasing traffic levels. According to the models, the baseline schedule representative of the daily maximum number of concessioner buses allowed under current (2011) management was not likely to meet the standards. Two concessioner buses had to be removed from the schedule before reasonable compliance was found.

Specifically, model results for the sheep gap spacing indicator highlight how increasing traffic levels result in loss of compliance in meeting this standard along the road. Mile 21.6 showed the least amount of compliance with this standard with increasing traffic levels, and generally vehicle levels above 147 during the day (160 including nighttime vehicles) would not be in compliance with this standard.

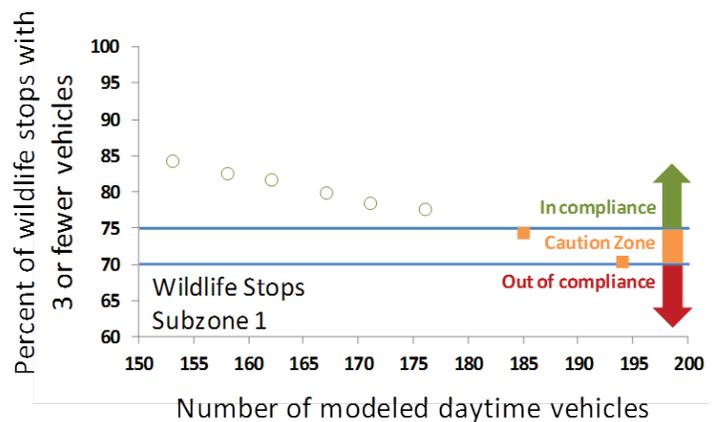


Traffic model results for the sheep gap indicator at two park road locations. All datapoints above the top horizontal line (open circles) are in compliance with the indicator standards. The sheep gap spacing indicator states that Milepoints 21.6, 37.6, 52.8, 60.6, and 68.5 will have at least a 10-minute gap in traffic every hour 95% of the time (23 of 24 hours) averaged over 5 years; and that no one year will have gaps less than 90% of the time (22 of 24 hours).

At this vehicle level, the other sheep gap locations that would be monitored generally met the standard, although care would need to be taken at Miles 37.6 and 60.6. Based on the traffic model results, Mile 68.5 was always in compliance regardless of the number of vehicles.



For the wildlife stop indicator, modelers had a difficult time finding a schedule that would meet the standards in wildlife viewing subzone 2 (Teklanika Bridge to Eielson Visitor Center). Traffic model results indicate that the standard in subzone 1 (Savage Checkstation to Teklanika Bridge) can be readily met at traffic levels of 147 daytime vehicles (160 inclusive of nighttime traffic). However, from the model results, there may be difficulty in running even this level of traffic and meeting standards in subzone 2.



Traffic model results for the wildlife stop indicator for Subzone 1. The standard for the wildlife stop indicator is different depending on the wildlife viewing subzone: at least 75% of stops will have: 3 or fewer vehicles in subzone 1; 2 or fewer vehicles in subzone 2; and 1 vehicle in subzone 3 averaged over 5 years; and no one year will have less than 70% of stops with those values. There are further restrictions to ensure that the other 25% of stops do not have excessive numbers of vehicles.

## Central Alaska Network

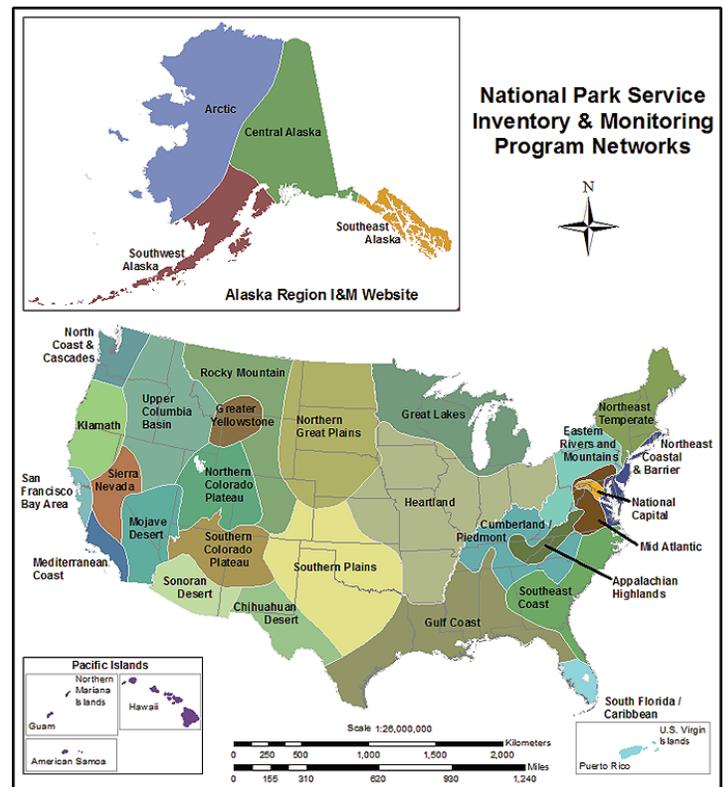
The Central Alaska Network (CAKN, pronounced KACK-en) is one of 32 National Park Service Inventory and Monitoring Networks. Each network exists as part of a national effort to better understand and manage park lands using science-based information. Networks consist of neighboring park units that share similar natural resources. Other Alaska networks include: Arctic Network, Southwest Alaska Network, and Southeast Alaska Network.

The Central Alaska Network is made up of 3 parks: Denali National Park and Preserve, Wrangell-St. Elias National Park and Preserve, and Yukon-Charley Rivers National Preserve. Together, these 3 parks contain over 21.7 million acres and makeup 25% of all the land in the National Park Service. They represent a great diversity of climate and landform, from temperate coastal rainforests to glaciated mountain ranges. What they share in common are their largely wild and unaltered landscapes.

In order to track the condition of our parks, Central Alaska Network scientists have chosen 34 key indicators, or “Vital Signs,” to represent the overall health of the network. Each vital sign falls into one of 4 categories: physical environment, plant life, animal life, or human use. The network is currently working on 19 vital signs (some of these consist of a formally-approved protocol, some are in the final stages of protocol completion). Not all vital signs are monitored in each of the three parks.

**The 12 vital signs that have fully approved protocols that are being implemented in Denali are: air quality, climate, snow pack, glaciers, shallow lakes, vegetation, phenology <aspen>, passerines, golden eagles, moose, wolves, Dall’s sheep (12 vital signs).**

The three vital signs that have protocols nearing completion that are implemented in Denali are: caribou, small mammals, and streams (3 vital signs). All three of these protocols will be in review by the end of spring 2012, and are likely to receive formal approval by fall 2012. The permafrost protocol is in review and thus far has operated only at Eight Mile Lake.



### *What are the CAKN highlights from 2011?*

- **Program Cooperation with Arctic Network**  
Like many of the networks, the CAKN and the Arctic Network have several vital signs in common. These two networks have cooperated to use the same sample designs, methods, and analyses wherever practical. The opportunities to either combine or contrast data from the networks provide insights into ecosystem processes in the network parks. To solidify this cooperative approach between the programs, the CAKN and ARCN Boards of Directors signed an Agreement of Program Management in May 2011. This agreement ensures the two networks will continue this approach as long as practical.
- **Connecting German Students with CAKN parks**  
CAKN Physical Scientist, Pam Sousanes, worked with the Murie Science and Learning Center to present climate and science program information to college students from University of Bochum-Ruhr. She presented information via Skype. The new format for outreach has been dubbed “Hikenskype.”

- **Students Inspired by Small-mammal Monitoring**

The fifth year (2011) of the Central Alaska Network's small-mammal monitoring outreach program recruited two local high-school students from Fairbanks to join the small-mammal monitoring project in Denali. Volunteers gave 168 hours of effort during seven days of field work on the Rock Creek legacy plots. Staff provided volunteers with training on small-mammal identification, trapping, and tagging techniques. The volunteers worked side-by-side with biologists and gained hands-on experience trapping and handling small mammals. In addition, volunteers collected data on hand-held computers and practiced backcountry and bear safety skills and leave-no-trace camping.

- **Other accomplishments in 2011**

Established a rating curve for the Toklat River (graph that shows the relationship between river stage (water height in feet) and the discharge (in cubic feet per second))

Collected extensive discharge data in collaboration with Jill Crossman (Oxford University) as part of project to create a hydrologic model for the Toklat Basin

Prepared/published reports and journal articles include a paper describing the network methodology for sheep monitoring (Journal of Wildlife Management), and annual reports for wolf monitoring, glacier monitoring, golden eagle monitoring, and passerine bird monitoring (completed or in review).

### *Looking Ahead to DNA Barcode Library for CAKN Aquatic Invertebrates*

Accurate and consistent identification of aquatic invertebrates can be quite difficult. In 2012, Trey Simmons will loan the aquatic insect voucher specimens collected during aquatic monitoring to the Canadian Centre for DNA Barcoding (CCDB). The Central Alaska Network has entered into a collaboration with scientists from CCDB to develop a DNA barcode library of Alaskan aquatic insects. The CCDB, based at the University of Guelph (where the idea for DNA barcoding originated), is one of the main partners in the International Barcode of Life project, the largest biodiversity genomics initiative ever. One of the primary goals of this project is to construct a barcode library for up to 500,000 species by 2015, and eventually for all multicellular life on earth. DNA barcoding uses a standardized region of the

genome to identify different species based on the DNA sequence. Each species must have a unique DNA sequence in this region, allowing for unambiguous assignment of any specimen to the correct species. Over 100,000 species have been barcoded thus far. Eventually, it will be possible to identify any unknown specimen by comparing its DNA barcode sequence to those in the library.

Under the agreement with CCDB, the CAKN will provide accurately identified invertebrate specimens to the CCDB. In return, the CCDB will extract and sequence the barcode DNA, and enter the barcode sequence into the database. Voucher specimens will be returned, as only the very tip of an antenna or leg is needed to get enough DNA for the barcoding.

One of the reasons the CCDB is interested in using the CAKN voucher specimens is the lengths CAKN goes to to assure accurate identification.

The three primary benefits from the collaboration:

1. DNA barcoding will allow the identification of aquatic larvae so it will be possible to know exactly how many species there are, and what they are.
2. It will be possible to confirm whether the four specimens, which are thought to be from four previously undescribed (new) genera (one from the dance fly family Empididae, one from the stonefly family Capniidae, two from the midge family Chironomidae), are indeed new genera. How cool is that to find four new genera of aquatic insects?
3. The CAKN will have the best-documented and most accurate voucher collection anywhere. This collection will allow invertebrates to be identified with confidence, even if the primary identification specialist Mike Cole were to leave ABR, Inc. (where the CAKN collections are now identified).

For more information:

<http://ibol.org/>

<http://www.barcodeoflife.org/>

## Wilderness and Backcountry Management and Monitoring

2012 marks the opening of a new chapter for wilderness and backcountry management and monitoring at Denali. The new Backcountry District Ranger position will be in charge of overseeing implementation of Denali's 2006 Backcountry Management Plan. As of this writing (early May 2012), this position hasn't been filled so in the meantime Ranger Matt Smith and Backcountry Resources Coordinator Rob Burrows are filling the duties of this position.

The primary affirmative mandate of the 1964 Wilderness Act is that land management agencies preserve the wilderness character of all areas designated as wilderness. In the last four years, a framework for describing just what wilderness character is, has emerged and is proving to be a powerful tool in monitoring, mapping, planning, and clearly communicating wilderness issues.

In the framework wilderness character is divided into five qualities; (1) natural, (2) untrammeled, (3) undeveloped, (4) outstanding opportunities for solitude or a primitive and unconfined type of recreation, and (5) other features of ecological, geological, scientific, educational, scenic, or historical value (see next page for further explanation).

The definitions of these qualities are standard across all wilderness areas, but what indicators and measures are used to represent each quality is chosen locally and unique to each area.



Monitoring certain conditions and indicators using the best available science is an important effort in tracking and preserving wilderness character, protecting Denali's resources, and providing opportunities for high-quality visitor experiences in the backcountry. Efforts are underway to implement monitoring of

the indicators of visitor experience and resource conditions that are identified in Denali's 2006 Backcountry Management Plan. This monitoring is an inter-divisional and interdisciplinary team effort. Below are the focus areas of park staff for 2012:

*Informal (Social) Trail Monitoring* – Rob Burrows and Monitoring Rangers Alonzo Mandanna and Sarah Hayes are focused on implementing a new protocol for monitoring informal trails in the backcountry. This protocol was developed by Jeff Marion and Jeremy Wimpey of Virginia Tech and Denali's former Wilderness Coordinator Joe Van Horn.

*Triple Lakes Visitor Use and Encounter Rates* – Andrew Ackerman, Denali's Social Scientist, has designed a study to determine if the park is meeting the Backcountry Management Plan standards for encounter rates of other hikers and large groups on the Triple Lakes Trail. This will gauge the impacts to visitors' opportunity for solitude on the trail without a survey. Numerous park staff will hike the trail to collect data on encounter rates with other hiking groups.

*Monitoring Aircraft Overflights* – The Denali Aircraft Overflights Advisory Council updated their best practices recommendations for air taxi and flightseeing operators. This includes avoiding the crest of the Alaska Range and the area immediately north of the crest between Refuge Valley in the Sanctuary River drainage and Anderson Pass. In order to measure any changes to impacts, park staff will monitor aircraft overflights using soundscape stations and direct observations by backcountry rangers when they are out on patrol.

*Wilderness Character Spatial Modeling* – In conjunction with Peter Landres and James Tricker of the Aldo Leopold Wilderness Research Institute, park staff are working to create a wilderness character spatial model. This model uses digital map layers of various measures—which have been chosen by park staff with long and deep experience in the Denali Wilderness—that are thought to degrade each of the five wilderness character qualities. A draft map will be available in late summer or fall 2012. For more information and to see an example of a map and report for Death Valley: [www.wilderness.net/toolboxes/documents/WC/Mapping%20wilderness%20character%20in%20Death%20Valley%20NP.pdf](http://www.wilderness.net/toolboxes/documents/WC/Mapping%20wilderness%20character%20in%20Death%20Valley%20NP.pdf)

**SUMMARY OF QUALITIES, INDICATORS, AND MEASURES OF WILDERNESS CHARACTER**

<p><b>NATURAL</b> Wilderness "...is protected and managed so as to preserve its natural conditions"</p> <p><b>Wilderness ecological systems are substantially free from the <u>effects</u> of modern civilization</b></p> <p>Indicators are:</p> <ul style="list-style-type: none"> <li>• Plant and animal species and communities</li> <li>• Physical resources</li> <li>• Biophysical processes</li> </ul> <p>Measures could include:</p> <ul style="list-style-type: none"> <li>• abundance/distribution for species of concern</li> <li>• non-native species</li> <li>• grazing allotments</li> <li>• visibility, ozone, chemical deposition</li> <li>• departure from natural fire regimes</li> <li>• loss of connectivity</li> <li>• measures related to climate change</li> </ul>	<p><b>UNTRAMMELED</b> Wilderness is "...an area where the earth and its community of life are untrammed by man..." and "...generally appears to have been affected primarily by the forces of nature"</p> <p><b>Wilderness is essentially unhindered and free from the <u>actions</u> of modern human control or manipulation</b></p> <p>Indicators are:</p> <ul style="list-style-type: none"> <li>• Actions authorized by the Federal land manager that manipulate the biophysical environment</li> <li>• Actions <u>not</u> authorized by the Federal manager that manipulate the biophysical environment</li> </ul> <p>Measures could include:</p> <ul style="list-style-type: none"> <li>• spraying weeds</li> <li>• suppressing or lighting fire</li> <li>• introducing non-native species</li> <li>• unauthorized actions such as predator control</li> </ul>
<p><b>UNDEVELOPED</b> Wilderness is "...an area of undeveloped Federal land...without permanent improvement or human habitation" and "...where man himself is a visitor who does not remain"</p> <p><b>Wilderness retains its primeval character and influence, and is essentially without permanent improvement or modern human occupation</b></p> <p>Indicators are:</p> <ul style="list-style-type: none"> <li>• Non-recreational structures, installations, developments</li> <li>• Inholdings</li> <li>• Use of motor vehicles, motorized equipment, or mechanical transport</li> </ul> <p>Measures could include:</p> <ul style="list-style-type: none"> <li>• authorized installations and developments such as scientific equipment, radio repeaters, fish barriers</li> <li>• unauthorized installations and developments</li> <li>• inholdings</li> <li>• administrative and emergency uses of motor vehicles, motorized equipment, or mechanical transport</li> <li>• unauthorized uses of motor vehicles, motorized equipment, or mechanical transport</li> </ul>	<p><b>SOLITUDE OR PRIMITIVE AND UNCONFINED RECREATION</b> Wilderness "...has outstanding opportunities for solitude or a primitive and unconfined type of recreation"</p> <p><b>Wilderness provides outstanding opportunities for solitude or primitive and unconfined recreation</b></p> <p>Indicators are:</p> <ul style="list-style-type: none"> <li>• Remoteness from sights and sounds of people inside the wilderness</li> <li>• Remoteness from occupied and modified areas outside the wilderness</li> <li>• Facilities that decrease self-reliant recreation</li> <li>• Management restrictions on visitor behavior</li> </ul> <p>Measures could include:</p> <ul style="list-style-type: none"> <li>• visitor use</li> <li>• area affected by travel routes</li> <li>• night sky visibility</li> <li>• impacts to soundscape</li> <li>• authorized recreation facilities such as trails, toilets, bridges, shelters</li> <li>• unauthorized recreation facilities such as user-created campsites, illegal motorcycle/ATV trails</li> <li>• visitor management restrictions</li> </ul>
<p><b>OTHER FEATURES</b> Wilderness "...may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value."</p> <p><b>Wilderness preserves other tangible features that are of scientific, educational, scenic, or historical value</b></p> <p>Indicators and measures of other features must be identified separately for each wilderness, and not readily fit within one of the other qualities. Examples include cultural and historic sites, and paleontological features.</p>	

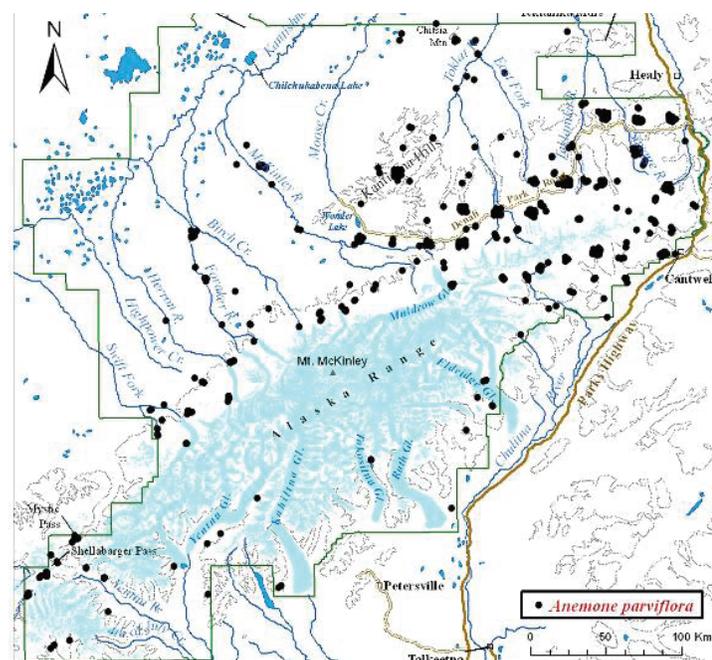
Modified from -- *Keeping it Wild: An Interagency Strategy to Monitor Trends in Wilderness Character Across the National Wilderness Preservation System. 2008. USDA Forest Service RMRS-GTR-212. Fort Collins, CO.*

# Plants and Vegetation

## Web-based Projects: Ecological Atlas of Central Alaska's Flora and Repeat Photography

Visitors to Denali's web pages will soon be able to explore two web sites that are major syntheses of information about Denali's plant species, vegetation community data, and the ecology and landscape change patterns of interior Alaska. Whether a virtual visitor is preparing for a visit to the park or conducting research, the visitor can access and explore these products at their own pace and from their own home or office.

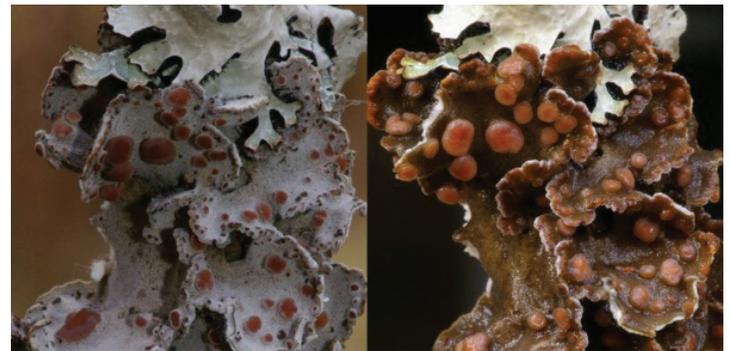
*An Ecological Atlas of Central Alaska's Flora* will synthesize plant species and vegetation community data integrated from the botany staff's inventory, monitoring, and research efforts over the past 12 years. The website will provide detailed ecological, geographic, and community data summaries for both vascular and nonvascular species. The species summaries will be accompanied by narrative material, photos, species descriptions, and maps (see example for windflower *Anemone parviflora* below). The detailed planning, design, and compilation of written and visual materials for these websites is well underway, with unveiling planned for 2013.



## Exploring Landscape Change through Repeat Photography

This is a web version of an existing interactive exhibit that will feature over 200 historic and recently matched photo pairs. These photo pairs can be searched or browsed by type of landscape change, ecoregion, and location along the park road. This website expands on the exhibit of 30 photo pairs that was installed in the Murie Science and Learning Center in 2010. The MSLC exhibit was updated in 2011 to include a narration track for visually-impaired visitors. It is also viewable at [go.nps.gov/denalandchange](http://go.nps.gov/denalandchange).

When the two websites are completed, they will be accessible from [www.nps.gov/dena](http://www.nps.gov/dena) (Denali's website) and <http://science.nature.nps.gov/im/units/cakn/> (the Central Alaska Network website).



*Erioderma pedicellatum*

## Habitat Study of an Endangered Lichen

During fieldwork for the bryophyte and lichen inventory (2007-2008), the globally rare and endangered lichen *Erioderma pedicellatum* was discovered growing at four forested locations along the southern edge of the Alaska Range in Denali. Over the past three summers (2009-2011), vegetation crews revisited all four of the original collection localities to thoroughly describe the species' habitat and investigate its abundance in what is only the third known population center in the world.

Field observations suggest that *E. pedicellatum* is found primarily near the tips of dead branches in the lower canopies of live white spruce trees. Final analyses of habitat preferences (does the lichen only grow on trees of a certain size? what are the forest characteristics where the lichen grows) and a discussion of abundance patterns within Denali will be compiled into a paper for submission to an appropriate scientific journal in 2012.

## Nonvascular Plant Collection and Identification

Over the last 10 years, botany staff have quantified the ground-layer communities of bryophytes (mosses, hornworts, and liverworts) and macrolichens at 1600 sites, making this one of the largest efforts of its kind in North America. Of the 12,000 specimens collected, staff have now identified 84 percent of the bryophyte and 92 percent of the lichen collections.

As the monumental task of identification is nearing completion, staff are poised ready to share significant new information about species distributions, species associations, and abundance patterns of these species across a variety of ecological gradients. Across the park, mosses and lichens cover an average of 61 percent of the ground layer. Thus knowledge of their distribution and abundance patterns are key to predicting potential shifts in vegetative communities subject to a changing environment.

Several publications in relevant scientific literature are planned or in process about Denali's nonvascular plants, including an updated species list of the bryophytes of Denali (147 species added to the list since the last published list from 1973).

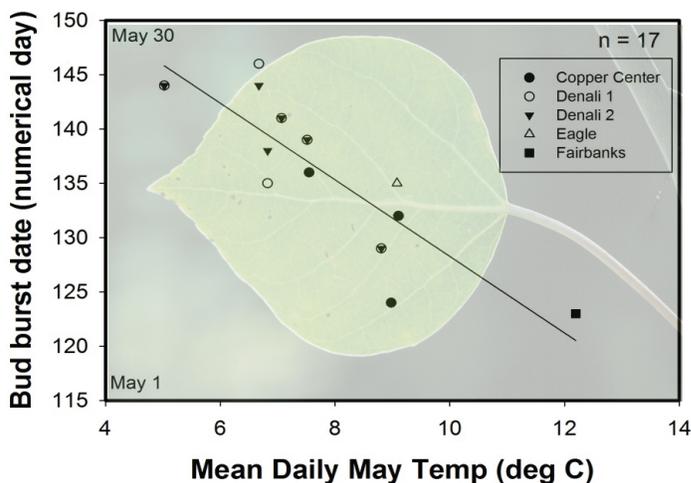
Significant botany program efforts about nonvascular plant biodiversity and rare species include:

- Denali's nonvascular species list has reached 1000 species (an increase of 40%)
- When botany staff collected the moss *Iwatsukiella leucotricha* with sporophytes in Denali, it was only the second collection of this moss with sporophytes in North America
- When staff collected the moss *Dicranum flagellare*, in Denali, it was the only the second known location in Alaska, and the farthest west occurrence in North America
- Important macrolichen finds include *Erioderma pedicellatum*, a new record to the United States and Western North America, *Collema leptaleum*, a new record to Alaska, and a new-to-science species of the genus *Parmelina*, currently being described.

## Aspen Phenology Monitoring:

The Central Alaska Network is monitoring the phenology of aspen (*Populus tremuloides*) flowering, leaf-out, and senescence. Phenology (nature's calendar of biological events) is being monitored because climate change may be extending the growing season of plants in northern latitudes and high elevations. A longer growing season has important consequences for plant growth and reproduction, plant-animal interactions such as herbivory and pollination, and factors interacting with climate such as carbon exchange.

Carl Roland, Denali's botanist, began monitoring the phenology of aspen in Denali in 2005, and in other locations (Eagle, Copper Center, and Fairbanks) soon after. Aspen was chosen because it is a circumpolar species monitored by other phenology programs. The objectives are to determine whether the dates of aspen flowering, leaf-out, and senescence are changing over time and what climatic variables are the most significant cues to aspen phenology. From results so far, leaf-out in aspen is highly correlated with spring temperatures, i.e., leaf-out occurred earlier when mean daily May temperatures were higher (see figure below).



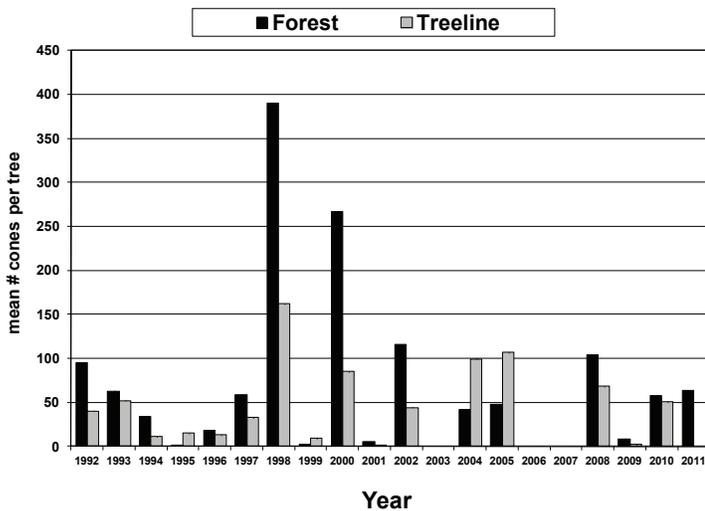
Length of the growing season varied from year to year. In one plot in Denali the longest growing observed was 114 days in 2005 and the shortest was 90 days in 2006 (date of green up varied while senescence was more stable). This 22% variation represents a considerable difference among years in the time available for aspen growth and development. Overall, the initial observations suggest warmer springs will lead to earlier green-up and longer growing seasons, while warmer, drier summers and autumns may lead to later senescence.

## Rock Creek Vegetation Plots

Carl Roland and his botany crew continues to monitor vegetation plots installed in 1992 within the Rock Creek drainage near Park Headquarters.

### *Spruce Tree Growth and Reproduction*

Each summer, staff measure the annual growth, cone production, and seed production of selected white spruce trees in the permanent plots. Spruce cone production has varied substantially among years, with especially high productivity observed in the years 1998, 2000, and high productivity in 2002, 2004, 2005, and 2008. Low cone production occurred in the years 1999, 2001, 2003, 2006, and 2007. In 2011, the spruce trees in this study produced an average of 64 cones per tree in the forested sites and zero cones per tree at treeline. These results break the trend (begun in 2004) that the smaller trees at treeline produce nearly as many or more cones than the larger lowland forest trees. On average, the trees in the forested sites have produced more cones per tree than did trees in the treeline plots over the course of this study.



*White Spruce Cone Production in Rock Creek Plots*

### *Permanent Vegetation Plots*

In 2011, the botany crew completed the third 10-year resampling of permanent vegetation plots. Plots are distributed among riparian, forest, permafrost, treeline, and tundra site locations. Data collected on these plots includes such variables as quadrat-level species composition and cover, soil depth and type, tree data, seedling and sapling data, log decay class, and tree/shrub mapping.

When the plots are sampled, a photo is taken at each corner of each of the square plots. The change, or lack of change, in some photos was immediately apparent. For example, Riparian Plot 2 (see photo pair below), the original plot marker had been completely buried by flood-deposited debris in the Rock Creek drainage. It was only because the crew had GPS coordinates, that it was possible to find the plot.

*Rock Creek Riparian Plot 1997*



*Rock Creek Riparian Plot 2011*



Another example of changes in vegetation in the Rock Creek drainage over the past twenty years occurred in the permafrost plots. Seedling tags that had been placed at the base of the tree in 1993 were buried by a mat of mosses, which, in some cases, was a foot deep in 2011. In the tundra plots, slumping of the soils had caused noticeable shifts in the alignment of some plot markers.

The 2011 decadal reading of the Rock Creek permanent plots was a successful step in long term ecological monitoring.

## Off-Road Vehicle (ORV) Impacts

In 2011, botany staff completed the fifth season of the ORV impacts monitoring program in the Cantwell Traditional Use Area (TUA). The staff also assessed (for the third time since 2003) impacts from an illegal incursion trail west of the the Bull River (not in the Cantwell TUA).

### *Trail length*

Using Trimble GPS units with sub-meter accuracy, technicians mapped 19.4 km of trail in the Cantwell TUA and 5.2 km in the Bull River area. There has been a 20 percent decrease in total mapped trail length since 2007 for the three main subsistence ORV trails of the Cantwell TUA (Windy Creek, Pyramid Creek, and Cantwell Creek). This reduction is partially due to the consolidation of trail-use to the designated trail only.

### *Repeat photography*

Repeat photography of all ORV trails allows a visual comparison of trails over time. Within the Cantwell TUA, these photos show that impact conditions have generally remained similar through time. Some sites in the Bull River incursion area (only disturbed once), showed discernible recovery of vegetation since they were last visited in 2004.

### *Plans for 2012*

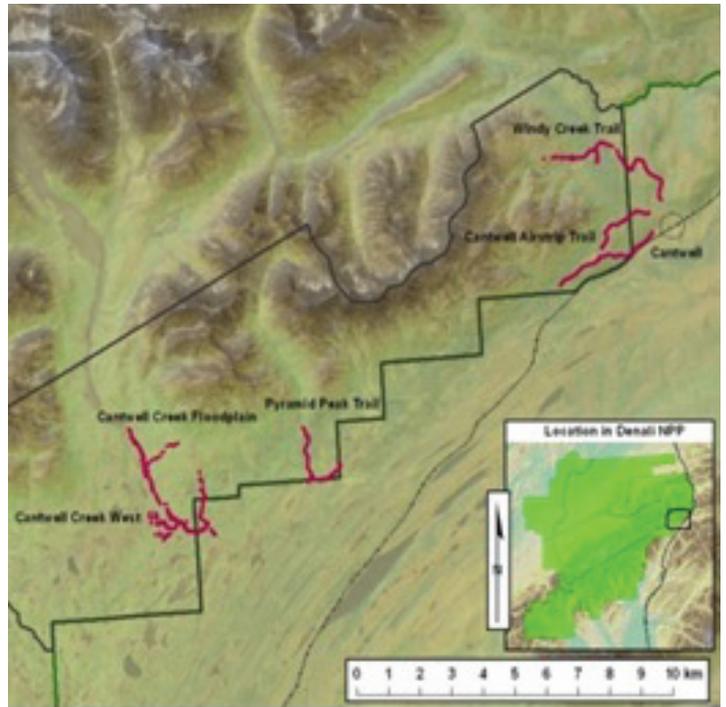
In 2012, staff will continue to monitor ORV use in the Cantwell TUA and perform Denali repeat photography and trail mapping protocols to document conditions. In an area of wet meadows west of the Cantwell Creek Floodplain, (closed to ORV use), there are seven vegetation recovery plots which are being monitored to determine the rate of recovery from disturbance by vehicles. Referred to as the Cantwell Creek West area, this area has experienced considerable injury due to ORV incursions in the past. In the vegetation plots, technicians collect data such as species composition and cover, soil type and depth, and perform repeat photos each year.



*Cantwell Traditional Use Area 2007*



*Cantwell Traditional Use Area 2011*



## Temperature-Elevation Gradient Study

This Central Alaska Network (CAKN) project is placing small, relatively inexpensive dataloggers to measure temperatures of the air (at ground level) and soil surface temperatures along elevation gradients in the three network parks (Denali, Wrangell-St. Elias, and Yukon-Charley Rivers). The goal is to better understand the relationship between elevation and temperature in the three CAKN parks, and how this relationship impacts vegetation patterns. A pilot study for this project has been underway in Denali for the past two years (elevation transect on Mount Healy), and will be expanded to all three parks in 2013.

The idea for this project arose when there were striking patterns revealed during the analyses of more than 1400 permanent vegetation plots across the three parks. There were major differences in the elevation position of treeline and shrubline among study areas in these parks. Specifically, the peak abundance of woody plant species shifted approximately 200 to 400 meters (600 to 1200 feet) higher in the eastern Alaska Range in Wrangell-St. Elias compared to the western Alaska Range in Denali.

Botanist Carl Roland hypothesizes that the differences in the response of vegetation to the elevation gradients among these three parks may be related to the higher growing-season temperatures (continental climate is more pronounced) in the eastern part of the state than in Alaska's western Interior. Comparing an elevational temperature gradient between the western and eastern parts of interior Alaska will shed light on how vegetation may change in response to global warming in central Alaska.

## Muldrow Glacier Succession Plots

During the 2012 field season, Denali botanists will be re-measuring historic vegetation plots located just west of the Muldrow Glacier terminal moraine in outwash of the McKinley River. The goal is to compare plant and soil succession on terraces of the river.

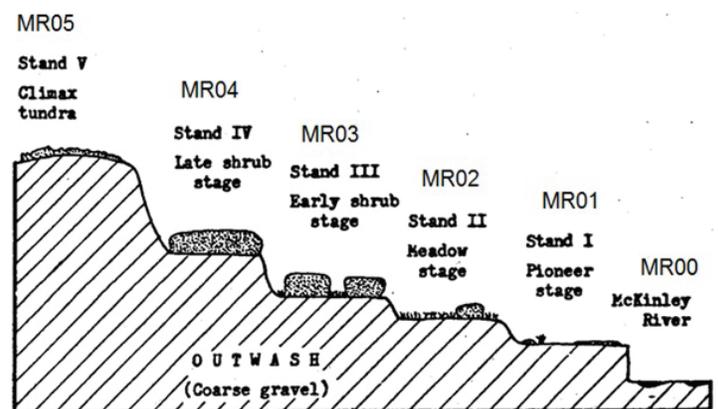
### *History of the plots*

Dr. Leslie Viereck established permanent quadrats on the gravel outwash of the Thorofare River and on the McKinley River in 1958. In the two McKinley River plots, Viereck mapped vegetation and also recorded

species cover. In 1975, Dave and Roseann Densmore re-read the Viereck plots and installed additional ones along newly-created transects intended to sample each stage of succession. Plots along the new transects are designed to document species composition and cover for tree and shrub data. In 2000, staff attempted to locate the 1958 permanent quadrats and the 1975 transects. The two permanent quadrats were located, but only one transect could be positively located. New transects were laid out in the vicinity as the missing transects using maps and photographs to approximate the right location. During the 2000 revisit, Denali researchers established a new transect to represent an early pioneer stage. This transect is located on a new gravel bar (it didn't exist in 1958) that is immediately adjacent to the McKinley River.

### *About the terraces*

The terraces or steps (see diagram below) represent stages of vegetation: early pioneer stage (MR00), pioneer (MR01), meadow (MR02), early shrub (MR03), late shrub (MR04), and climax tundra (MR05). The age of these steps ranges from 25-30 years old (pioneer stage) to 200-300 years old in the late shrub stage, and range in elevation from 748m at the early pioneer stage to 779m at the climax tundra stage.



### *Planned activity in 2012*

During a revisit of the historic Muldrow plots, Denali botany staff will be collecting data on all of the historical plots from 1958 and 1975; as was done in 2000. The location of all plot-markers, transects, quadrats, and repeat photographs will be mapped to sub-meter accuracy with new differential GPS. Detailed vegetation measurements will be completed, including species composition, species cover, tree and shrub counts, and "repeat photos" will be collected. The vegetation of the plots will also be re-mapped to determine changes.

## Landscape Patterns in Vascular Plant Diversity and Tree Species Abundance and Distribution

Researchers have been hard at work analyzing the large CAKN dataset from 10-15 years of data, 3063 sites, and more than 1000 permanent vegetation plots in a grid pattern across the northeastern section of Denali.

### *Modeling Plant Diversity across the Park Landscape*

This exciting new project investigates patterns in plant diversity across the park landscape. Carl Roland and his botany staff have compiled a comprehensive database for 620 vascular plant species. At each sites where plant occurrences were noted, field staff also recorded the site's ecological characteristics—such as elevation, slope angle, lithology, permafrost status. Now, the data are being combined to create statistical models that predict the probability of occurrence for each plant species in the study area. Using the Park GIS, researchers have combined the results of these statistical models for hundreds of plant species to estimate plant diversity at locations across the park landscape. The study area for this analysis is approximately the northeast third of Denali including the entire park road corridor.



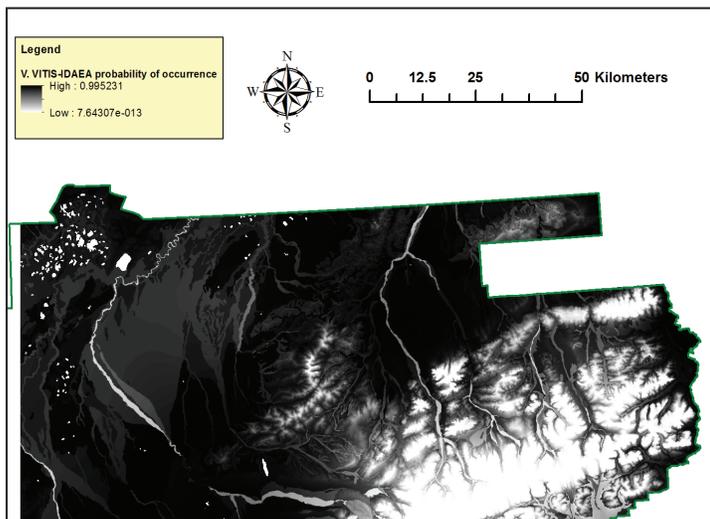
*Low-bush Cranberry*

Modeling plant diversity allows a better understanding of the important ecological and historical factors that have created the park's patterns of biological diversity and of the fundamental ecosystem properties that the park protects.

### *What Tree Species Grow Where in Denali?*

One major synthesis of the vegetation data focuses on the ecological factors that govern the patterns in tree species occurrence and abundance at a landscape-scale. Changes in forest structure or distribution have far-reaching consequences for other ecosystem components. Many predictions have been made about the future of forests in interior Alaska in relation to expected changes in climate in the coming decades. This analysis contributes greatly to the understanding of tree species dynamics in Alaska because: (1) the detailed field measurements of trees and their site characteristics were taken across a very large spatial extent (1.28 million hectares, or one half the size of Vermont), and (2) the randomized study design allows the results to be applied to a very large landscape.

The six native tree species in the park are governed by two primary ecological gradients: (1) the gradient from low elevation, poorly-drained, permafrost-influenced sites with shallow active layers and low soil pH (dominated by *Picea mariana*) to deeply-thawed and more productive sites at mid-elevation with higher soil pH and mineral substrate (dominated by *Picea glauca*); and (2) the gradient from undisturbed sites (dominated by conifers) to those recently affected by disturbance



*Low-bush cranberry is common in lowland sites characterized by permafrost and thick, low-pH organic soils.*

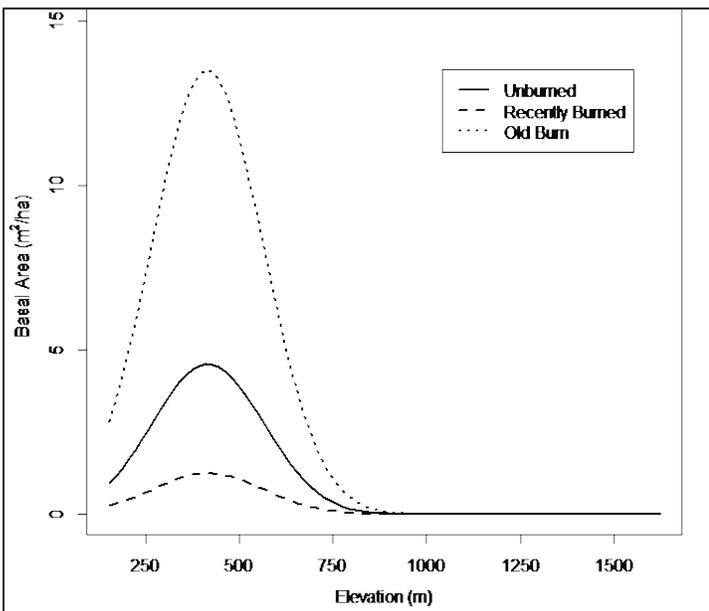
The map above illustrates the patterns in probability of occurrence for one species, low-bush cranberry (*Vaccinium vitis-idaea*). Dark indicates a high probability of occurrence, while light indicates a low probability of finding this species.

in the form of fire and flooding (increased occupancy of broadleaf species like balsam poplar and quaking aspen and birch).



*Balsam Poplar*

The establishment of broadleaf species was largely dependent on disturbance. Mixed forests (broadleaf and spruce) and pure stands of broadleaf trees were rare and occurred in localized areas. As an example, when the abundance (basal area) of Alaska birch (*Betula neoalaskana*) was analyzed by elevation, this species abundance was maximized around 400 m elevation (1200 feet) for all sites, but the basal area was least in recently burned, greatest in “old burn” areas, and minimal in unburned areas. Thus this species thrived (largest basal area of trees) in “old burn” areas.



*Tree abundance (basal area) for Alaska birch in relation to elevation on recently burned, old burn, and unburned sites.*

## Eradication of Invasive Plant Species

Wendy Mahovlic, a.k.a., the Dandelion Queen, along with Student Conservation Association (SCA) interns and volunteers, pulled a total of 650.5 lbs of 11 invasive plant species in 2011 (see table next page). One of the species—Hempnettle—had not been noted in the park prior to 2011.

The two SCA interns contributed hundreds of hours to invasive species work, as well as to collecting and planting native seeds: Eric Walter, 512 hours between May 23 and August 13; Ryohei Yamamori (from Japan), 320 hours between June 29 and August 24. Four volunteers dug dandelions for a total of 136 hours during mid-June.

## Native Seed Collections

Wendy Mahovlic, along with Student Conservation Association (SCA) interns and volunteers, also collected a total of 28 lbs (uncleaned weight) of native seeds for revegetation projects.

Seed collections were made at the east and west ends of the park:

### East End:

*Oxytropis campestris*: 2 lbs  
*Hedysarum alpinum*: 4 lbs  
*Agropyron* sp.: 4 lbs  
*Elymus innovatus*: 2 lbs  
*Hedysarum mackenzii*: 6 lbs  
**TOTAL = 18 lbs**

### West End:

*Hedysarum alpinum*: .5 lbs  
*Agropyron* sp.: 4 lbs  
*Elymus innovatus*: .5 lbs  
*Hedysarum mackenzii*: 1 lb  
*Oxytropis campestris*: 1 lb  
*Epilobium latifolium*: 3 lbs  
**TOTAL = 10 lbs**

Hundreds of pounds of invasive plant species were pulled in 2011 (listed in order of pounds pulled).

If you think you see one of these plants at a location other than the ones listed in the table below, please contact Wendy Mahovlic at 907-683-6246.

Plant Species Removed	Common Name	Pounds Removed	Location Where Removed	Photograph
<i>Vicia cracca</i>	Bird Vetch	200 lbs (lots of dirt)	Mile 1 - 3 park road, Mile 231.75 Parks Highway	
<i>Taraxacum officinale</i>	Dandelion	185 lbs	Mile 1 - 40, Mile 76 - 93 of the park road	
<i>Hordeum jubatum</i>	Foxtail Barley	82 lbs	Recently revegetated areas, Mile 4 park road	
<i>Trifolium hybridum</i>	Alsike Clover	50 lbs (lots of dirt)	Kantishna Horse Corral	
<i>Melilotus alba</i>	White Sweet Clover	45 lbs	Mile 232.5 and Mile 238 Parks Highway	
<i>Crepis tectorum</i>	Hawk's-Beard	40 lbs	Sewage Lagoon, Mile 1 of the park road, Bus parking lot	
<i>Galeopsis bifida</i>	Hempnettle	40 lbs (lots of dirt)	Kantishna Horse Corral	
<i>Linaria vulgaris</i>	Yellow Toadflax	4 lbs	Railroad tracks, Denali Depot	
<i>Hieracium umbellatum</i>	Narrowleaf Hawkweed	2 lbs	Mile 231.75 and Mile 235 Parks Highway	
<i>Tripleurospermum perforata</i>	Scentless False Mayweed	2 lbs	Railroad tracks, Denali Depot	
<i>Silene noctiflora</i>	Night-blooming Cockle	0.25 lbs	Kantishna Horse Corral	

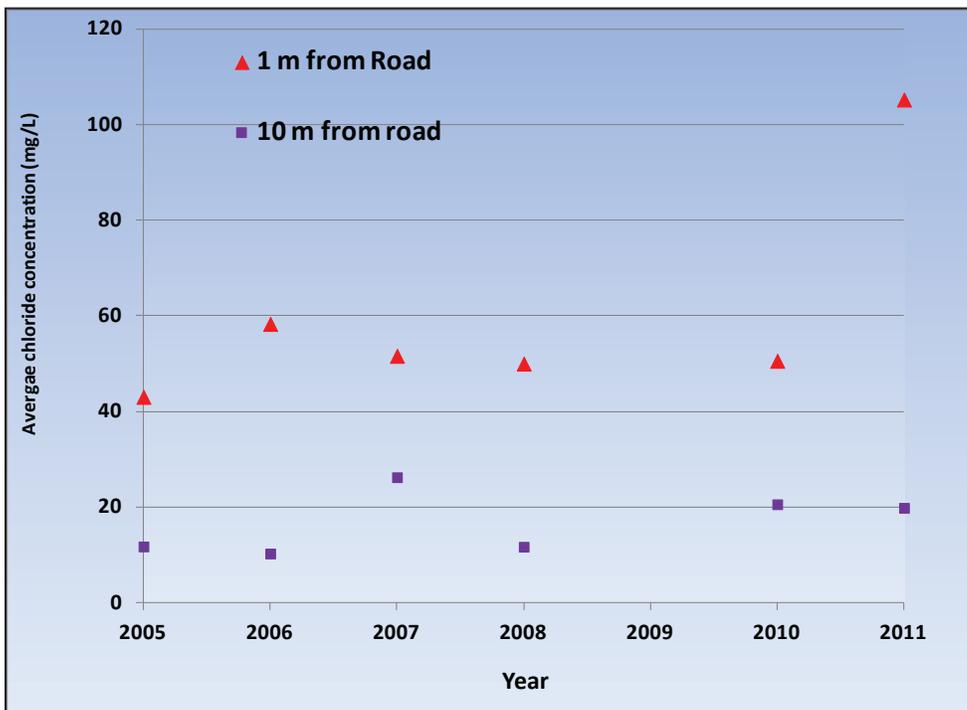
## Monitoring Dust Palliatives on the Park Road

To reduce road dust created by vehicular traffic, park maintenance crews apply an aqueous solution of calcium chloride ( $\text{CaCl}_2$ ) to the surface of the park road. The application reduces dust and the need for replacing the fine materials constantly lost from the road as dust. However, adding this compound also has the potential for adversely affecting ecosystems adjacent to the road.

The National Park Service has developed a monitoring plan to assess and monitor the possible effects on soil, water, and vegetation of applying calcium chloride to the park road.

In 2005, park staff installed 15 pairs of lysimeters (instruments designed to sample water from within the topsoil) at Mile 15.2, 18.6, 22.2, 23.4, 26.9, 28.9, 31.2, 41.5, 49.1, 58.4, 60.4, 64.5, 71.3, 79.8, and 88.4—one lysimeter was buried near the road, and one about 10 meters away. Water samples are being taken annually from lysimeters and nearby water bodies to test for chloride ions.

Average chloride concentration data from soil water samplers from the first six years of sampling (2005 – 2011) are shown in the graph. The high average levels staff observed in 2011 at the road edge were the result of very high concentrations at one station, at a level which may be of serious concern. Staff will continue to monitor these stations in 2012.



*Average chloride concentrations at 15 soil water sampling sites located 1 m (triangles) and 10 m (squares) from the edge of the park road.*

*Samples were not taken in 2009 due to dry weather and an early snow-storm.*

# Wildland Fire

## Fire Highlights for 2011

The only fire in Denali in 2011 was discovered on July 9, 2011. A pilot noticed a black spot and some smoke at the foothills near Chitsia Mountain on the west side of the Toklat River. Lightning in the area of the smoke report had been detected by the lightning detection system three days earlier. This fire was located in the region of the park that usually experiences relatively frequent small (10 acres) to medium (1,000 acres) wildfires. The Chitsia Mountain fire ultimately burned for a little over a month and the final area reported was 2,534.9 acres.



*Chitsia Mountain fire one day after being discovered (July 10, 2011)*

On numerous occasions in 2011, the Western Area Fire Management staff at Denali cooperated with the Alaska Fire Service (BLM) and the State of Alaska's Division of Forestry. Managing fires inside and outside of the park was accomplished by implementing the "Closest Forces" concept, i.e., NPS personnel monitored wildfires in the greater Denali area and took suppression actions on nearby fires. For example, the Park Airstrip was utilized as a helibase for initial actions on fires near Healy, and the Fire Exclusive Use Helicopter was utilized on those fires and others

supporting the State of Alaska's Division of Forestry, Fairbanks Area. Denali's fire staff detailed to the Alaska Interagency Coordination Center Type 2 helicopter module for support of the East Volkmar Fire near Delta and the Hastings fire near Fairbanks. Fire staff also completed other remote wildfire support.

*There was one wildland fire and there were six prescribed fires in Denali in 2011.*

Fire Name	Burn Period	Acres	Fire Type	Comments
Chitsia Mountain	7/9/11 - 8/19/11	2,534.9	Wildfire	Fire ignited by lightning
Lower Savage Pile Burn	2/10/11 - 1/14/11	0.6	Prescribed Fire <sup>1</sup>	Burning of biomass debris from hazard fuels treatment projects
Admin Road 1	4/4/11 - 4/6/11	2	Prescribed Fire <sup>1</sup>	Burning of biomass debris from roadside maintenance projects and hazard fuels treatment projects
Moose Creek Pile Burn	8/12/11 - 8/14/11	0.6	Prescribed Fire <sup>1</sup>	Burning of biomass debris from hazard fuels treatment projects
New Thorofare Pile Burn	8/16/11 - 8/17/11	0.2	Prescribed Fire <sup>1</sup>	Burning of biomass debris from hazard fuels treatment projects
New Birch Creek Pile Burn	8/22/11 - 8/23/11	0.8	Prescribed Fire <sup>1</sup>	Burning of biomass debris from hazard fuels treatment projects
Kantishna Pile Burn	9/19/11 - 9/23/11	6.2	Prescribed Fire <sup>1</sup>	Burning of biomass debris from hazard fuels treatment projects

## 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-nine percent of the burnable vegetation acres (2,983,460 acres) lie within “limited fire management options.” These 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 in the fire’s path. Fire 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.

*Several prescribed fires are planned for 2012*

Fire Name	Burn Period	Acres	Fire Type	Comments
Lower Windy Patrol Cabin	3/2/12 - 3/9/12	0.7	Prescribed Fire	Burn biomass debris from hazard fuels treatment projects
Admin Road 1	3/14/12 - 3/19/12	1.9	Prescribed Fire	Burn biomass debris from roadside maintenance projects and hazard fuels treatment projects
Toklat slash burn	2012	0.9	Prescribed Fire	Burn biomass debris from roadside maintenance projects and hazard fuels treatment projects
Parker Cabin	2012	1.1	Prescribed Fire	Burn biomass debris from hazard fuels treatment projects

## Defensible Space Projects

Hazardous vegetation “fuels” around structures in the developed and backcountry areas of Denali have been or are being reduced to create a “defensible space” around the structures. Firewise is the name given to the creation of defensible space by thinning, limbing, or clearing space around structures. 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.

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 since construction. Spruce were sparse at Park Headquarters in 1947 (see photo below left), but more than fifty years later, major firewising at Headquarters was needed, and was accomplished in 2004.



*Aerial view of Park Headquarters, 1947  
Lowell Sumner Photo, #12508, Harpers Ferry Center*

In 2011, fire management staff improved the defensible space at Park Headquarters, as well as at cabins in the backcountry by trimming branches to varying heights from the ground to give a natural appearance.

In 2012, staff will burn debris from past hazard fuels projects at the Lower Windy Patrol Cabin, as well as the Parker, Igloo, and Sanctuary cabins. Some cutting/thinning will be done at Moose Creek Cabin. The cutting and burns will complete the cycle for the initial treatment of these sites. These sites will then enter a maintenance cycle. The fire crew documents hazard fuels thinning around backcountry structures using photos.

Project Name	Burn Period	Acres	Fire Type	Comments
Headquarters Historic District	May to August 2012	2.0	Main- tainInitial Treatment	Create/improve defensible space
Murie Science and Learning Center	August 2012	1.0	Prescribed Fire	Create defensible space
Toklat Road Camp	2012	1.0	Prescribed Fire	Create/improve defensible space

Throughout the defensible space project, fire staff provide Denali employees with project updates and other fire information.

Hazard fuel success stories are posted at: [http://www.nps.gov/fire/public/pub\\_firestories2011.cfm](http://www.nps.gov/fire/public/pub_firestories2011.cfm)

## Denali Fire Management and Fire Ecology Program

To maintain and understand fire-adapted ecosystems, the Alaska NPS Fire Ecology program provides science-based information to guide fire planning, decisions, and fire management practices. The program focus areas are: (1) provide effective evaluation of Alaska NPS fire management program activities and fire on the landscape through monitoring, (2) coordinate research and facilitate the use of scientific data, modeling, and technology to enhance the fire management program, and (3) provide fire ecology information and outreach to fire managers, other park staff, and the public. The Alaska NPS fire monitoring program is designed to determine whether fire and resource management objectives are being met, as well as to document any unexpected consequences of fire management activities.

*Fire effects* are monitored by establishing vegetation/soil plots in front of active fires or after fires have burned to evaluate the changes as a result of fire on vegetation, wildlife habitat, or soils. Similarly, *hazard fuels reduction (thinning) treatment effects* are monitored by establishing vegetation/soil plots prior to hazard fuels reduction treatments and evaluating them before and after hazard fuels treatments. The fire ecology monitoring fieldwork in Denali is largely accomplished



by Western Area Fire Management seasonal technicians and permanent staff, under the guidance of the regional fire ecologists.

## Effects of Shortened Fire Return intervals

Understanding the impacts of shortened fire return intervals may be important for future climate warming. In general, spruce forests in interior Alaska have a fire return interval ranging from 60 to 150 years. Yet 13 percent of the area burned in Alaska in the past 60 years has burned more than once, including several long-term monitoring plots established by the fire ecology program. This coincidence provided an opportunity to track vegetation response to multiple fire events at varying levels of burn severity at 10 plots in the park.

In 2005, 43 plots were established in one- to five-year-old fires and 10- to 20-year-old fires. During that summer, 10 of the plots were burned again by the 114,000-acre Highpower Creek Fire. To determine the impacts of a short fire-return interval on vegetation, the plots that were burned twice in the last three decades were re-measured in 2006 and 2011. The purpose was to assess impacts of a shortened fire-return interval (sites burned in 1986 or 1990 and again in 2005) on vegetation, fuels, wildlife browse, and permafrost.

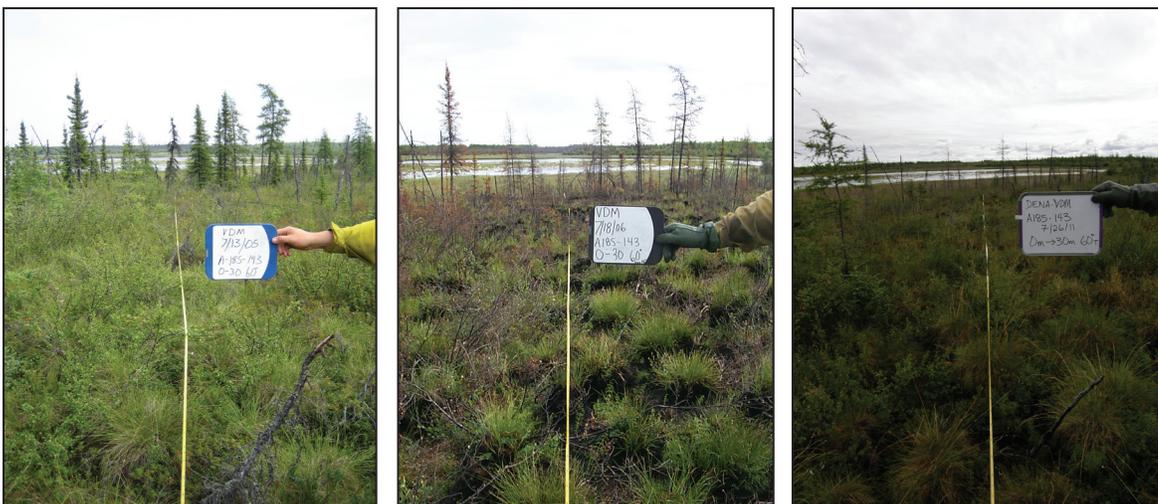
Preliminary analyses suggest that multiple fire events at high levels of burn severity can lead to a forest community type conversion not evident at lower levels of severity. For example, a black spruce forest burned twice at a high level of severity is now a grass-land with a few deciduous trees, with little resemblance to the pre-fire community (upper tier of repeat burn photos), while some forest types appear to be fairly resilient to multiple burns—particularly aspen/spruce forests and black spruce/tussock forests (see lower tier of repeat burn photos).



**Fire effects of a high severity repeat fire in a black spruce feathermoss forest type**

*From L to R:*

*2005: 19 years after a 1986 fire, this black spruce forest had a dense cover of Labrador tea shrubs with small black spruce saplings established. 2006: 1 year after the Highpower Fire burned this plot again in 2005. The second fire burned severely through the highly flammable Labrador tea and burned down to mineral soil. A few deep rooted horsetails and a few shrubs have re-sprouted 1 year post-fire. 2011: 6 years after the repeat fire, the area has sparse grasses and horsetails with some shrubs and aspen growing. No seedlings spruce were detected in the plot, but adjacent to the area some spruce seedlings have established.*



**Fire effects of repeat fire of moderate severity in a black spruce woodland with tussock shrub understory**

*From L to R:*

*2005: 19 years after a 1986 fire, now dwarf birch and tussock tundra where it had presumably been woodland black spruce with tussock understory. 2006: 1 year after the Highpower Fire burned this plot again in 2005. The resilient tussocks have resprouted. 2011: 6 years after the Highpower Fire burned this plot twice, the tussocks and shrubs have continued to grow. Spruce seedlings have established in this twice burned area; likely due to the seed source of live spruce that survived the 1986 fire (see background trees in the 2005 photo).*

## Monitoring Hazard Fuels Reduction Treatments

Monitoring fuels treatment projects is important for adaptive management. One of the first major hazard fuel reduction projects was conducted in at Park Headquarters, the Denali Visitor Center, Employee Housing, and the Toklat Roadcamp.

The study to monitor these areas after they have been Firewised (reducing potential fuels for fires) is designed to: (1) evaluate whether the hazard fuels prescription was implemented, (2) model the effects of the fuels treatment on potential fire behavior, and (3) monitor the effects of the fuels treatments on vegetation and fuels. Plots were established in 2003 (pre-thinning) and the thinning was completed in 2004. Re-measurements of the plots were taken in 2005 (1-year post thinning) and 2009 (5-years post thinning). A final report on this project will be completed in 2012.

## Staff Changes

**Keith Mitchell** will step into the position of Assistant Fire Management Officer, vacated when Charlie Reynar took a fire management position with Rocky Mountain National Park. Keith is scheduled to arrive in Denali in July 2012, driving north with his family from Wind Cave National Park.

**Jennifer Barnes**, fire ecologist for the NPS Alaska Region, is splitting her “office” time between the Fairbanks NPS office and Denali.

## Fire Education

Western Area Fire Management, the Regional Fire Communication and Education Specialist, and Murie Science and Learning Center staff will continue to incorporate wildland fire management messages in select presentations.

The Alaska Western Area fire staff will promote the recently revised Alaska FIREWISE concept in 2012. They will offer Firewise workshops that teach community members how to reduce the combustible material around their homes to reduce the risk of wildland fire.

Each year Fire Management staff provides updated maps and information about fires in and outside of the park. Fire danger information is also updated and posted at various locations.

Recent findings about wildfire ecology are summarized in a fact sheet:

- *Wildland Fire Ecology*

downloadable as a pdf at:

[www.nps.gov/akso/nature/fire/documents/FireEcology2011.pdf](http://www.nps.gov/akso/nature/fire/documents/FireEcology2011.pdf)

Two other fact sheets about Wildland Fire are available at [www.nps.gov/dena/naturescience/factsheets.htm](http://www.nps.gov/dena/naturescience/factsheets.htm):

- *Wildland Fire Risk and Response: Why are you cutting those trees?*
- *Where is all that smoke coming from?*



# Wildlife

## Wildlife Observations along the Park Road

Wildlife sighting data recorded by bus drivers and trained observers constitutes a valuable long term data set. This dataset is useful in monitoring wildlife populations along the road, and also the quality of visitor experience in Denali (because visitors want to see wildlife), which managers are tasked to maintain.

Since 1996, bus drivers and park staff have recorded the numbers of bears, moose, sheep, caribou, and wolves they see on trips along the park road. Initially, data was collected on paper data sheets, but starting in 2006, touch screen panels linked to GPS tracking units on twenty buses allowed the automated collection of wildlife stop data.

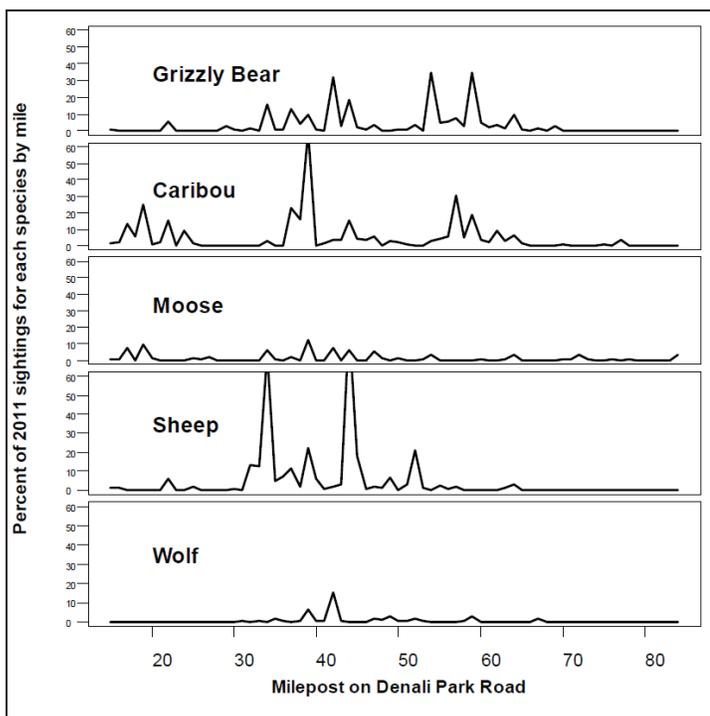
In summer 2012, message display terminals (MDTs) will be installed in the entire bus fleet, in conjunction with a new realtime GPS tracking system, replacing the touch screen panels. Future data collection via the MDT will focus on classifying stops as wildlife stops only. Trained observers will collect the more detailed information on species at sightings, distance from the road and other attributes.



The use of trained observers to record wildlife stop attributes began in 2010, called the Ride Observe and Record (ROAR) project. ROAR observers use handheld GPS receivers for collecting detailed information about wildlife sightings along the park road. ROAR observers collected data on 98 trips in 2011, recording detailed information on 915 wildlife stops along the park road. Based on the ROAR data, the chances of seeing wildlife are as follows...

The percentage of trips on which at least one individual of each of the “big five” species on a bus trip at least as far as Eielson Visitor Center in 2011 was:

- 82% for grizzly bears
- 92% for caribou
- 85% for Dall’s sheep
- 64% for moose
- 21% for wolves



From data collected 1997-2011, the highest probability of seeing a moose was in 1997 (65% of trips); in 2011, it was second highest (64% of trips). From data collected over the last 10 years, visitors going at least as far as Eielson Visitor Center on a bus see at least one grizzly bear from 75 to 90 percent of the time.

The average percentage of trips on which species were seen over the last 12 years (1999-2011) was:

- 84% for grizzly bears
- 91% for caribou
- 82% for Dall’s sheep
- 40% for moose
- 23% for wolves

## Keep Wildlife Wild

Denali's resource staff continues to educate people with the basic message:

### *Keep wildlife wild - do not approach or feed wildlife*

Anecdotal observations continue to indicate that the program is 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, brochures, and signs bearing a universal symbol "Do not feed the animals" with text explaining why this is important. Again in 2010, staff distributed these materials around the park and will do so in 2011. 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. Wildlife staff encourages everyone working at the park to take every opportunity to discourage the feeding and subsequent habituation of wildlife.

## Bear Monitoring

### *Grizzly Bear Monitoring - West*

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. Radio-collared females have been located from den emergence to the end of September to locate and follow the mortality of the sows and their cubs. The study was winding down in 2011, and this part of the park's bear monitoring project will come to a close in 2012 as the efforts make the final shift to a new study area and objectives.

In 2011, bear capture was conducted on May 24 from a helicopter, with fixed-wing aircraft support. Wildlife staff removed collars from 3 female grizzly bears.



Wildlife staff followed 6 collared bears (all female) in 2011, three of which were followed for most of the season. At den emergence, out of the six bears, three sows started the season with a total of 4 yearlings (2 litters of 2) and 3 two-year-olds (one litter of 3). None of the remaining sows produced cubs. The fate of the one litter of 2 yearlings and the litter of 3 two-year-olds could not be determined since the sows' collars were removed in May. Both yearlings in the remaining litter were alive at the end of the season. Four of the 6 yearlings survived.

Staff plan to remove the remaining three radio collars in 2012.

### *Grizzly Bear Monitoring - North*

The transition to a new grizzly bear monitoring study area began in 2009. The new study area is on the north side of the Outer Range between the Kantishna Hills and the east end of the park. The objective of this study is to document the ecology of grizzly bears and movements on the northeast portion of the park, especially outside the north park boundary where they may be subject to legal harvest and possible future predator control efforts by the State of Alaska.

Bear capture was conducted on May 22, 23, and 25, 2011 from a helicopter, with fixed-wing aircraft support. A total of ten bears were captured, three females and seven males. Three bears captured for the first time, and one recaptured bear, were fitted with GPS radio collars. Four bears captured for the first time, and two recaptured bears, were fitted with conventional VHF radio collars. Five females produced a total of 8 cubs (3 litters of twins and 2 single cubs).

One female had one yearling; none had two- or three-year-olds. By late August, five cubs remained.

Bears were radio tracked one to two times per month from May through November. No bears were located outside the park boundary on any flight. Finer resolution GPS data will not be available until September 2012 when GPS collars are scheduled to be recovered. Travel by bears outside the park boundary will not be verified until after that time.

There are currently 19 bears, 15 wearing GPS radio collars and 4 wearing VHF collars in the study.

Plans for 2012 are to deploy 4 refurbished GPS collars and up to 12 VHF collars. The fit of collars on young bears will be checked during May capture operations. All bears will be radio tracked one to two times per month.

## 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.*

Between May 13, 2011 and September 21, 2011, 47 bear-human interactions were documented. These were classified 39 encounters and 8 incidents. The total of 47 BIMS this year marks a 45% decrease from the previous year's total of 86.



*Bear resistant food container*

Of those interactions rated as encounters, 14 occurred in the frontcountry and 25 occurred in the backcountry (see table below). Of the 8 interactions classified as incidents this season, 3 occurred in the front country while the other 5 occurred in backcountry. Backcountry interactions between humans and bears decreased from 65 in 2010 to 30 in 2011, which is approximately a 54% decrease.

<b>Interactions</b>	<b>Frontcountry</b>	<b>Backcountry</b>	<b>Total</b>
Observation	0	0	0
Encounter (when bear is aware of human and thus bear's behavior is altered)	14	25	39
Incident (when bear is involved in close charge, actual contact, or damage to human or property)	3	5	8
Control Action	0	0	0
<b>Total</b>	<b>17</b>	<b>30</b>	<b>47</b>

*Bear-human interactions in Denali that were documented in 2011 in the Bear Incident Management System (BIMS) database*

## Moose

Wildlife biologists used a spatial moose survey estimation method to estimate the number of moose (*Alces alces*) on the north side of the Alaska Range in Denali. The 10,004 km<sup>2</sup> (3862 mi<sup>2</sup>) area was surveyed from November 10-23, 2011. Observers noted 496 moose during the aerial survey. Using the estimation method, there are an estimated 1477 +/- 238 moose for the entire survey area. (There is a 90% chance that the real population number falls within this confidence interval.)



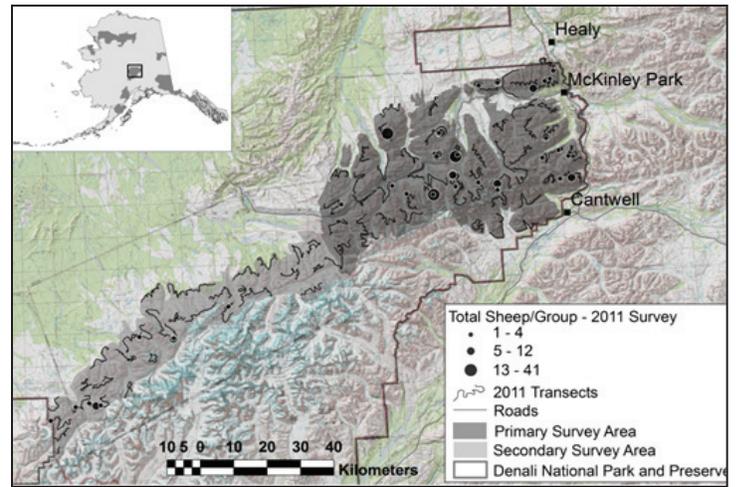
Overall density was 0.15 moose/km<sup>2</sup> (.38 moose/mi<sup>2</sup>). The calf:bull:cow ratio was 29:53:100. The survey results indicate that 75% of cows were without calves, 21% of cows had 1 calf, and 4% of cows had 2 calves present.

## Dall's Sheep

### Aerial Survey

Denali biologists conducted Dall's sheep surveys from July 17-21, 2011 using a new transect survey technique developed by the Central Alaska Network. This survey method enables researchers to survey a large area in a short amount of time and provides statistically robust estimates of population size (for details on the survey design and methods, see Schmidt et al. 2012. The Journal of Wildlife Management 76: 317-327.

In less than a week, surveys of all transects, in both the primary (darker shading) and secondary (lighter shading) survey areas shown in the map, were completed. Results of the survey are shown in the table, with confidence intervals in parentheses. Overall the mean population estimate for the 2011 Dall's sheep population north of the Alaska Range in Denali National Park and Preserve is 2,321.



### Ground-based Surveys

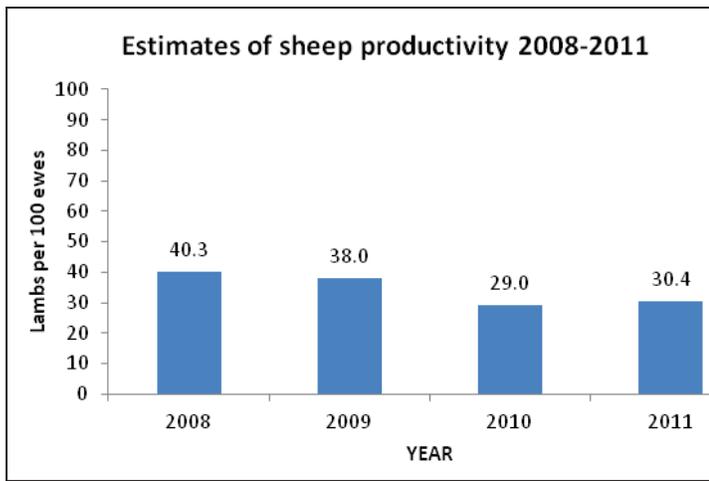
From 2008 to 2011, park staff have conducted annual ground-based Dall's sheep surveys. Ground surveys allow closer and more careful observation of sheep and provide more detailed and accurate composition data, but the areas that can be surveyed on foot are very limited. Staff had conducted ground-based surveys for many years prior to 1998, but summer 2008 was the first year the ground-based Dall's sheep surveys were reinstated since 1998.

Ewe-like	Lambs	Rams (< full curl)	Rams (≥ full curl)	Total Sheep (95% confidence interval)
1,242	314	547	293	2,321
(53%)	(13%)	(24%)	(13%)	(1,840-3,030)

*The percentages for each composition class are approximate and do not total 100% due to rounding errors.*

Denali staff conducted ground-based Dall's sheep surveys on July 20, 2011 on Tattler Creek, Cathedral Mountain, and Sable Mountain. These surveys classified 49 sheep. The lamb productivity estimate was 30 lambs per 100 ewes, above the previous year's estimate of 29 and below 2009 and 2008 estimates of 40 and 38 lambs per 100 ewes (see bar graph on next page).





## Caribou

### *Background and Historical Overview*

Denali has been the site of continuous research on the population dynamics of the Denali Caribou Herd since 1984, with an age-structure sample of radiocollared females since 1987, and a sample of bulls since 2007. Research is currently carried out by USGS biologist Layne Adams and colleagues. The park provides an opportunity to investigate caribou population dynamics where ungulate populations (caribou, moose, and Dall's sheep) and the large carnivores that prey on them (wolves, grizzly bears, and black bears) are largely unaffected by human harvest (hunting, trapping).

Research on Denali's large carnivore/ungulate system serves as an important naturally-functioning benchmark for comparison to manipulated systems. This caribou research is also a component of Denali's large mammal monitoring program, providing data about long-term trends of park wildlife populations and the causes of population changes.

To date, much has been learned about the interactions between predation and weather that drive the dynamics of the Denali Caribou Herd.



### *Objectives*

The current goals of this research are (1) to document population trends, primary vital rates (calf production, calf recruitment, adult female survival), and other important population characteristics (female age structure, adult sex ratios) that determine the status of the Denali Caribou Herd (2) to evaluate growth, survival, and seasonal distribution of adult males of the Denali Caribou. (3) Relate caribou population status, trends, and vital rates to climatic variables and predator population characteristics.

The data presented here represent information gathered during October 2010-September 2011.

*When this study began in the mid-1980s, the Denali Herd was increasing at about 7 percent per year during a period of relatively mild winters. Survival of caribou cows was high (96% per year) and about 50% of the calves produced were recruited. With the onset of a period of severe winters in 1988, caribou numbers leveled off at 3,200 in fall 1989, then declined by one-third over two years to approximately 2,300 caribou by fall 1992. During the period of decline, adult cow survival dropped substantially, to an average of 85%/year, and calf recruitment dropped to just 5%.*

*During 1993-2003, with a return to moderate winter snowfall, the caribou herd continued to decline, but a much slower rate of about 2.5% annually. Adult cow survival was comparable to the period of herd growth in the mid-1980s, but calf recruitment to fall continued to be very low (mean = 15%). With low calf recruitment during 1990-2003, the female age structure became heavily weighted towards older females, a harbinger of impending population declines regardless of winter snowfall patterns. In May 2002, an estimated 24% of the females in the herd were >13 years old. As a result of these old females dying, adult female survival was low in the 2002-03 and 2003-04 winters (average = 83%) even though winter snowfalls were substantially below average. These survival rates are comparable to rates measured during the extreme winters of 1990-93.*

*During the last 8 years (2004-2011), calf survivorship until fall has improved to an average of 28% and recruitment of female calves has essentially balanced adult female mortality. The age structure is still weighted disproportionately to older females (16% females ≥ 13 years old in May 2011) and therefore susceptible to a sizable decline should the region experience one or more severe winters.*

## *Herd Size*

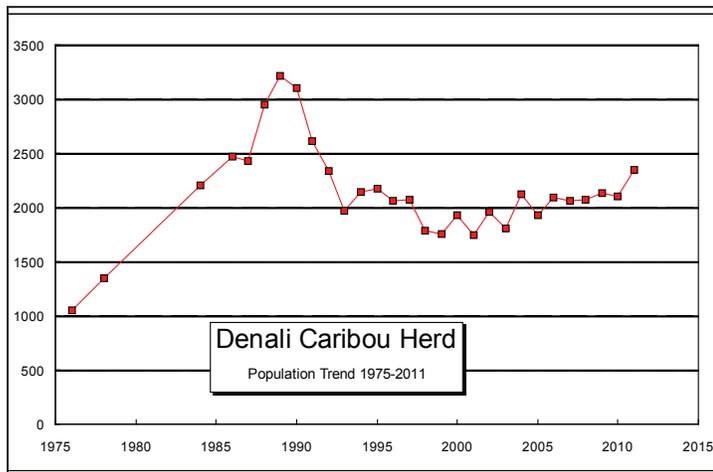
Researchers derived a preliminary herd size estimate of 2,350 caribou for September 2011; that number will likely change depending on results of the 2012 herd census. Although preliminary, this population estimate is the first notable increase in about 7 years, and the highest herd number since 1992 as the population was crashing. Prior to this year, herd size has been relatively stable over the last 7 years.

## *Adult Sex Ratios*

The herd's adult sex ratio of 42 bulls:100 cows was similar to last year; these rates are the highest since 1992. Adult sex ratios declined from an average of 56:100 during 1984-1989 to a low of 29:100 during 1997-1998 as a result of increased mortality of males during severe winters in the late 1980s and early 1990s, along with limited recruitment of male calves. Bull:cow ratios have increased slowly since 1998 but are still well below levels at the beginning of the study.

## *Calf Production And Survival*

Productivity of cows  $\geq 1$  year old was estimated at 86% in mid-May 2011, based on 63 radiocollared females in the age-structured sample (higher than the 25-year average of 78%). Of the 9 non-parturient females in



the sample, 6 were yearlings and 2 were two-year-olds. Two-year-olds exhibited the highest productivity with 7 of 11 individuals (64%) with indicators of pregnancy. All but one of the 61 females  $>2$  years-old were pregnant. Herd natality rate (low of 59% in 1990 to high of 92% in 1994) is primarily influenced by the proportion of population consisting of yearlings and the variable productivity of the 2-year-old cohort.

During the early-June 2011 postcalving composition survey, researchers noted 33 calves:100 cows. By

the late September composition count, that ratio had declined to 22:100. There was an estimated 25% survival of the 2011 calf cohort to September. Calf survival has averaged 28% over the last 8 years, compared to 15% during 1991-2003. Approximately 12 female calves were recruited per 100 older females. The female segment of the herd is showing stability to slow growth.

## *Female Survival and Age Structure*

During October 2010 – September 2011, 7 females from the age-structured sample died for an annual mortality rate of 11%, similar to the study average of 12% (range 2-23%). The proportion of older females has declined over the last few years. The adult female mortality rate averaged 7% during 1986-1989 when the herd was growing, and 19% during 1989-1993, the period of severe winters and marked herd decline. Since about 2000, mortality rates for adult females have averaged 12% in spite of mild to average winter conditions (the age-structure was skewed toward older females, and they died during this period).



## *Adult Bull Survival*

During September 2007- September 2011, researchers have captured, radiocollared, and monitored 165 male caribou including 117 captured as adults  $\geq 1$  year old (45 in 2007, 12 in 2008, 15 in 2009, 25 in 2010, and 20 in 2011), and 48 captured as 10-month-old calves (12 in March of each year from 2008-2011). As of September 30, 2011, 85 were carrying functioning radios, 58 have died, 10 had their collars torn off during the rut, and 12 radiocollars have failed prematurely. Suspected causes of death included wolves (27), bears (10), unknown large predator (7), unknown (10), accident (1) and capture-related (3). During the 4 years in which survival of males was evaluated (October 2007 – September 2011), annual survival has averaged 76%,

substantially lower than the 88% estimated for adult females throughout the study. Although sample sizes for some age-classes are small, age-specific survival appears to be highest through to about 4 years of age, averaging 87%, and then clearly declines for older age-classes. Mortalities predominantly occur during July – November, with few mortalities during February – June.

### *Bull Growth Patterns*

Researchers have weighed 113 of 133 adult bulls captured in September (2007-2011). Bull mass ranged from 93 to 264 kg (205 to 582 lbs). Body mass increased markedly with age from 1 to 5 years of age, gaining an average of 27 kg (60 lbs) each year, and plateaued at an average mass of 231 kg (509 lbs) after age 6.



Antler length (mean of right and left contour antler length measured for 125 bulls) varied from 29 cm to 137 (11 to 54 inches). Antler length was strongly correlated with body mass, and therefore increased with age in a similar pattern to body mass. Caribou antlers become wider and more complex with increasing age and body mass (number of antler points and antler spread correlated with antler length).

### *Planned Activities*

Researchers plan to continue efforts to assess population dynamics of the Denali Caribou Herd and studies of survival, growth, and seasonal distribution of bulls:

1. Capture and radiocollar caribou females as needed to maintain an age-structured sample of approximately 60 individuals.
2. Maintain a sample of 45-50 previously radiocollared bulls and capture 12 10-month-old males (2011 cohort) to assess age-specific growth and survival, and seasonal distribution.
3. Continue to locate all instrumented caribou in late November, late January, mid-March, late April, mid-May, early June, late July, and late September, or as needed to meet study objectives.

4. Conduct the post-calving census and composition survey and the fall composition survey to determine herd size, calf recruitment, and adult sex ratio.

## **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. Intensive research was concluded in 1993, but research and monitoring efforts continue.

The current study consists of maintaining one or two radio-collared wolves in each known pack inhabiting the park north of the Alaska Range. Radio-collared wolves are located about twice per month, with additional locations during late September to early October to determine fall pack sizes and to count pups, and during March to determine late winter pack sizes. In recent years, the use of GPS/ARGOS collars that upload locations daily or even more often has greatly increased the number of locations available for most collared wolf packs.

Telemetry locations acquired over one year 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, den locations, mortality factors, behavior, and population dynamics.

### *Wolf pack territories and radiocollared wolves*

As of April 1, 2012, there were 8 wolf packs in Denali with collared

wolves in them. Three types of collars were used. Twelve wolves wore conventional, VHF radio collars that are located from antennae-equipped aircraft. Another 7 wolves carried GPS collars that determine the animal's location *once per day*, store the data, and upload it through the ARGOS satellite system. Another

6 wolves wore GPS/ARGOS collars that determine the wolf's location *every 3 hours* and upload the data. The wolves that wore these GPS/ARGOS collars were from three packs (East Fork, Grant Creek, and McKinley Slough) that live near the park road; these collars are programmed to detach from the wolves in fall 2012.

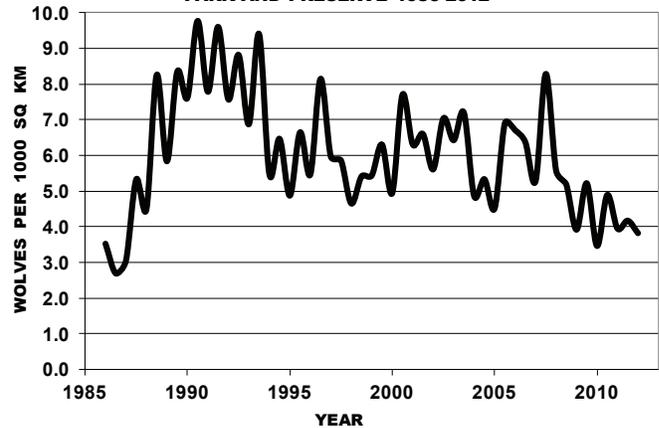
four were killed by humans. Three of the four wolves killed by humans had dispersed away from park packs and were killed near Paxon, Tok, and Nikolai. One collared member of the Grant Creek pack was snared just outside the park on the Savage River.

### Estimated Density of Wolves in Denali 1986-2012

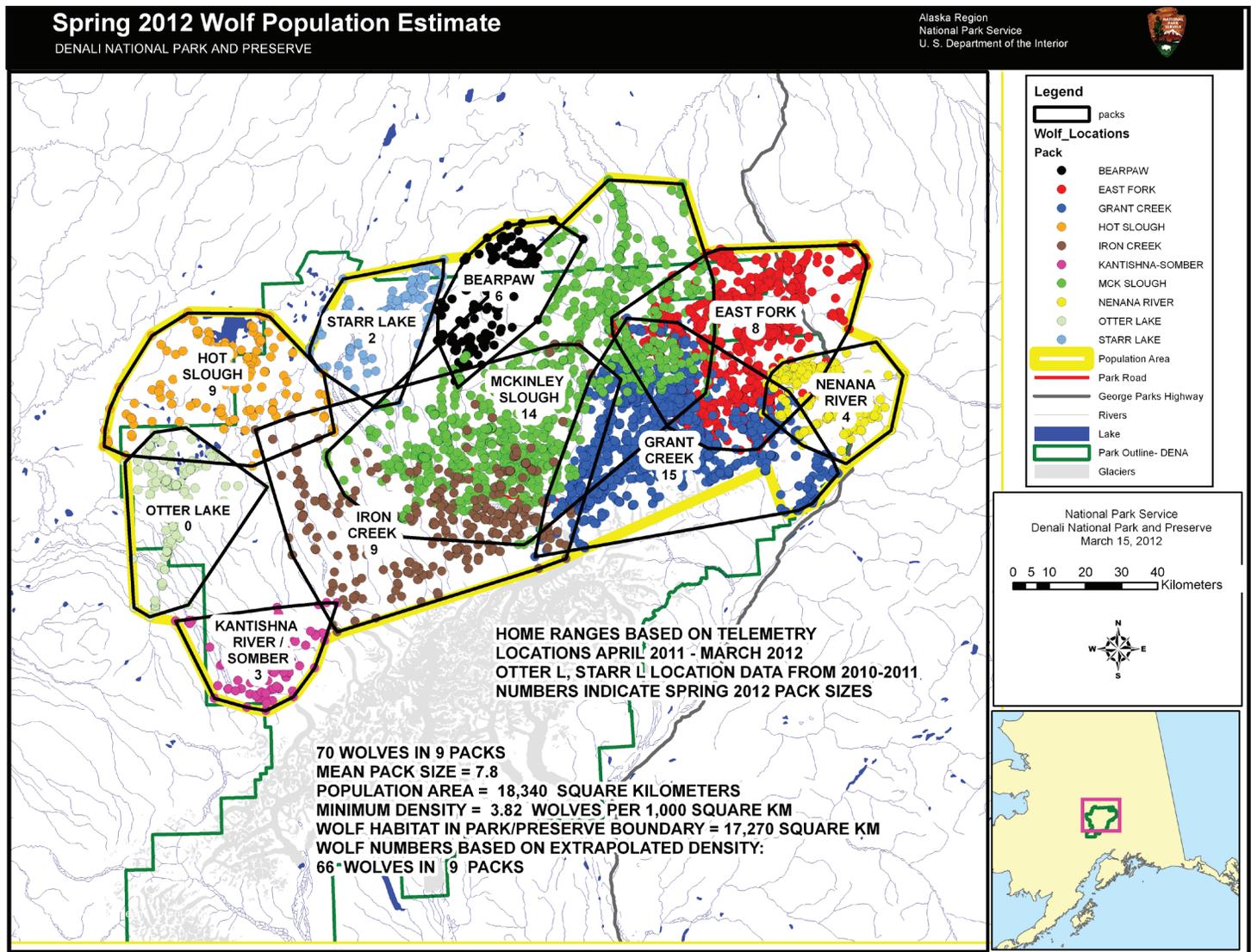
In April 2012, there were 70 wolves in the 9 packs being monitored by park biologists. The estimated density of wolves in Denali (about 9.9 wolves per 1000 square miles or 3.8 wolves per 1000 square kilometers) was slightly lower than last year's estimate of 10.2 wolves per 1000 square miles or 3.9 wolves per 1000 square kilometers.

Biologists captured and radio-collared 14 wolves in March 2012. In the year ending April 30, 2012, five radio-collared wolves died from natural causes and

SPRING AND FALL WOLF DENSITY, DENALI NATIONAL PARK AND PRESERVE 1986-2012



Wolf density from 1988 through April 2012.



## Wolverines

Very little is known about the wolverine population in Denali. Greg Colligan, a wildlife technician at Denali in 2011 and a park volunteer last winter, initiated a pilot study (January-March 2012) to learn about wolverines in Denali. Because wolverines have distinctive markings on their chests and throats (ventral patches), Greg used remote cameras set up at four stations (Riley Creek, Savage River, Teklanika River, and Toklat River) following non-invasive (no animal capture) protocols developed by wolverine expert Audrey Magoun. Between January and March, over 5,000 pictures of three different wolverines were collected. A fifth photo station set up near an old moose kill at the Savage River documented another wolverine for a total of 4 wolverines “captured” with digital images. In addition to photographic documentation of wolverine individuals, the stations contained rows of alligator clips (see photo, above the platform) to snag a wolverine hair (to extract DNA for wolverine genotype and other analyses), which collected hair samples from two different wolverines. These methods to survey for wolverines proved successful, but difficult given the winter conditions. During the initial eleven-day trip to select sites and set cameras, temperatures ranged from -46 to -25. All travel for this study was done by ski and dog sled (total miles travelled was 70 miles on skis and 313 miles by dog sled).

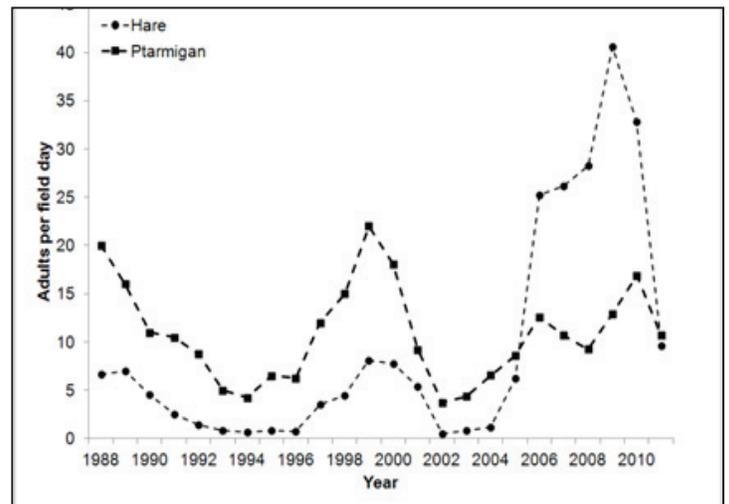


Wolverine investigating the station on Reilly Creek.

## Snowshoe Hare (and Willow Ptarmigan)

NPS biologists in Denali calculate annual indices of abundance for snowshoe hare and willow ptarmigan by recording the number of adults of each species observed during routine field activities from late April through June. These data allow biologists to identify the frequency and magnitude of the population cycles of each species over time. Biologists with Alaska Department of Fish and Game are conducting similar counts during Breeding Bird Surveys near Delta Junction and new efforts are underway to conduct similar counts across the road system in interior and northern Alaska.

The number of snowshoe hare detected per field day decreased substantially in 2011 compared to 2010, suggesting that the species entered the low phase of its cycle. Detections of willow ptarmigan also decreased in 2011.



Hare and ptarmigan indices from 1988-2011

## Small Mammals

Populations of three species of voles in Denali have been monitored since 1992 using mark-recapture methods, and will continue to be monitored as part of the Central Alaska Network (CAKN) Monitoring Program. The three vole species are northern red-backed vole (*Myodes rutilus*), tundra vole (*Microtus oeconomus*), and singing vole (*Microtus miurus*).

In 2011, Melanie Flamme, CAKN wildlife biologist, coordinated the 19th year of small mammal trapping in the Rock Creek study area (originally part of the Longterm Ecological Monitoring program, the plots are considered “legacy plots” from that effort).

One hundred Sherman live traps were deployed on two riparian plots and two forested ridge plots. All traps were baited with irradiated (can't sprout) sunflower seeds and biodegradable bedding. All 400 traps were checked 3 times daily (6 am, 1 pm, and 8 pm) from August 8-14, 2011. Captured individuals were identified by sex and species. Reproductive status was determined, and weight was calculated. Researchers inserted rice-grain-sized tags under the skin of previously unmarked individuals. Each passive integrated transponder (PIT) tag has a unique code and once implanted can be scanned to read the code. The tagged animals were scanned and released.

In 2011, the small mammal populations at the Rock Creek legacy plots made a comeback after crashing in 2010. Of the 4800 trap checks completed over the 4-day trapping session, there were 419 total vole captures (both new and recaptures).



**2011 Rock Creek Vole Count: 419**  
(4-Day Trapping Session)

362 red-back voles  
10 singing voles  
47 tundra voles

*Singing vole*

These numbers contrast to the low number of total vole captures in 2010 (84), and to the high number of vole captures in 2008 (1301) and 2009 (611). Conditions on the trapping plots in 2011 were very wet and boggy with abundant blueberries, in contrast to the unusually dry conditions in 2010.

The two new high-school volunteers, who were recruited from the Fairbanks area to help in 2011, volunteered 140 hours. The students gained experience working side-by-side with biologists in the field.

Voles (*Microtus* spp. and *Myodes* [formerly *Clethrionomys*] sp.) are not highly visible in the boreal forest, yet their collective biomass is a larger proportion of the animal community than that of grizzly bears. Voles play an important ecological role in that they can influence species above and below them in the food chain. Population numbers reflect local conditions because of their short life spans, high reproductive rates, and restricted movements (< 2 miles or 4 km).

Small-mammal populations are excellent candidates for detecting change in boreal ecosystems over time.

## Birds

*Monitoring abundance and distribution of passerines* Passerine (perching) bird monitoring programs started in Denali in 1992 when the park was one of four prototype parks selected for the NPS Long-term Ecological Monitoring Program. Eventually, the bird monitoring was incorporated as one of the “vital signs” being monitored in the Central Alaska Network (CAKN) Inventory and Monitoring program. One of the major CAKN objectives in monitoring passerine birds is to detect changes and trends in bird abundance. The current protocol for monitoring passerine birds, instituted in 2002, is undergoing extensive revisions to incorporate new survey and analyses methods. In 2009 and 2010, scientists tested a repeat-survey approach in Denali. This approach includes conducting a series of standardized surveys across the breeding season.

The Order Passeriformes (passerines or perching birds) is the single largest order of birds, comprising over 50 percent of avian species diversity. Of the 169 species of birds documented in Denali, 65 (38%) are in the order Passeriformes.

From late April through June 2011, clipboards in hand, and binoculars raised, biologists conducted standardized bird surveys along the three roadside survey routes in Denali (see table on next page). Each survey route contains 50 sampling points spaced approximately ½ mile apart. At each survey point, biologists conducted standardized 3-minute surveys and recorded all birds heard and all birds seen within ¼ mile of the point. The surveys start ½ hour before sunrise and end about five hours later.

Biologist detected 64 species on the roadside surveys in 2011. This repeat survey method will allow the detection in trends in abundance of a suite of common passerine birds in Denali. (In the past decade and a half, the number of Wilson's Warblers and Fox Sparrows detected on these survey routes has decreased by 50 percent and increased by more than 50 percent, respectively. In 2012, this project will continue with surveys in all three CAKN parks, including Denali.

Route	Number of repeat surveys	First and last survey dates	Number of bird species detected (seen or heard) for all surveys	Most frequently seen species (in order of frequency)
1 (Mile 0 - Mile 24.5)	8	April 21 - June 20	42	White-crowned Sparrow, American Tree Sparrow, Fox Sparrow, Dark-eyed Junco, Yellow-rumped Warbler, and Wilson Warbler
2 (Mile 25- Mile 49.5)	7	May 5 - June 21	44	White-crowned Sparrow, American Tree Sparrow, Fox Sparrow, Orange-crowned Warbler, Dark-eyed Junco, Wilson's Warbler, and Yellow-rumped Warbler
3 (Mile 50- Mile 74.5)	5	May 19 - June 24	45	White-crowned Sparrow, Wilson's Warbler American Tree Sparrow, Fox Sparrow, Savannah Sparrow, and Orange-crowned Warbler

*Results of passerine bird surveys in 2011.*



*What bird species is detected most frequently in surveys along the Denali Park Road?*

In 2012, there will also be a soundstation specifically placed along the park road near the Sanctuary River, in order “listen in” for bird vocalizations. The results from acoustic recordings can be compared with those from the roadside bird surveys. This small pilot project will assess the use of the soundscape monitoring stations as a way to enhance bird monitoring programs.

### *Breeding Bird Survey (BBS)*

The North American Breeding Bird Survey (BBS) is a large-scale survey of North American birds. Nearly 4,100 BBS routes are located in the U.S. and Canada and about 2,900 routes are surveyed annually. The BBS has accumulated over 40 years of data on the abundance, distribution, and population trends of more than 420 species. These data are useful for assessing if changes of a species in certain states are related to a continental decline or merely represent population shifts within their breeding range.

Park biologists usually survey two BBS routes in Denali in June each year: the Savage BBS and the Toklat BBS. Each route contains 50 sampling points located ½ mile apart. At each point, the observer conducts a three-minute count and records all birds detected within ¼ mile of the sampling point. No BBS routes were conducted in Denali in 2011. BBS routes in Denali will be conducted in June 2012.

### *Reproductive success of Golden Eagles and Gyrfalcons*

Denali contains the highest nesting density of Golden Eagles in North America, with over 80 territorial pairs living in the northern foothills of the Alaska Range. The National Audubon Society designated this region of Denali as an Important Bird Area because of the high density and substantial number of nesting Golden Eagles.

2011 was the 24th consecutive year of Denali Golden Eagle study, initiated by Carol McIntyre in 1987. It is the longest running ecological study of a migratory population of Golden Eagles in the world and is currently the only study providing current information on the ecology of a migratory population of Golden Eagles in northwestern North America.

Golden eagles are a “vital sign” of the Central Alaska Network (CAKN). As part of the CAKN Inventory and Monitoring Program, biologists monitor the occupancy of nesting territories and reproductive success of Golden Eagles and Gyrfalcons in the northeast region of Denali.

Park biologists collect data using two standardized aerial surveys conducted from a helicopter, and additional ground observations and foot surveys. The survey to document occupancy of nesting areas and breeding activities was conducted in late April, additional foot surveys were conducted from May through July, and the survey to document fledgling production and reproductive success was conducted in late July.

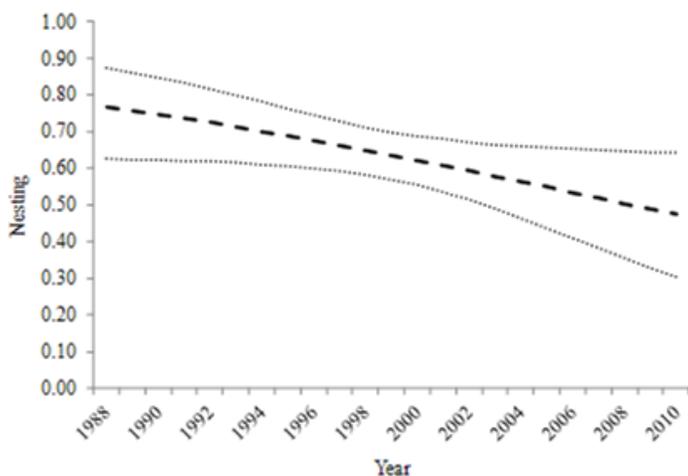
In 2011, NPS biologists monitored 83 Golden Eagle nesting territories. Within these territories, egg laying

was documented at 41 nests and fledglings were raised at 20 nests, and 25 fledglings were produced. All measurements of reproductive success decreased in relation to a decrease in the abundance of snowshoe hare. Results of the Golden Eagle monitoring program were published in the *Ibis* in January 2012.

The results of this long-term study suggest that the



probability of a female Golden Eagle laying eggs in Denali is lower than when the study started in 1988 (see figure below). Conditions on the breeding ground did not explain observed declines in nesting rates and fledgling production in Denali. Thus, other factors such as change in the age structure of the population, increased intraspecific competition, or deterioration of migration and wintering habitat are likely driving the long-term population trends of Denali's Golden Eagles. Denali biologists are working with the US Fish and Wildlife biologists to identify the factors driving the population trends of Denali's Golden Eagles.



Park biologists also monitored 12 Gyrfalcon nesting territories in 2011. Gyrfalcon reproductive success in Denali was lower than most years.

This project will continue in 2012.

### *Bird Species of Conservation Concern*

In 2011, Denali biologists, staff at Camp Denali and North Face Lodge, and several park rangers documented the distribution and occurrence of a suite of 34 bird species of conservation concern. Species included are those with documented population declines (e.g., Olive-sided Flycatcher and Rusty Blackbird) and those that respond quickly to changes in their habitat (e.g., Gray-cheeked Thrush and Golden-crowned Sparrow).

The project was conducted from early June through mid-September in two study areas: Grassy Pass east to Toklat and Grassy Pass west to Kantishna. Observers recorded their first detections of each species during their routine activities. Denali scientists are using data about the presence of these birds along the western portion of the park road to help assess changes in bird distribution over time. Naturalists and rangers can use the data to provide park visitors with current information about birds and their conservation issues. This project will continue in 2012.

### *Abundance and distribution of boreal forest wetland birds*

In 2010, NPS biologists started a field study in the western region of Denali to document the presence, relative abundance, and distribution of a suite of birds that nest in boreal forest wetlands. The study will provide a reference point for measuring change in these bird attributes in relation to a changing climate. Boreal forest wetlands are one of the least studied ecosystems in Denali. Many of the birds that nest in these wetlands are habitat specialists. Some species are among the most vulnerable to habitat loss, and some species are already experiencing declining population trends. For example, Lesser Yellowlegs and Rusty Blackbirds have experienced 98 percent population declines over the last 40 years. This project collaborates with the CAKN shallow lakes program that monitors the physical and chemical features of Denali's wetlands.

In 2011, FWS and NPS biologists surveyed two wetland areas: near the upper Foraker River (mid-June), and in the Clearwater Creek area south of the McKinley River (late July and early August).

*Upper Foraker River.* Biologists detected 64 species in this area. The most frequently detected species were

American Tree Sparrow, White-crowned Sparrow, Savannah Sparrow, Redpoll, Fox Sparrow, Wilson's Warbler, Alder Flycatcher, Blackpoll Warbler, Arctic Tern, Lesser Yellowlegs, Yellow-rumped Warbler, American Robin, Wilson's Snipe, Bonaparte's Gull, and Rusty Blackbird.

*Clearwater Creek.* Biologists detected 38 species in this area. The most frequently detected species were Savannah Sparrow, Scaup spp., Long-tailed Jaeger, American Tree Sparrow, Red-necked Grebe, American Wigeon, White-crowned Sparrow, Redpoll spp., Mew Gull, Red-necked Phalarope, Arctic Tern, and Black Scoter. The most exciting observation made during the Clearwater Creek surveys was the discovery of a Tundra Swan with three well-grown cygnets. This was the first documented nesting record of Tundra Swan in Denali.



*One of the many ponds sampled in the Clearwater Creek study area in 2012.*

Field work for this project was completed in 2011. Results of the project will be available in December 2012.

### *Citizen-based Bird Counts in the Local Area*

*Christmas Bird Count.* The Christmas Bird Count (CBC) is a long-standing program of the National Audubon Society, with over 100 years of citizen science involvement. The CBC is an early-winter bird census, where thousands of volunteers across the US, Canada and 19 countries in the Western Hemisphere, count birds within a designated 15-mile (24-km) diameter circle, counting every bird they see or hear during a 24-hour period. The results 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 CBC is to monitor the status

and distribution of bird populations across the Western Hemisphere. When CBC data are combined with data from other surveys such as the Breeding Bird Survey, 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.

Nan Eagleson organizes and compiles the results of the Denali CBC (AKDE) which has been conducted every year since 1992. Jill Boelsma organizes and compiles the results of the Cantwell CBC (AKCA) that was started in 2008. To learn more about the Christmas Bird Count, visit: [www.audubon.org/bird/cbc/](http://www.audubon.org/bird/cbc/)

*Spring Migration Count.* Dan Irelan and a group of local birders re-ignited a spring bird migration count in 2011. A similar count was conducted in the mid-1990s in Denali as part of the North America Migration Count. The objectives of the new Spring Bird Migration Count are to (1) observe and count species in and near the eastern end of Denali during spring migration, (2) provide new park employees an opportunity to meet and learn from other recreational birders, (3) bring birders of all skill and experience levels together.

In 2011, the Denali Spring Bird Count was held on May 15. Thirteen birders counted 46 species. The most frequently detected species on the 2011 Spring Bird Migration Count were White-crowned Sparrow, Mew Gull, Boreal Chickadee, America Wigeon, and American Robin. The 2012 Spring Bird Count is scheduled for Saturday, May 12. Contact Dan Irelan ([Dan\\_Irelan@nps.gov](mailto:Dan_Irelan@nps.gov)) for details about this count.

# *Physical Resources*

## **Staff Changes**

Welcome to **Dave Schirokauer**. He's the new Physical Science Program Manager for Denali as of January 2012. Dave will oversee the physical sciences and social sciences at Denali, as well as lead the permafrost monitoring program for the Central Alaska Network. Dave draws on five years of experience as the Natural Resource Program Manager at Klondike Gold Rush National Historic Park. Dave has also been the GIS biologist at Point Reyes National Seashore, coordinated the acoustic study for the Sierra Network parks, and served as a wildlife biologist with USGS at Glacier National Park. In the late 80s and 90s, he worked as a seasonal interpreter and backcountry ranger for the NPS at several parks including Katmai, Denali, and Grand Canyon. He is very excited to be returning with his family to a place that he considers 'home'.

**Rob Burrows**, hired in 2011 as the Physical Sciences technician to conduct glacier monitoring and permafrost monitoring, has been hired as the new coordinator for monitoring backcountry resources. He will retain responsibility for glaciology. Rob's primary duties will be to monitor wilderness character and the indicators described in the Backcountry Management Plan.

**Pam Sousanes**, as the weather monitoring coordinator for the Central Alaska and Arctic Networks, is now based out of Fairbanks. She continues snow surveys and weather monitoring in Denali.

## **Parkwide Climate Monitoring**

Climate monitoring at Denali is part of the vital signs monitoring of the Central Alaska Network (CAKN), which also includes Wrangell – St. Elias National Park and Preserve and Yukon-Charley Rivers National Preserve. Climate monitoring continues at a total of 17 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.

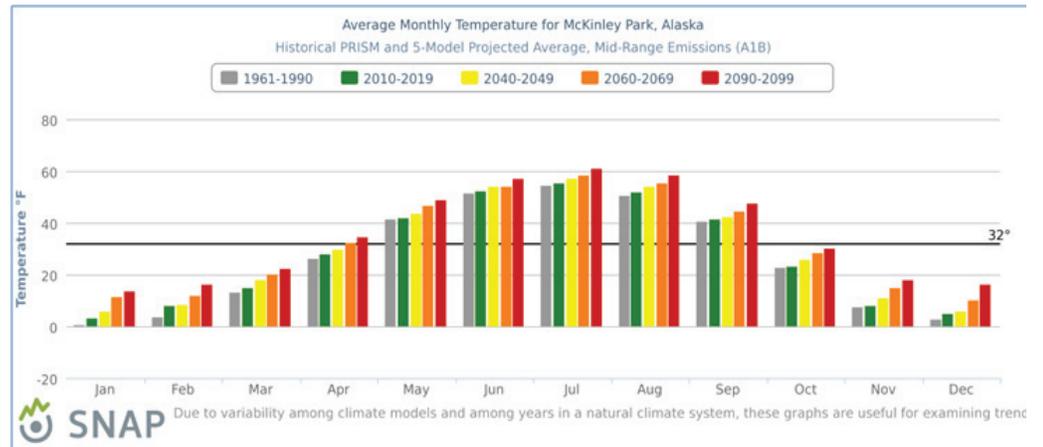
Annual data reports are available from the Central Alaska Network website at <http://science.nature.nps.gov/im/units/cakn/reportpubs.cfm>. Most of the stations are automated and send hourly data via satellite.

Climate data from NPS sites provide critical observations that contribute to, refine, and validate regional climate models that have been down-scaled from global circulation models. These models can be used to estimate future temperature and precipitation values within the park.

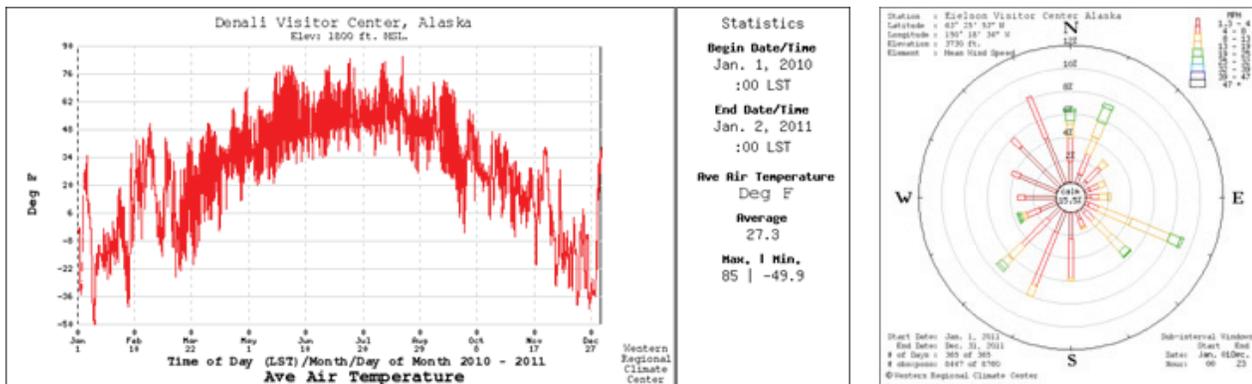
The Scenario Network for Alaska (SNAP), a group that explores a range of possible futures based on these models, is partnering with the NPS on climate change scenario planning for all of the park units in Alaska. This three-year project will help Alaska NPS managers, cooperating personnel, and key stakeholders develop plausible climate change scenarios for all NPS areas in Alaska, including Denali (see example, next page).

The challenges associated with climate change science transcend political and jurisdictional boundaries and require a more networked approach to conservation. The NPS is partnering with other state and federal agencies through newly formed Landscape Conservation Cooperatives (LCCs) that leverage resources and strategically target science to inform conservation decisions and actions. These LCC partnerships can accomplish more together than any single agency or organization alone.

Expected temperature increases by month for McKinley Park [=Denali Park]. This bar graph is an example of the type of resource that the Scenario Network for Alaska (SNAP) provides (<http://www.snap.uaf.edu/>).



Weather data summaries and data analysis tools to apply to Denali's data are available at <http://www.wrcc.dri.edu/NPS>. Here are two examples of the kind of data summaries that are available.



## Weather Monitoring at Park Headquarters

Weather information has been collected at Park Headquarters for more than eight decades. It is one of the longest and most valuable climate records we have for the Central Alaska Network. This long record would not be possible without the diligent attention of the kennels crew who take these daily observations.

On the next page are summaries of the 2011 climate data for temperature and precipitation collected at Park Headquarters, and compared with averages from the long-term database. Weather data are summarized by calendar year, hence the presentation of 2011 data.

## Weather Notes for 2011

- The mean annual temperature was 0.5° F below the long-term average
- The spring and summer of 2011 were cooler than normal; early fall was warmer than normal
- November was 13.4° F colder than normal, the 5th coldest November on record (tie with 2005)
- December was 6.5° F warmer than normal
- Every month was drier than normal in 2011, except February and December
- In February, 43.9 inches of snow fell, the 3rd snowiest February on record

## Temperature

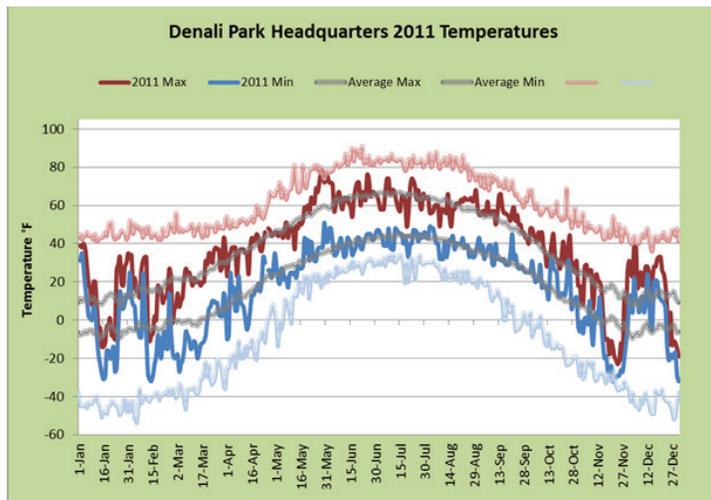
- Maximum temperature 78° F recorded on both May 28th and 29th
- Minimum temperature -32°F on February 14, November 21, and December 31
- Mean annual air temperature 26.7°F (0.5° below historical average of 27.2°F)

## Precipitation

- Total Precipitation 12.83 inches
- Departure from Normal -2.09 inches
- Max. 24 hr precipitation 0.70 inches on July 3
- Total Snowfall 80.7 inches (7/1 to 6/30)
- Departure from normal +0.7 inches
- Maximum 24 hr snowfall 13.2 inches on 2/25

Denali Headquarters Average Monthly Temperatures		
	2011	Historic Average
January	5.5	2.2
February	3.1	6.7
March	9.2	12.7
April	26.1	27.3
May	43.1	41.8
June	53.0	52.2
July	53.5	54.9
August	49.5	50.7
September	43.6	41.1
October	27.7	24.2
November	-4.1	9.3
December	9.9	3.4
<b>Yearly Average</b>	<b>26.7</b>	<b>27.2</b>

Denali Headquarters Average Monthly Precipitation		
	2011	Historic Average
January	0.35	0.72
February	2.45	0.60
March	0.02	0.42
April	0.05	0.43
May	0.73	0.79
June	1.95	2.19
July	2.49	2.98
August	1.85	2.70
September	0.27	1.55
October	0.37	0.95
November	0.62	0.75
December	1.68	0.82
<b>Yearly Total</b>	<b>12.83</b>	<b>14.92</b>



### 2011 Record-Breaking Weather Observations at Denali Park Headquarters

May 29	High temperature of 78°F
Nov 21, 22	Low temperature of -32°F, -30°F
Feb 21	Record snowfall of 11 inches
Feb 25	Record snowfall of 13.2 inches
Sept 29	Record snowfall of 2.6 inches
Nov 11	Record snowfall of 3.5 inches



## Snow Surveys

In the winter of 2010-2011, park staff conducted snow surveys in Denali during the survey window (last 4 days of each month) during the winter season. Thirteen snow courses and aerial snow markers were surveyed throughout the season. The following narrative describes the *2010-2011 season*:

At Denali Park Headquarters, the day of the first persistent snow was October 22, a few weeks later than normal. On December 1, there was 7 inches of snow at park headquarters, the long term average is 10 inches. The first measurable snow that persisted on the south side of the Alaska Range in the Tokositna Valley was on October 25, 2010. On January 1, the Tokositna SNOTEL reported 41 inches of snow, normal is 51 inches, with 9.6 inches of water content, which is near normal.

By February 1, the snowpack north of the Alaska Range was well below normal, Kantishna had 14 inches of snow with a snow water content of 2.5 inches, normal is 26 inches of snow with a water content of 4.5 inches. The sites at and around Denali Park Headquarters were between 70 percent of normal with depths around 14 inches and snow water content ranging from 40-70 percent of normal. The sites near park headquarters gained a bit of snow throughout February bring the snow depths to an average of 30 inches or ~ 130 percent of normal. Kantishna was just below normal and Lake Minchumina was slightly above normal for both snow depth and water content. The snowpack generally decreases throughout April with warming temperatures; however most of the sites still had snow cover for the May 1 snow survey.

There was not much additional snow accumulation in January and February throughout the region. The Tokositna site had 52 inches of snow on March 1, which is 77 percent of normal. There was some additional snow accumulation in April and by May 1, the Tokositna Valley site had 45 inches of snow with 14.1 inches of water content, which is 83 percent of normal. The aerial markers were on average about 71 percent of normal. Nugget Bench had 32 inches of snow and the normal for this time of year is 46 inches. Dutch Hills had 57 inches of snow, normal is 74 inches and Chelatna Lake had 23 inches and normal is 33 inches for the May 1 snow survey.

The Kantishna SNOTEL site recorded 7.3 inches of total winter precipitation (snow water equivalent) from

October 1, 2010 through May 1, 2011, 118 percent of average. The total annual precipitation for the site was 22.0 inches; the winter snow accounted for 33 percent of the total annual precipitation. The McKinley Park long-term NWS site was 101 percent of normal for the year with an annual total of 80.7 inches of snow. The precipitation gage at Tokositna Valley recorded 21.5 inches of precipitation from October 1, 2010 through May 1, 2011, which is 0.6 inches below the 1971-2000 normal. This is 48 percent of the total annual precipitation of 44.4 inches for the 2011 water year.



*Snow surveys include ground measurements at snow courses or aerial surveys where an observer will fly by a marker and count the exposed crossbars to determine the snow depth.*

## Air Quality Monitoring

Continuous air quality monitoring has been conducted in the park since 1980 at a station near Park Headquarters. Sampling occurs through several nationwide air quality monitoring networks, which measure atmospheric deposition, ground-level ozone, sulfur and nitrogen oxides, fine particles, visibility, and associated meteorological parameters. A second station in Trapper Creek, established in 2001, also measures fine particles and visibility through the nationwide IMPROVE monitoring network (Interagency Monitoring of Protected Visual Environments).

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 into the park each year in a recurring seasonal pattern. The peak concentrations of international contaminants generally occur in the late winter and spring. Local and regional emissions are also measured in the park in small quantities each year. During summer, naturally-occurring wildfire smoke is the primary contributor to air quality degradation.

More information about the National Park Service air quality monitoring program can be found at the following web site: [www.nature.nps.gov/air/](http://www.nature.nps.gov/air/).

## Visibility Web Camera

The Denali visibility web camera is part of a nationwide network of webcams operated by the NPS Air Resources Division. During summer, the camera takes a picture of the Alaska Range once every 15 minutes, and the image is transmitted to the web via satellite. The webcam home page also displays current ozone and weather data from the air quality monitoring station near Park Headquarters. All images are archived throughout the summer for a long-term visual record of visibility, one of the air quality related values (AQRVs) protected under the Clean Air Act. The Denali visibility webcam can be found through an internet search for “Denali webcam,” or at [www.nature.nps.gov/air/WebCams/parks/denacam/denacam.cfm](http://www.nature.nps.gov/air/WebCams/parks/denacam/denacam.cfm).

## Monitoring Landslide at Mile 45

A mass movement (landslide) near Mile 45 of the park road threatens the foundation of the main park transportation route. The landslide is a classic rotational slump with a headwall scarp, subsiding basins, pressure ridges and fractures, and flow features. Survey stations were first established in 1993 by park personnel to monitor the horizontal and vertical velocity of the slump. Approximately 60 stations have been established between 1993 and the present. Some have been lost due to surface fracturing, squeeze-out, and animal damage. New ones are added almost every year, maintaining an average of 35 stations.

Slumping velocity has varied through space and time, with peaks in movement occurring in high precipitation years. After successful efforts to divert surface water away from the area in 1999, slump movement slowed markedly. The annual survey of the slump did not occur in 2009 or 2010, but it was re-surveyed in the fall of 2011. Immediately below the park road, but above the active slump, movement is slight but detectable due to surface cracks in the ground. Inside the active slump, velocities for many of the surveyed points between 2008 and 2011 were 5-10 cm (2-4 inches) per year. Although the downslope movement of the slump continues, the rate of upstream growth of the scarp suggests no immediate threat to the park road.



*Mile 45 Slump (Landslide)*

In 2012 park personnel will finish implementing a new monitoring plan for the slump. In 2011, measurements were recorded for the first time using differential GPS, accurate to within one centimeter. Previously, measurements were recorded using traditional surveying techniques in a local coordinate system. In early 2012, all previous data were imported into the park’s geographic information system (GIS) to allow comparison with the 2011 GPS data. In the fall of 2012, new survey stations will be established that will minimize visual impacts and maximize the speed at which surveys can be conducted.

## Paleontological Survey of the Lower Cantwell Formation

A student on a field trip found the first dinosaur track in the park in 2005. Since then, several thousand tracks have been found in the Lower Cantwell formation, a late-Cretaceous sedimentary unit consisting of shale, sandstone, and conglomerate. In addition to tracks, the Lower Cantwell Formation also preserves many forms of plant and invertebrate trace fossils.

### *Paleontological Survey*

In 2011, park staff conducted a month-long paleontological survey, mainly near Toklat. The field team located 15 new sites, and over 40 new specimens, including new dinosaur tracks and abundant angiosperm leaves and gymnosperm needles. The specimens and sites were entered into the paleontology database. This database, which was created in 2010, now contains information about 225 sites and over 380 fossil specimens.

### *Geocorps Program Partnership in 2011*

The paleontological survey was carried out through a

partnership with the Geological Society of America's GeoCorps Program, which arranges geoscience "internships" in national parks and national forests, and on BLM lands. Two GeoCorps participants came to Denali for 10 weeks. They joined seasonal technician, Nadine Reitman, on the paleontology survey, and also created educational products for the park. Nancy Parker crafted a poster about fossil tracks for the Murie Science and Learning Center. Mariah Richards produced the idea of a resources fact sheet for kids and provided original artwork, photos, and text for this new fossil fact sheet (download it at [www.nps.gov/dena/naturescience/upload/Dinosaur-kids2011.pdf](http://www.nps.gov/dena/naturescience/upload/Dinosaur-kids2011.pdf)).

### *Fossil Collected for Display*

A well-formed hadrosaur track was found by a fieldtrip participant in June. Because the rock with the fossil was loose and easily moved, park staff later collected it, in order to prevent loss of the track due to theft or natural processes. The track will be displayed at a visitor center in the near future.

### *Plans for 2012*

The paleontological inventory will continue in 2012 with new GeoCorps participants focusing on different areas in the park and developing improved search techniques. They will also revisit some documented sites and provide updated evaluations of conditions.

## **Toklat River Dynamics and Gravel Acquisition**

The Denali Gravel Acquisition Plan authorizes gravel to be removed from the Toklat River floodplain in alternate years to support maintenance needs of the Denali Park Road. In 2008 and 2010, approximately 22,200 cubic yards of gravel were extracted from the river by a "mirror channel" method whereby channels were excavated to mirror existing braids in the river. This method allows for minimum impact on the river system because it mimics natural river processes and forms while providing a long-term, sustainable gravel yield. Harvesting gravel locally minimizes traffic on the park road, use of fossil fuels, and the potential for introducing invasive plants from external gravel sources. Gravel will be harvested again in 2012.

Park staff are monitoring natural and human-induced floodplain changes and will complete a comprehensive

analysis of the Toklat River system in 2012. This analysis will assess cumulative impacts to the river system from (1) bank reinforcement along the road system, (2) the existing bridges and causeway, and (3) gravel extraction. To aid in the analysis, in 2009 and 2011, staff obtained high-precision digital elevation models and high-resolution aerial photographs of the floodplain. The digital elevation models for the two years were compared ("differenced") to quantify change through time. Also included in the comprehensive analysis, was the 2011 re-survey of cross sections of the river that is made annually for long-term monitoring of river dynamics. Once complete, the analysis will help inform short- and long-term management decisions.

## **Taking Digital Images of Cabin Peak Dinosaur Footprints**

During the 2007 field season, paleontological researchers found a unique dinosaur trace fossil site in the Cantwell Formation at Cabin Peak. The site is composed of a rock bedding surface that displays countless trace fossils of several different dinosaurs, as well as associated flora and fauna. Together, these trace fossils provide a world-renowned view of life during the Cretaceous Period (65-70 million years ago). Trace fossils at the Cabin Peak site include footprints (some with skin textures), dinosaur coprolites (feces), and many invertebrate traces.



*Cabin Peak*

The rock bedding surface containing these traces is about 20 m (60 feet) wide, and 60 m (180 feet) long, although the surface has been broken into four panels. Each panel is fractured and sliding as part of a slump block that is highly unstable. This unique dinosaur trackway is likely to be destroyed in the near future by natural processes. It is difficult for researchers to examine the fossils closely because of the angle and height of the bedding surface. Because of the site's remoteness, few visitors would pass by the location.

The solution for making this trackway available to researchers and visitors alike was to take very detailed digital photos. These can be enlarged for viewing or exhibitry, and analyzed for many purposes. The NPS enlisted UNAVCO to carry out the technical aspects of the digital photography in August 2011. UNAVCO is a non-profit consortium that facilitates geoscience research and education. The UNAVCO engineers relied on the paleontology expertise of Dr. Anthony Fiorillo, of the Museum of Nature and Science in Dallas, who has conducted research in Denali for many years.

To generate detailed three-dimensional (3D) digital images of the panels to preserve the information for future study and public outreach products, the team used terrestrial LiDAR (Light Detection And Ranging). LiDAR uses lasers to detect the distance to an object, making it possible to gather many data points from the surface to create a detailed terrain map of the panels. The resulting terrain map has a resolution of less than 1 mm for some particularly interesting areas of the panels. The micro to macro imagery will be suitable for textural investigations, multi-track "behavioral" research, and investigating the natural processes affecting the panels.

The materials that will be produced are cutting edge—both technologically and educationally. Such products as a 3D visualization of the panels will display this unique geospatial dataset to visitors. The NPS has developed a Cooperative Ecosystem Studies Unit (CESU) agreement with Alaska Geographic to create the products. What better partnership than with Alaska Geographic whose mission is to help individuals better connect with public lands through dissemination of resource-based knowledge. The National Park Service seeks to conserve natural objects and to leave them unimpaired for the enjoyment of future generations.

## Soundscape Inventory and Monitoring Program

A soundscape research program has been underway at Denali since 2001. Natural and human-generated sounds are being systematically inventoried across the entire landscape of the park, including popular backpacking areas, glacial lowlands, high alpine, Mt. McKinley climbing routes, and along the park road. From the 14000+ hours of digital recordings and sound levels that have been documented in the park's three acoustical zones (alpine, sub-alpine, and scrub/forest), park staff can calculate the percentage of time and the number of times per day that a sound is audible as well as the calibrated sound level of important events. The sound-level data are used to compare the levels of human-made sounds to the natural ambient levels.



*Sound station at Fang Mountain*

Soundscape staff implemented the sixth season of a revised systematic sampling plan in 2011, deploying six automated sound monitoring stations and rotating them among seven locations. These locations were: one winter-season site, 5 Central Alaska Network (CAKN) Inventory & Monitoring grid points, and 2 locations in support of the Soundscapes Social Survey. Over a ten-year period, stations are being placed at six new locations each year—these stations will be randomly selected from a coarse grid of 60 points spread evenly throughout the park.

From the acoustic data processed since 2006 (from 48 locations in Denali), wind is the most common natural sound and aircraft overflights are the most common human-generated sound. At some locations, wind can

be heard up to 24 hours a day. At locations with brush or trees, birds can also be heard throughout the day (and “night”) during the spring breeding season. An interesting observation in 2011 involved the periodic audibility of rivers at distance. This phenomena is likely due to changes in daily temperature gradients.

At locations near common flightseeing routes, it is typical to hear 30 overflights per day. At glacier landing strips, it is common to hear more than 100 overflights per day. At locations away from common flightseeing routes, the number of overflights heard per day rarely exceeds ten. At most sites, there are usually around five commercial jets heard per day. The best way to visualize the variation in traffic is spatially. The following map shows a pie-chart breakdown of traffic by aircraft type for every site sampled in the inventory to date. The radius of the pie-chart circle is proportional to the average number of aircraft overflights per day.

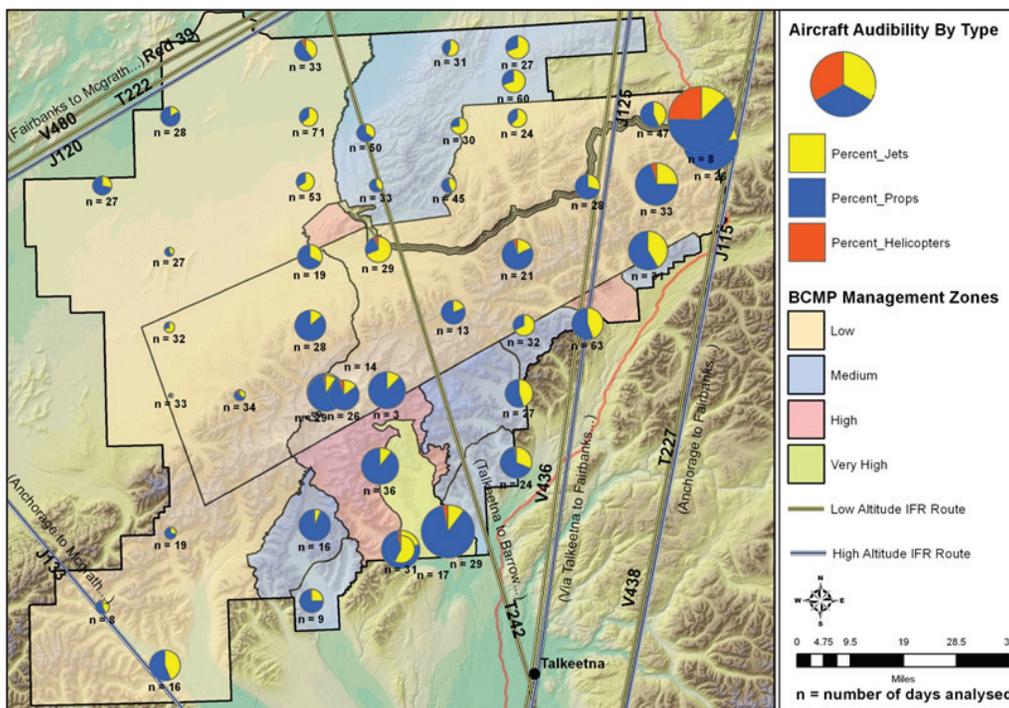
The data collected with the sound stations can be converted to a spectrogram of the sound levels recorded. A trained technician can identify overflights and classify the type of aircraft (propeller plane, jet plane, or helicopter) by visually examining the spectrogram. The soundscape program is using a software package developed by the NPS Natural Sounds Program Center to analyze for acoustic events, the percentage of time they are audible, and how loud (maximum sound pressure level) they can be.

In 2012, sound stations will be placed at seven more Inventory & Monitoring grid points. In addition a station will be placed along the park road to collect bird information during peak avian breeding season. Another station will resample the site at the Upper West Fork of the Toklat River, to check whether there is any difference in the sounds heard, now that best practice recommendations have been made by the Denali Overflights Advisory Council.

Three winterized stations were installed in the winter of 2011-2012 (Dunkle Mine Road to monitor snowmachine activity; on Hines Creek as a baseline for park road conditions, and one overlooking Bison Gulch as a baseline to compare noise emissions from the Healy Unit 2 Coal Plant.

Also in 2012, a set of two sound stations will be moved through 12 locations along the road corridor to measure the acoustic energy radiated by passing buses. Park staff will quantify noise impacts by bus type over a variety of terrain (comparison of newly-purchased hybrid buses to the conventional fleet) to assess their relative impacts upon the park soundscape. This effort is a collaboration between the Resources and the Concessions divisions. The outcomes will inform the development of future concessions contracts.

Detailed soundscape data reports can be found on the Denali website:  
<http://www.nps.gov/dena/naturescience/soundscape.htm>



*This map shows the spatial arrangement of sound monitoring stations in relationship to the number of aircraft per day (size of circle) and aircraft type (shade of section of pie chart is different for jet, propeller, and helicopter). Data from 2006-2011.*

## Overflights Committee

The Denali Overflights Advisory Council, a FACA-chartered (Federal Advisory Committee Act) group, was established in 2007 with the task of advising the Superintendent, through the Secretary of the Interior, on how to mitigate the impacts on the park from aircraft overflights. The Council is comprised of representatives from various park user groups including air taxi operators, aviation interest groups, and backcountry and wilderness advocates. Denali's Soundscape Program has been working intensely to collect and interpret acoustic data that the Council can use to make informed recommendations.

In 2011, the council conducted a listening session which varied the distance of airplanes from the observers. From the results of the session it was determined that the perception of loudness clearly correlates with the maximum sound pressure level of an event. In addition, the variation of sound pressure level with distance and instrument-setting was noted. This session is a followup from one in 2009 in which flights were arranged so the council members standing on the ground could listen to aircraft flying overhead at known altitudes. Both of these efforts have yielded tools for understanding the physical implications of any particular best-practice recommendation.

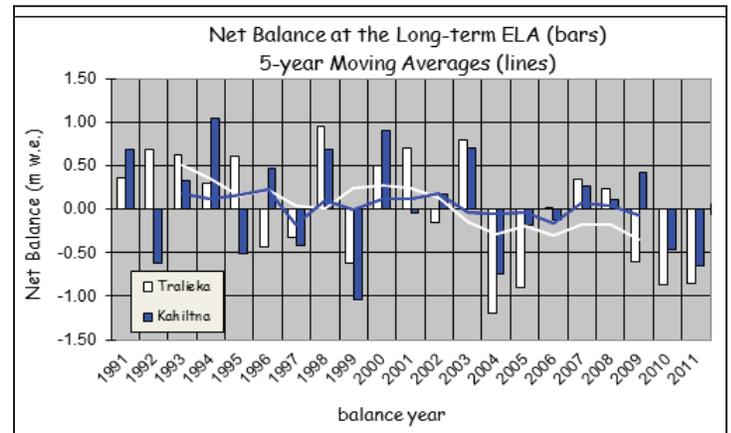
## Glacier Monitoring

### *Traleika and Kahiltna Glaciers (Index Sites)*

In 1991, Denali researchers established sites on the Traleika and Kahiltna Glaciers to monitor long-term glacier flow and mass balance changes. These glaciers were selected to compare glaciers on the north (Traleika) and south (Kahiltna) sides of the Alaska Range (drier and wetter climates, respectively).

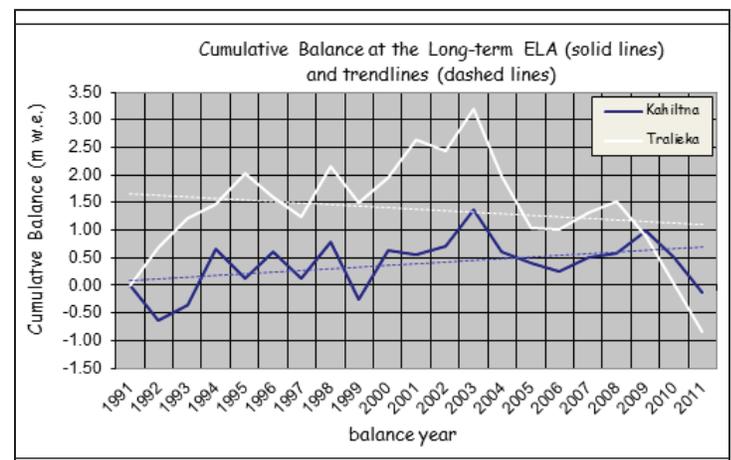
Measurements of snow depth and snow/ice loss are taken during a spring visit and a fall visit at a single "index" stake placed vertically into the ice. Each stake is located on each glacier near the long-term equilibrium line altitude (ELA). This location can be used to approximate the balance of the entire glacier. The measurements track the snow water equivalent of total winter snowfall (winter balance) and the water equivalent of summer melt (summer balance). The difference is the net balance. In the case of a positive net balance year, snow is left over at the end of the

summer melt season and the site has gained mass. In a negative net balance year, additional firm and ice melt away and the site loses mass. Based on how net balance measurements change with elevation, the values determined at Denali's index stakes can be used to estimate the balance of the entire glacier. Given the huge areas of these glaciers, these estimates carry quite a bit of uncertainty.



*The Kahiltna and Traleika net balance values often track the same direction (positive or negative) in a given year, but not always, demonstrating the distinction between the climate zones on the north and south side of the Alaska Range.*

Both index sites had negative annual balances in 2011 (see above figure, where both bars for 2011 are below the balance line) contributing to the trend of ice loss that began in 2004 (see figure below). The winter balance at both glaciers were below average with

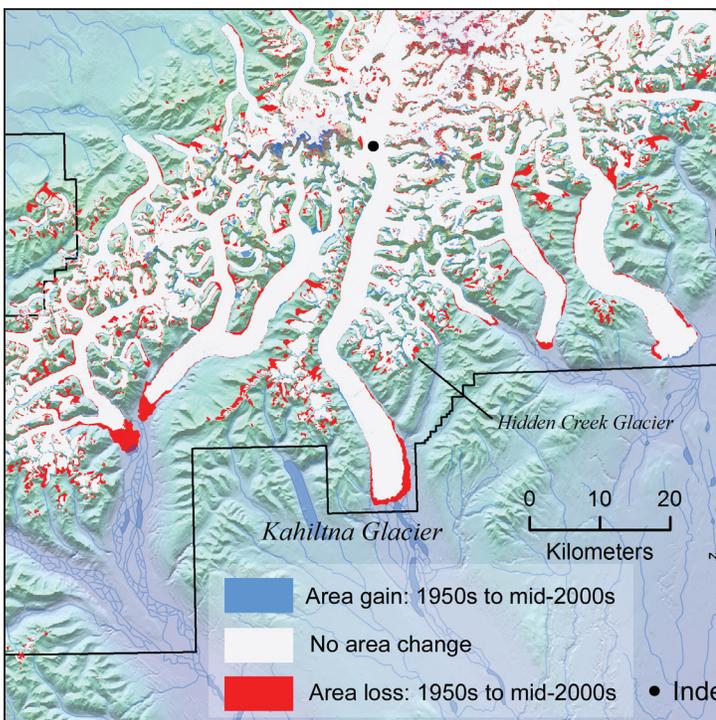


*Both glaciers show similar short-term cumulative trends, but the Kahiltna has an overall positive trend and Traleika has an overall neutral trend.*

Kahiltna at 42 percent of average and Traleika at 61 percent of average. The winter balance measured at the Traleika index site likely overestimates winter balance since it sits in a depression. Summer balances were both slightly above average with Kahiltna at 107 percent of average and Traleika at -137 percent of average.

### *Changes in Glacier Area since the 1950*

A new glacier extent map and a glacier inventory for Denali was delivered in 2011 via a cooperative agreement established with University of Alaska, Fairbanks (UAF) and Alaska Pacific University (APU). The area of Denali glaciers decreased by 8 percent between 1952 and 2010, with most of this loss occurring on small to medium size glaciers at mid-elevations (1400-1800 meters elevation). A few glaciers increased in area, but this was due to surging, most notably Muldrow and Peters glaciers. The UAF and APU cooperators will deliver volume change estimates from select glaciers in the park in 2013 (data obtained from laser altimetry on board a UAF airplane) and plan to deliver new inventories and volume change estimates for glaciers in all Alaska's national parks by the end of 2013. These results are also made available to the international community via the Global Land Ice Measurements from Space database ([www.glims.org](http://www.glims.org)).

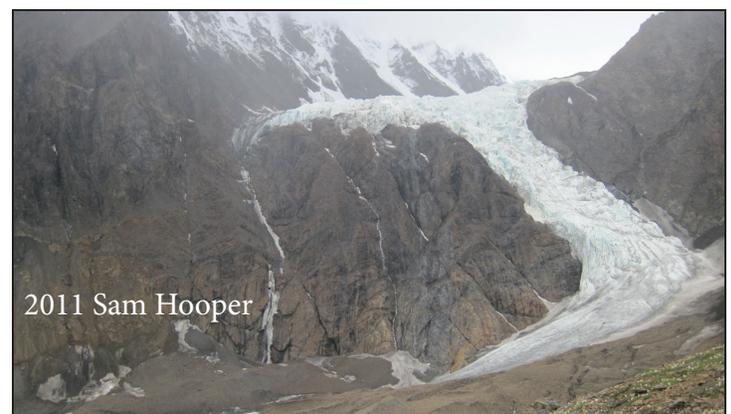
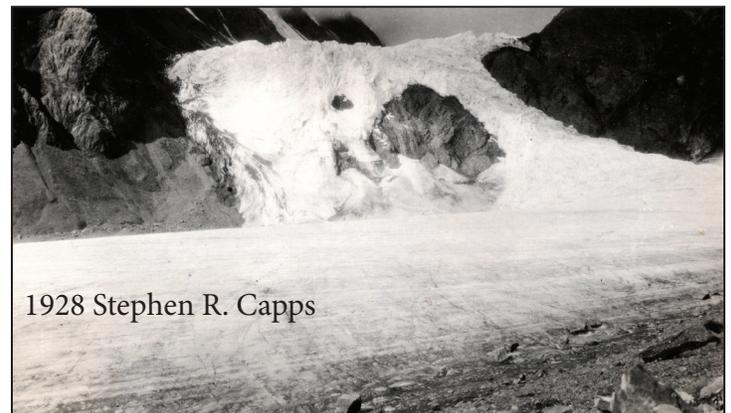


*Closeup of map showing changes in glacier area from the 1950s to 2000s.*

### *Monitoring Glaciers with GPS Surveys and Comparative Photography*

Three groups of volunteer citizen scientists contributed to the effort of tracking glacier change of three different glaciers by mapping terminus positions and glacier condition with GPS and comparative photography.

- Sam Hooper conducted repeat photography and took GPS points of the terminus of West Fork Cantwell Glacier (Figure 4).
- Brian Schimdt and friends collected GPS points that mark the current terminus of the West Teklanika Glacier.
- Ron Karpilo repeated several Stephen Capps photos of glaciers in Denali, originally taken in the early 20th century (the Polychrome Glaciers and small glaciers in the Sanctuary River watershed).



*Repeat photography for the West Fork Cantwell Glacier.*

NPS glacier monitoring staff continued with gigapixel panoramas this year at the index glaciers and other select glacier-related sites. Many of these are being incorporated into Denali's website where they offer the opportunity for exploration and a virtual immersive experience (<http://www.nps.gov/dena/photosmultimedia/360-panos.htm>).

Monitoring Denali's glaciers with repeat photography is featured in the Summer 2011 issue of *Park Science*: "Glacier trends and response to climate in Denali National Park and Preserve" Authors are Denali and UAF researchers: Rob Burrows, Samuel Herreid, Guy Adema, Anthony Arendt, and Chris Larsen (<http://www.nature.nps.gov/parkscience/index.cfm?ArticleID=509>).

### *Surging Glaciers*

No glaciers in Denali are known to be surging as of April 2012.

### *Monitoring the Muldrow Glacier*

The Muldrow Glacier last surged in 1956-57. Surges may occur at 50-year intervals, so while another surge might be anticipated within a few years of 2007, as of now, the Muldrow is still a quiescent glacier between surges. Monitoring in the last few years adds to the baseline of what a glacier is like in the quiescent phase.

Denali staff have monitored ice elevations and flow rates of the Muldrow Glacier since 1992. Two movement markers (metal tripods weighted down with rock filled baskets) have been placed on lower Muldrow Glacier to track velocity of this surge-type glacier.

## **Glacier Research**

### *Spatial Patterns of Mass Balance on the Kahiltna*

Joanna Young, a M.S. student working under Dr. Anthony Arendt at University of Alaska Fairbanks, is assessing spatial patterns of mass balance on the Kahiltna Glacier. In 2010 and 2011, she made mass balance measurements along an elevational gradient up to 11,000 feet on Kahiltna Glacier. The balance and meteorological data will help to validate a mass balance model for the area glaciers, and generate glacier runoff estimates.

### *Volume Loss on the Muldrow Glacier*

Nate Murphy, Chris Larsen, and Sam Herreid of the University of Alaska (UAF) Glaciers Group examined the volume and topography changes in Muldrow Glacier, from 1952 through 2010 using a combination of digital elevation models (DEM), centerline laser

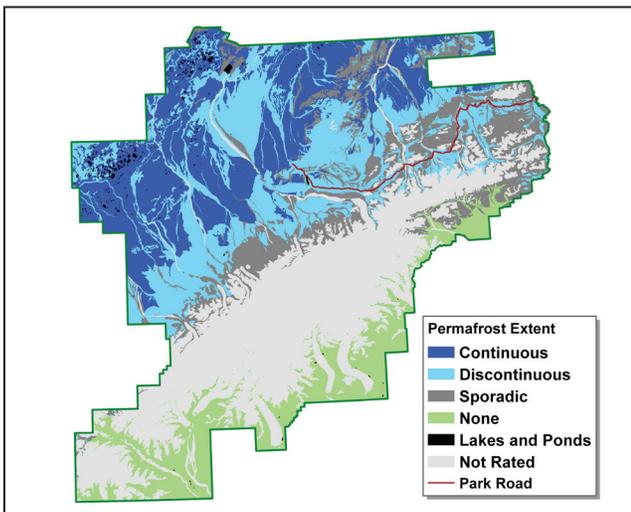
altimetry (1994, 2001, and 2008) and LiDAR data (2010), and debris cover maps. Current data show that the volume loss rate for Muldrow Glacier has increased significantly during this period from a mean rate of  $\sim -0.02 \text{ km}^3$  per year from 1952 to 1976 to a mean rate of  $\sim -0.19 \text{ km}^3$  per year from 2008 to 2010. Laser altimetry and LiDAR measure elevation changes along the centerline of the glacier with an accuracy of  $\pm 30 \text{ cm}$ .

Debris cover on glaciers often has significant and spatially variable effects on the melt rate of glaciers. Due to the spatial variability of debris cover on a glacier, it can represent a source of uncertainty when extrapolating the centerline elevation data to the entire glacier. The UAF scientists used debris field maps acquired during the mid-1970s and  $\sim 2006$  in combination with the DEMs to investigate the insulation effects of debris on differential melt rates across the glacier. By also comparing the DEM and debris cover data with data from the aircraft laser altimetry and LiDAR surveys, they can better estimate the effect of surface debris on the volume changes estimated from the centerline elevation changes for all debris-covered glaciers included in these surveys.

## **Permafrost Monitoring**

Denali lies near the southern limit of discontinuous permafrost, and the region's climate is likely to warm over the next few decades; thus, permafrost-controlled landscapes in Denali will likely change significantly over the next several decades. Changes in the size, shape, and juxtaposition of permafrost patches are going to be increasingly important in influencing landscape patterns of vegetation, wildlife habitat, fire regime, and water quality. The Central Alaska Inventory and Monitoring Network, academic researchers, and Denali staff are developing multi-scale permafrost monitoring program which will focus portions of the Denali, Yukon-Charley Rivers National Preserve, and Wrangell-St. Elias National Park and Preserve.

At the finest scale, index monitoring sites (areas with interesting and rapidly changes permafrost features) will be identified, characterized, and revisited every 5-10 years. In Denali, the permafrost map, which was completed in 2004 as part of the park's soil survey is an important tool for identifying sensitive permafrost.



Boreholes, designed for temperature profile measurements down into permafrost, are located near Denali (8-mile Lake) and near Yukon-Charley Rivers and Wrangell-St. Elias; these boreholes are monitored annually. Sequestered carbon being emitted from thawing permafrost into aquatic system is also being monitored at a research site at Eight-mile Lake. As the processes chemical and physical carbon release from thawing permafrost are better understood, results will be applied through models to broader areas. It has been hypothesized that thawing permafrost will be a significant contributor to atmospheric CO<sub>2</sub> over the next century. At broader scales, satellite imagery is being used to detect change in permafrost condition at decadal time scales.

## Long-term Stream Monitoring

Trey Simmons began collecting data from Denali streams in 2007 as part of the Central Alaska Network (CAKN) long-term stream monitoring program. This program collects data about aquatic insects, diatoms (a group of algae), fish, water chemistry, temperature, stream flow and geomorphology. This information will be used to detect and quantify changes in the condition of Denali's stream and river ecosystems as they respond to climate warming or other human-caused impacts. Aquatic insects are especially useful in helping to assess the status of stream ecosystems. Although fish are the most obvious organisms in some streams because of their size, aquatic insects are ubiquitous, occur at high densities, are diverse (20-40 species in most streams), and play a variety of critical roles in the ecosystem. Because they also tend to be sensitive to environmental conditions (things like water temperature, pH,

nutrients, channel stability and streamflow patterns), aquatic insects can be extremely valuable as biological indicators of ecosystem condition and water quality. This is important, because we can't always measure easily the many ways in which the physical and chemical aspects of streams are changing. Diatoms are also important biological indicators for streams. Not only do they represent the base of the food chain, but they are also present in very high densities, exhibit remarkable diversity (30-50 species in most streams), and are also sensitive to changes in environmental conditions.



*Sampling diatoms along the Sanctuary River*

Simmons has now sampled 36 streams and rivers in Denali, mostly along the park road. Many of these sites are sampled every year, which increases the ability to detect changes in a site's condition. However, because these "sentinel" sites were not selected randomly, they can't be used to infer what's going on elsewhere in Denali. Therefore, 100 other randomly-selected sites in the park are also being sampled, so that data collected at those sites *can* help provide inference to the condition of stream ecosystems across the entire park. Because most of these random sites are very remote and require the use of helicopters, they are expensive to sample, and so only a few are visited each year. On average, these remote sites will only be sampled once every 10 years. Combining information gathered at the two types of sites will maximize our ability to accurately monitor changing conditions in Denali's streams. In 2012, Simmons will collect data from streams along the park road (from Rock Creek near Park Headquarters to Moose Creek in Kantishna), as well as visiting some remote sites in the far western part of the park.

# Visitor Characteristics and Social Science

## Park Visitation

Park visitation increased in 2011 by 28,894 visitors compared to 2010 (7.65 percent increase; see graph). There were 406,580 annual “recreational” visitors, as reported in the Monthly Public Use Report.

While annual visitation has not yet returned to 2007 peak levels, 2011 numbers are close to “pre-recession” levels (400,000+ visitors) and are trending upwards again. The park experienced a 2.77% annual rate of growth in visitors between 1996 and 2007 before experiencing a the rapid decline of -12.9% between 2007 and 2009. In the two years since 2009, the annual visitor percentage rate has increased at 6.35%.

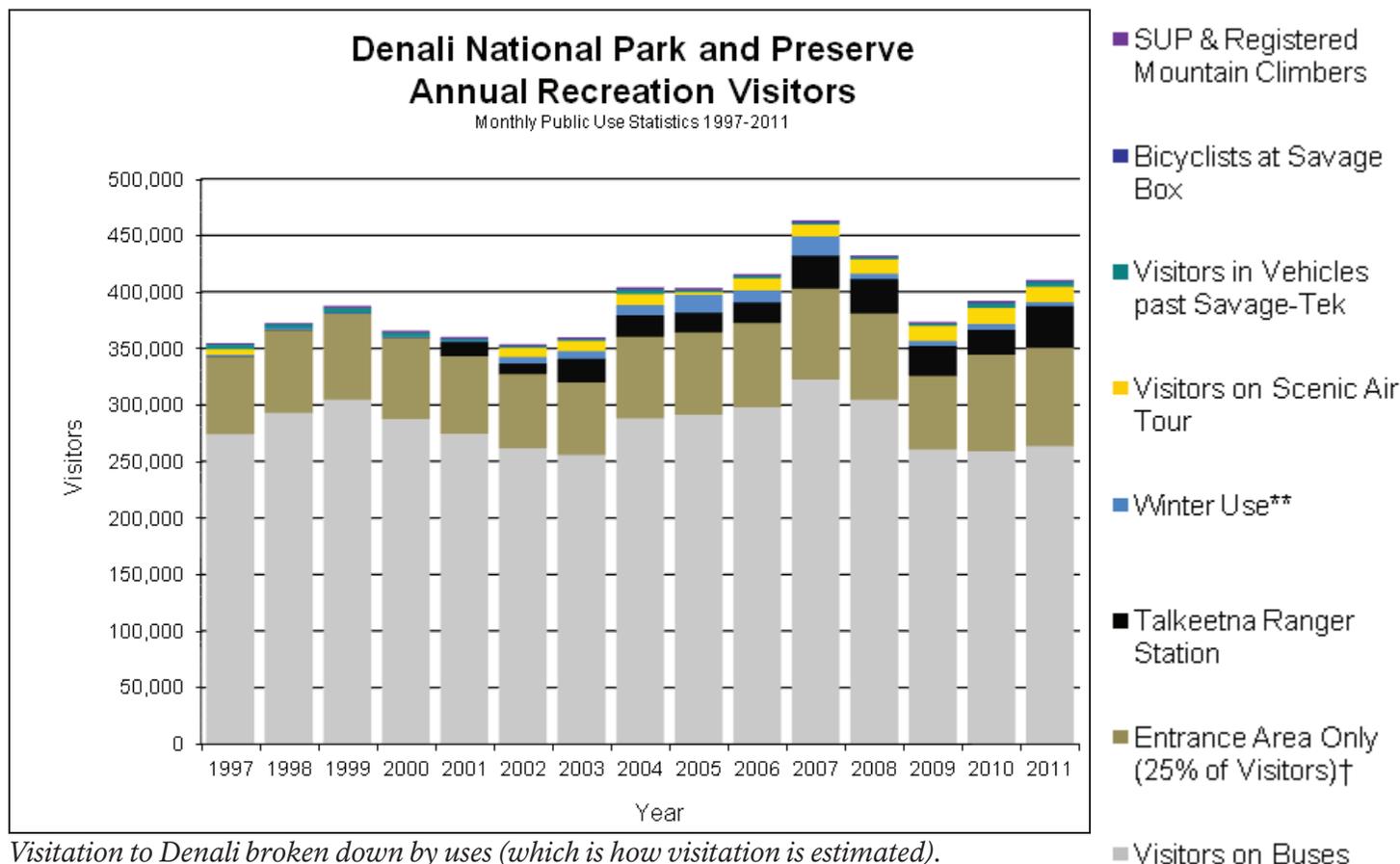
2011 also represented the first year since the recession that bus ridership within the park increased over the

prior year. Just over 3,000 more visitors rode a park tour bus or shuttle along the park road in 2011 than did in 2010. While this is a rather insignificant increase, it does represent a return to growth in bus ridership after significant declines in 2007-2009.

## Improving Estimates of Visitors and their Activities

Starting the first week of April 2011, three field technicians were hired to conduct short visitor interviews in the entrance area of the park and in Talkeetna (at the airport) as part of the recreation visitor estimation and activity study initiated via a cooperative agreement with the University of Alaska Fairbanks.

The survey was designed to: (1) determine how many visitors access the park via the Talkeetna Airport but do not register or have contact with the park at the ranger station, (2) estimate the number of visitors who both visit the ranger station and fly-in the same day, (3) improve counts of visitors arriving by vehicle or other means and driving into the park (but not taking a bus beyond the Savage Check Station), (4) estimate the number of visitors who visit both Talkeetna and the entrance area, and (5) gather key information



Visitation to Denali broken down by uses (which is how visitation is estimated).

about where Denali visitors are going, how long they are staying, and what they are doing during their visit. Over 13,700 complete data points were collected over the entire six month visitor season (in comparison, the Visitor Services Project collected an average of 736 surveys per year in 2006 and 201; the road study collected an average of 790 surveys each year in 2006, 2007, and 2010).



*What do spring visitors do?*

Andrew Ackerman, park social scientist, collaborated with Dr. Pete Fix, University of Alaska-Fairbanks, and Ginny Fay, University of Alaska-Anchorage, Institute of Social and Economic Research, to carry out this intensive survey.

Because the survey was conducted over the entire visitor season, the variables about visitors can be analyzed to determine how the visitation changes based upon the effect of time of season, time of day, and weather and temperature.

The study was also the first to conduct a comprehensive survey of springtime users of the park road, as well as being the first to sample across the entire peak visitor season. In spring 2011, the park road was open to the public to Teklanika Rest Area by the end of the second week of April. This allowed for sampling to begin a full month before vehicle access was restricted beyond the Savage Check Station and park buses began operating.

The springtime visitor to Denali is predominately from Alaska (68 percent), while most of the remaining spring visitors (27%) are from the Lower 48. Spring visitors are primarily sightseeing (30%), driving the park road (26%), and wildlife viewing (21%) (see pie chart at left).

Based on the 2011 survey results, for every 100 visits to the park, 41 do not travel beyond the Savage Check Station, while 59 do travel beyond (i.e., on a shuttle or tour bus). This ratio can be used to estimate the total visitation from the known visits on buses past Savage, i.e., multiply the bus visits by 1.666 (which is 59/41). The multiplier that had been used since 1996, when the last survey of this type was conducted, was 1.333. The new multiplier translates to an estimated total visits per year in 2011 of 409,970, instead of 328,470. The increase in visitation is due to an increase in visitation of 16 percent in the entrance area (Miles 0-15 of the park road).

### Counting Visitors Who Use Trails

In 2011, automated trail counters were again placed on trails around the entrance area (summer months) and during the fall months on the Stampede Trail and Cantwell Traditional Use Area trails. This was a cooperative effort with the Wilderness Rangers.

### Social Norms about Soundscapes

#### Phase I

During the summer of 2011, Denali's social scientist worked with Dr. Peter Newman (Colorado State University) and his graduate students and post-docs to gather survey data on the sounds visitors heard during a listening exercise, and what their perceptions were toward these sounds. Soundscape specialist Davyd Betchkal also made acoustic recordings at the two survey locations (Triple Lakes Trail, McKinley Bar Trail). Results of Phase I suggest that visitors perceived natural sounds such as wind, water and bird song to be pleasing and highly acceptable, while human-caused sounds such as aircraft, vehicles, or people talking were found to be annoying and generally unacceptable.

#### Phase II

During Phase Two (May and June 2012), visitors at Triple Lakes Trail, the McKinley Bar Trail, and

the Backcountry Information Center will have the opportunity to assess different sound types and intensities (wearing headphones and listening to sound clips). The 2012 survey asks visitors to determine at what level, both frequency and amplitude, the human-caused sounds become unacceptable. The survey will use tablet technology and a new digital survey accompanied by a range of sound clips.

Also in 2012, researchers will conduct qualitative interviews with climbers in Talkeetna, in order to understand climber perceptions of frequency, duration, and amplitude of overflights in the backcountry. Data will be analyzed for presentation to the Denali management team later in the fall.

### Visitor Services Program (VSP) Survey

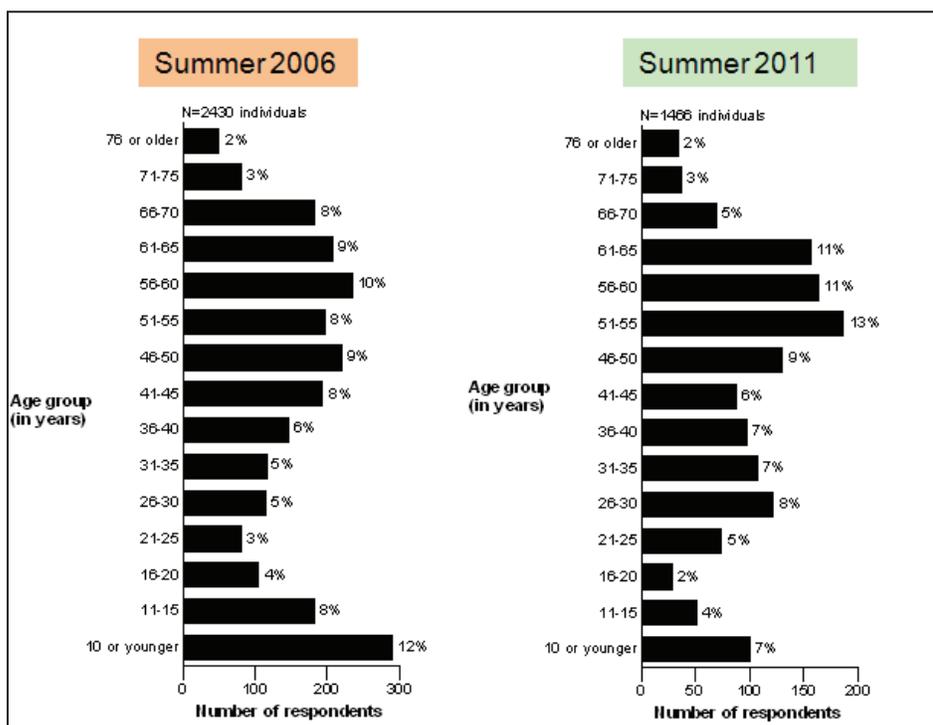
In 2011, there was a Visitor Services Program (VSP) survey in Denali. The most recent survey prior to this one was in 2006, which occurred during a period of new visitor services development—both in the front country area and along the park road. The 2011 VSP study was designed to look at changes in visitor perceptions before and after these major visitor-oriented developments, such as the Denali Visitor Center and Eielson Visitor Center. Additionally, because the park is in the process of crafting a vehicle management plan for the park road, managers wanted

to get more information about park users and use patterns. Finally, the park wanted to assess visitor spending in order to accurately assess economic impacts of the park on the region. All of this could be accomplished via an updated VSP survey.

The field work was conducted July 19-25, 2011 with 1032 questionnaires distributed to visitors. There was a 71 percent response rate (736 returned).

The study found there were shifts in ages of visitors, including fewer oldest visitors, fewer youngest visitors, and more visitors ages 51-65 (see bar graph below). Fewer visitors visited Denali with commercial guided tour groups (51% in 2006 versus 37% in 2011). More visitors spent more hours in the park (45 percent spent more than 10 hours compared to 36 percent in 2006), and more days in the park (10 percent spent 5 or more days in 2011, compared to 7 percent in 2006).

A fact sheet is in progress to share additional results. A final report in the Natural Resources Technical Report series has been completed.



*Based on the VSP study in 2011 (right), the age classes of visitors have changed since 2006 (left), including: fewer visitors less than 20-years-old, fewer visitors who are 65 and older, and more visitors who are 51-65 years old.*

# Subsistence

## Federal Subsistence Registration Permits

Denali staff managed the Federal Registration Permits for subsistence hunting of moose and caribou on park lands in Wildlife Management Unit 13E near Cantwell, and moose hunts on preserve lands in Unit 16B. A total of 74 caribou permits and 36 moose permits were issued for 13E, and 2 moose permits were issued in Skwentna for 16B. Permit applications were advanced to the Bureau of Land Management in Glennallen and permit data was stored in U. S. Fish and Wildlife Service's database.

## Subsistence Resource Commission

On August 26 and 27, 2011 the Denali Subsistence Resource Commission (SRC) met at the Murie Science and Learning Center. This past year three SRC vacancies were filled: Dan Esai from Nikolai and James Roberts from Tanana filled the Department of Interior vacancies and Kevin Mayo filled the Eastern Interior Regional Advisory Council vacancy.

## Updating the Denali Subsistence Management Plan

Amy Craver obtained additional funding from the regional subsistence program to continue updating Denali's Subsistence Management Plan. Meeting minutes will be used to update the documentation of actions proposed or taken by the Denali Subsistence Resource Commission. A revised electronic format will allow adding new materials more easily. Lucy Tyrrell, research administrator at Denali, has been working to draft a new layout and format for the plan.

The format will be shared with other parks. Amy Craver and Lucy Tyrrell will complete the update in 2012, and Lucy will begin working with other parks to revise their Subsistence Management Plans based on the Denali template created.

## Understanding Change: How Communities Perceive Climate Change at the Local Level

In Spring 2011, Denali received funding from the Alaska NPS Regional Office subsistence program to develop a Cooperative Ecosystem Studies Unit agreement with a University of Alaska Fairbanks's graduate student, Corrie Knapp. The goal of this project is to understand why subsistence users utilize park resources, how subsistence users perceive the ecosystems they rely on, their observation of changes brought about with global warming, and the types of information they need to make decisions regarding adaptation to climate change.

This study will pave the way for community and park adaptation planning by providing information about observed changes, perceptions of system function and by identifying indicators that communities are, or would be, interested in monitoring in order to make adaptation planning decisions.

Corrie Knapp is conducting interviews to learn from community members (subsistence or not) the kinds of change they have noticed in relation to climate change.

# Cultural Resources

## New Archeologist

The park's new archeologist is Phoebe Gilbert who was hired in March 2012. She holds a B.A. in anthropology from North Central College in Naperville, Illinois. She was a Student Conservation Association intern with the archeologist at Great Smoky Mountains National Park in 2003. She spent five years conducting contract archeology in many states, including Alaska. In the spring of 2011, she completed her M.A. in archeology from University of Alaska Fairbanks using geology to learn how climate affected the occupations of the Mead archeology site in Interior Alaska. From 2008 to prior to arrival in Denali, Phoebe work as a part-time archeologist for Yukon-Charley Rivers National Preserve and Gates of the Arctic National Park and Preserve.

## 1932 Lindley-Liek Movie

This movie is the first film footage taken of a climb of Mt. McKinley that has been professionally transferred to digital format. An audio recording was paired to the film footage to produce a 40-minute interpretive film with a brief introduction on a DVD.

## Archeology and Geomorphology of Ancient Lake Minchumina

Six new cultural resource sites were added to the inventory. A prehistoric site and a historic site were recorded in the Beaverlog Lakes area and a historic ruin was found at the head of Spencer Creek. Three new archeological sites and the locations of two previously reported sites were verified at Lake Minchumina. Radiocarbon dates were obtained on two sites: one, a house pit, dated to circa A.D. 1800 with a possible older component; the second date of A.D 690 was associated with another house site. The Beaverlog Lakes survey is recommended to continue in 2012 for an area south of Muddy River.

## Windy Creek Archeological Investigation

Cultural resource staff, with the assistance of one SCA and two volunteers, conducted field survey and

subsurface testing in the Upper Windy Creek drainage. The discovery of this 'cultural landscape' is significant because the opportunity to examine the relationships between material culture, human alteration of the landscape, and the natural environment, reveal how prehistoric peoples transformed and used the environment around them.

## Archeological Survey

While conducting archeological survey in the Wonder Lake region, the park archeologist discovered a previously unknown site type for Denali. Mortars (used to crush, grind and mix solid substances) were identified on a freestanding boulder. The discovery of this rare archeological site type enriches our understanding of how prehistoric people interacted with and exploited available resources distributed throughout their surrounding environment.

## Archeological Site Condition Assessments

In 1964 and 1965 Morgan and Treganza conducted extensive archeological surveys along the park road. Numerous prehistoric archeological sites were documented. Many of these sites had not been revisited in the 45 years since their discovery. While hosting an intern from the Alaska Regional Office, the park archeologist and the intern relocated and conducted condition assessments for one-quarter of these sites. The Sheep Pass Site, located in the Teklanika River region, was particularly noteworthy because of its pristine condition. It consists of a hunting blind, lithic scatter, and a commanding panoramic view of the valley below. An obsidian artifact collected from the surface has been sent out for obsidian sourcing. The addition of this artifact to the obsidian database will assist with studying prehistoric trade/exchange relationships and group mobility patterns through time based on the source location for the obsidian.

## McKinley Flora Manuscript

A manuscript, entitled "McKinley Flora" by Adolph and Louise Murie, was donated by Jan Murie to the park's collection in 2005 (DENA-00562). It had been shelved in a federal repository offsite. The manuscript includes field drawings (by Olaus Murie)

and photographic slides (by Adolph Murie). Amy Craver made contact with family and friends of Louise Murie regarding getting the manuscript published. It was catalogued in March 2012. The park hopes to publish this work in the next fiscal year. An oral history interview with Louise Murie regarding its context occurred in January 2012. The oral history was also videotaped.

## Museum

Cultural Resources has hired Kim Arthur of Window Rock, Arizona, as a Museum Technician for the 2012 season. Kim is currently pursuing her Masters of Library Science at the University of Arizona. Barb Brease will begin work as a seasonal Museum Technician as well. The Museum team will continue with the comprehensive inventory and digital imaging of the entire collection; these projects will enable the park to exhibit its collection online in the near future.

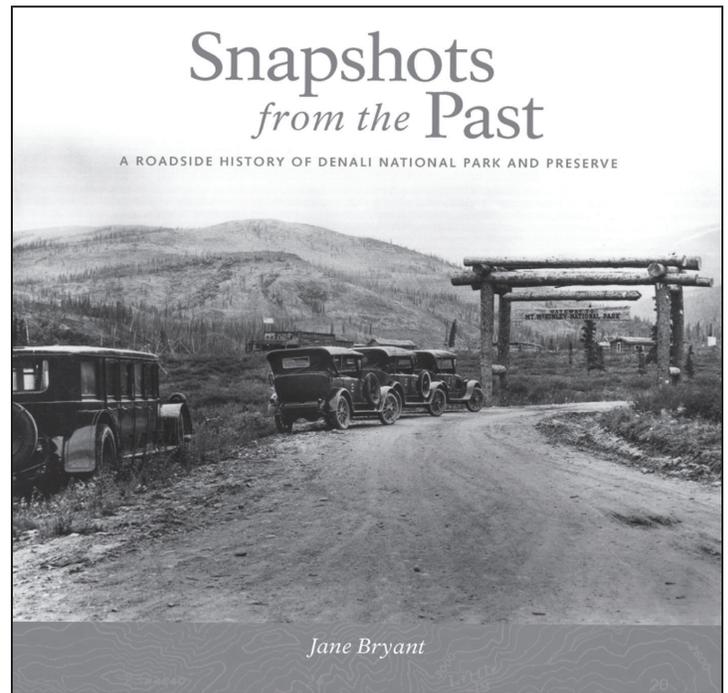


*Bearflower, Boykinia, was Louise Murie's favorite flower.*

Adolph Murie, DENA 32287.45 Denali National Park and Preserve Museum Collection

Backlog cataloging will continue to be addressed this fiscal year.

The McKinley Flora manuscript and associated drawings and photographs have been fully cataloged and staff are currently producing a finding aid for several thousand slides contained in that particular accession.



## Historical Research and Outreach

### *Snapshots from the Past*

*Snapshots from the Past – A Roadside History of Denali National Park and Preserve* was completed, printed, and available for distribution at a book signing on July 13, 2011. This publication was produced by Cultural Anthropologist Jane Bryant to present historic photos and the history of sites along the park road. Jane conducted research about the sites, collected historic photographs from individual collections and archives, and organized the information to flow from McKinley Park Station west to Kantishna. The 204-page book will be available for sale through Alaska Geographic in summer 2012.

### *Oral History*

Between 1995 and 2009, more than 28 oral history interviews were conducted and recorded by Jane Bryant. During 2012 this work is being digitized, transcribed, and supporting material assembled. While

all the material is currently available through Jane Bryant in the Cultural Resources office, the collections will be accessioned into the Denali Museum Collection for preservation and future use. A list of informants and topics follows:

-William Nancarrow – more than 16 hours of recorded interviews, detailing his arrival at Mt. McKinley National Park in 1948 and subsequent events during his long career with the NPS. Detailed interviews include his recollections about John Rumohr, revegetation, miscellaneous questions about park sled dogs, auffs, park infrastructure, and snow jeeps. In December 2006, Bill donated three personally-produced 16-mm films for transfer to digital format. Bill narrated the films and audio was put with the films. These provide a glimpse into life and activities at Mt. McKinley National Park in the early 1950s.



*William J. Nancarrow, 1921 - 2012*

-Jessie Murray – visitor to Savage Tourist Camp in 1928 tells about her trip, with personal album and 10 photos.

-Beatrice Herning – came to McKinley Park in 1938 with her father, a CCC supervisor. She met her husband, Harold Herning, who was a ranger in 1938-40 and later held mining claims on Mt. Eielson and built the Herning Cabin. She provided 60 digitized photos from a family album.

-Louise Gallop – tells how she purchased the Discovery Claim on Friday Creek in 1967, built Gallop Cabin and oversaw mining on Friday Creek with heavy equipment in the early 1980s.

-Mary Tallman Lee – CAA radio operator at Summit from 1941 to 1944.

-Ted Lachelt – built Eagle's Nest near Camp Denali in 1950, studied wolverine in McKinley Park by snowshoe in 1953, was seasonal ranger naturalist at McKinley Park in 1954, and returned in 1959 as the civil engineer overseeing construction of Eielson Visitor Center.

-Jim King – stories about being a seasonal ranger in 1950, how it changed it life, seasonal housing woes.

-Jack Gross – conducted a ground-based sheep census by horseback in 1957; saw market hunter cabins with piles of sheep horns.

-Florence & Dick Collins – Dick tells about how he came to Alaska and his work for CAA and FAA in Alaska and Lake Minchumina. Florence tells about being a geologist, a pilot, and rearing children at Lake Minchumina.

-George Hall – park superintendent 1967 – 69. Tells about 1967 Wilcox Expedition deaths on Mt. McKinley and other issues of that time.

-Mary Rhyne – talks about knowing John and Paula Anderson who lived at the north end of Wonder Lake and about her father, Joseph Dixon.

-Berle & Clare Mercer – tell about their use and observations of the Stampede Corridor, horse packing in Mt. McKinley National Park and packing for mountain climbers from Wonder Lake to the Muldrow Glacier. Recorded on digital video and audio.

-Ginny Wood & Florence Collins – the two pilots tell about their exploits making aerial equipment drops for two climbing expeditions on Mt. McKinley in 1954.

-Thayer McKinley Expedition 50th reunion, 2004 – participants gathered at Camp Denali to remember. Their discussions and narrated slide show were recorded on digital video and audio.

-James W. Corson – tells about being Wonder Lake ranger during summers 1956, 1957, & 1958.

-Lynn Stevens – tells about living at Summit CAA Airfield in 1946 & 47.

-Fred Dean – discusses his affiliation with the UAF Cooperative Park Studies Unit and research programs it conducted in Mt. McKinley.

-Tom Habecker – discusses his federal career as a ranger and his 15 years at Denali, 1990-2005. He contrasts the ranger division of 15 years ago with today, the Buffalo Chip, and other rangers experiences.

-Richard J. Stenmark – was Wonder Lake District ranger from May 1959 to February 1963. Worked on D-2 lands for NPS, retired in 1989 as Deputy Regional Director of AK Region.

-Earl Plumb – tells about living at McKinley Park Station in 1929 when he was 14 years old. His father worked for Mt. McKinley Tourist & Transportation Co. and he hauled baggage and stocked tent cabins at Savage Camp. His father built a cabin on Mt. Healy. Provided 10 photos.

\* \* \* \* \*

Oral history recordings already existing in the Denali Museum Collection were digitized and transcribed. Photograph collections from informants of those earlier interviews were added to some collections. These informants and topics include:

-Lena Howard, DENA #506 – Savage Tourist Camp; personal photos collected from Candace Waugaman.

-Norma Hoyt, DENA #513 – early McKinley Park Station, Morino Roadhouse, Savage Tourist Camp. Family photos provided by her son.

-George Flood, DENA #504 – 1923 resident and Dan Kennedy employee, personal photos from his family;

-Fritz Nyberg, DENA #510 – interviewed by Bill Myers. Talks about his ranger work in the early days.

-Harry Karstens, DENA #518 – recording of a Fairbanks Radio pioneer talk show.

-Louise Murie MacLeod, DENA #515 – talks about McKinley Park in the 1940s to 1970s.

# Research Support

## Geographic Information System

A Geographic Information System (GIS) is a digital database system for storing, analyzing, and displaying spatial information. Anything that can be depicted on a map can be incorporated into a GIS.

Denali's GIS is used by all functions in the park for analysis of park resources, including preparing maps for planning, public displays, drawings for construction, mining site rehabilitation, and design work. 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 an unlimited 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, laptops and other mobile devices. Efforts are on-going to make the technology and/or products more useful and available. A simplified interface called ArcReader requires no GIS background and makes much of the information available to casual users. Applications such as Google Earth have brought GIS technology to anyone with an internet connection. Increasingly, viewing the data and analyzing the information can be accomplished in a web browser, a capability that promises to make the technology available to a much wider audience.

The park's GIS program is involved in an on-going project begun in 2005 to collect high-resolution (1 meter) satellite imagery of the park. Most of the park has imagery although significant portions are cloud-obscured. It is hoped that eventually the entire park will be collected as clear (cloudless) images become available resulting in a base map far more accurate than the existing USGS Topo Quads. A statewide initiative is currently working to obtain 5-meter satellite imagery and elevation data for the entire state by 2014. This base data will serve as an extremely accurate basemap. Data for almost all of Denali has been collected and is currently being processed.

The USGS will be using this information to produce a new set of 1:24,000 scale topographic quads that will replace the existing 1:63,360 scale maps, some of which are almost 60 years old.

The park maintains a copy of the entire NPS GIS dataset for the state of Alaska locally (over 2.0tb 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. Major infrastructure layers are updated to reflect changes as a result of work accomplished in the summer season.

One especially exciting dataset comprises LIDAR (Light Detection and Ranging) data that covers the entrance area, headquarters and the Hines Creek Fault as far as Sanctuary. This elevation data is at a 2-meter resolution and is so clear trails can be seen.

A select set of GIS layers are available for easy public viewing (trails, backcountry units, animal movements) using freely available software such as Google Earth. The data files can be downloaded from the park's website ([www.nps.gov/dena/planyourvisit/gis\\_gps\\_data.htm](http://www.nps.gov/dena/planyourvisit/gis_gps_data.htm)). Recently, the high resolution satellite imagery viewable in Google Earth has been upgraded to include much of the eastern half of the park.

GPS (Global 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 tool has become a common addition to backpacks along with the first aid kit and map. The latest high-end handheld GPS collects positions as precise as 8 inches. The park glaciologist uses Survey-Grade GPS to measure movements of glaciers within 0.1 meter. 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.

# Research and Resource Communications

Denali's Research Administrator, Lucy Tyrrell, worked with researchers and resources staff to produce new and revised color fact sheets about Denali resources and scientific findings in 2011 and early 2012, bringing the total number of fact sheets she has created to 56. In addition, she produced the first fact sheet in a new series for kids. Additional fact sheets are nearing completion or are planned.



## *Fact Sheets about Park Resources and Research (as of 5/1/2012)*

- DENA-FS-001-2006 2006 Alaska Science Symposium: Park Science in Central Alaska. . .
- DENA-FS-002-2006 Central Alaska Network Inventory & Monitoring Program
- DENA-FS-003-2006 Monitoring Climate Change (update in 2007)
- DENA-FS-004-2006 Dinosaur Track Found in Denali
- DENA-FS-005-2006 Denali's Resource Stewardship Strategy: Developing a document, planning for the future (updates in 2006, 2007 (2 updates), 2008)
- DENA-FS-006-2006 An Integrated Study of Park Road Capacity 2006
- DENA-FS-007-2006 Large Mammals. . .How many are there? (updates in 2007, 2008, 2009, 2010)
- DENA-FS-008-2006 Moose Surveys (2010)
- DENA-FS-009-2006 Permafrost Landscapes
- DENA-FS-010-2006 Rivers and Streams (4-pages)
- DENA-FS-011-2006 Soil Survey and Ecological Classification
- DENA-FS-012-2006 Soundscapes
- DENA-FS-013-2007 Wildland Fire Risk and Response: Why are you cutting those trees? (update in 2010)
- DENA-FS-014-2007 Sharing Research (not printed)
- DENA-FS-003-2007 Monitoring Climate Change
- DENA-FS-015-2007 An Integrated Study of Park Road Capacity Summer 2007
- DENA-FS-007-2007 Large Mammals. . .How many are there?
- DENA-FS-016-2008 Climate-related Vegetation Changes
- DENA-FS-017-2008 Population Biology of the Wood Frog
- DENA-FS-018-2008 Reconstructing Ecosystems of the Lower Cantwell: Plants in the Age of Dinosaurs
- DENA-FS-007-2008 Large Mammals. . .How many are there?
- DENA-FS-019-2008 An Integrated Study of Park Road Capacity Summer 2008
- DENA-FS-020-2008 Painted Fossil Bison Skull: When, how, and why was it painted?
- DENA-FS-021-2008 Ecology of Upwelling Areas in the Toklat River
- DENA-FS-022-2008 Paleocology of Denali's Dinosaurs
- DENA-FS-023-2008 Stampede Creek and the Legacy of Mining: Antimony Movement in Stream Water and Sediment
- DENA-FS-024-2008 How old are these spruce? (not printed)
- DENA-FS-025-2009 Wolf Monitoring 1986 – 2009 (update in 2010)
- DENA-FS-026-2009 Large Lakes and Landscape Limnology
- DENA-FS-027-2009 Beavers Across Denali's Hydrologic Landscape
- DENA-FS-028-2009 Surveying Dall's Sheep Populations
- DENA-FS-029-2009 Treeline Shifts in Denali: Influences of Climate Change and Local Site Conditions

DENA-FS-030-2009 Air Quality Monitoring  
 DENA-FS-031-2009 Permafrost Thaw and Carbon Balance  
 DENA-FS-007-2009 Large Mammals...How many are there?  
 DENA-FS-032-2009 Long-term Monitoring after Restoration of Kantishna's Placer-Mined Streams  
 DENA-FS-005-2009 Implementing Denali's Resource Stewardship Strategy: Achieving desired conditions for park resources (updated with revised title)  
 DENA-FS-033-2010 Restoration of Mined Lands in Kantishna  
 DENA-FS-034-2010 Preservation of Cultural Resources  
 DENA-FS-035-2010 Ice Patch Archeology  
 DENA-FS-036-2010 Natural Resource Condition Assessment  
 DENA-FS-037-2010 Museum Collections: Preserving Denali's Stories  
 DENA-FS-038-2010 Understanding Park Visitor Characteristics  
 DENA-FS-039-2010 Integrated Study of Park Road Capacity Summer 2010  
 DENA-FS-007-2010 Large Mammals...How many are there?  
 DENA-FS-025-2010 Wolf Monitoring 1986 – 2010 (update)  
 DENA-FS-040-2010 Moose Rut  
 DENA-FS-008-2010 Moose Surveys  
 DENA-FS-041-2010 Subsistence  
 DENA-FS-042-2010 Prehistoric Upland Hunting Site  
 DENA-FS-043-2010 Measuring Movements along the Denali Fault  
 DENA-FS-013-2010 Wildland Fire Risk and Response: Why are you cutting those trees?  
 DENA-FS-012-2010 Soundscapes  
 DENA-FS-044-2010 Are Wolf Viewing Opportunities at Risk?  
 DENA-FS-045-2010 How Are Permafrost Landscapes Changing?  
 DENA-FS-046-2010 Monitoring Contaminants  
 DENA-FS-047-2010 Ecology of Golden Eagles  
 DENA-FS-048-2011 Ancient Hunters near the Teklanika River  
 DENA-FS-007-2011 Large Mammals...How many are there?  
 DENA-FS-049-2011 Where is all that smoke coming from?  
 DENA-FS-050-2011 Melting Glaciers in the Kichatna Mountains  
 DENA-FS-051-2011 The Status of Resource Stewardship in 2010: A Scorecard Approach to Reporting  
 DENA-FS-052-2011 Tracking Crevassed Human Waste on Denali  
 DENA-FS-053-2011 Mountain Building in the Alaska Range  
 DENA-FS-054-2011 Learning about Climate Change from Ice Cores  
 DENA-FS-055-2011 Wildland Fire Ecology  
 DENA-FSK-01-2011 Dancing with Dinosaurs  
 DENA-FS-025-2011 Wolf Monitoring 1986-2011 (update)  
 DENA\_FS-056-2012 Understanding and Managing Soundscapes

Follow this citation for fact sheets (substitute the correct date, title, and chronological code):  
 Denali National Park and Preserve. 2011. Melting glaciers in the Kichatna Mountains. DENA-FS-050-2011. Denali National Park and Preserve, Denali Park, Alaska.

All fact sheets are posted and available for download as pdfs at  
[www.nps.gov/dena/naturescience/factsheets.htm](http://www.nps.gov/dena/naturescience/factsheets.htm)

**Denali**  
 National Park Service  
 U.S. Department of the Interior  
 Denali National Park and Preserve

**Dancing with Dinosaurs**

**FOR KIDS**

This trackway shows how a dinosaur walked in some wet mud 70 million years ago. Unfortunately, the tracks are too blurry to tell what kind of dinosaur it was.

In a slice of time at the end of the Cretaceous Period—about 70 million years ago (Ma)—dinosaurs roamed in northern latitudes, including what is now Denali National Park and Preserve.

During that time period, sedimentary rocks hardened from the silts and muds where dinosaurs pressed their toes and left tracks. In Denali, these rock layers with dinosaur tracks are called the lower Cantwell Formation.

The discovery of dinosaur fossil tracks in Denali tells part of an amazing story. Dinosaurs once walked in the park!

But when paleontologists (researchers who study fossils) study all the other fossils in the same rock layers where the dinosaur fossils are found, they begin to put together a more complete story. What was the world of dinosaurs like?

**Learning about Dinosaurs**  
 After learning how fossil tracks form (below), jump into the next pages to explore (1) how paleontologists conduct research and reconstruct the environments when dinosaurs lived, and (2) what types of dinosaur fossils you could discover on a hike in Denali.

**HOW FOSSIL TRACKS FORM**

A dinosaur steps in wet mud, sand, or silt.

A depression or track is left behind.

The track fills with sediments that harden as rock when buried.

Millions of years later, one layer may be weathered away, leaving a fossil as a track car (raised bump, at top) or as a mold (depression) of the dinosaur.

Earth forces can tilt rocks at an angle so the fossil is found on a rock "wall."

Artwork by Mariah Roberts

## *The Faces of Research at Denali in 2012*

Research administrator, Lucy Tyrrell, is creating and updating a new webpage on Denali's website to keep current with researchers working in Denali in 2012. Researchers provide a photo of themselves to post on the web page to accompany a brief description of their scientific or scholarly work in the park. After their field work is completed, a new photo of their recent research can be posted.

## *Upgrades to Denali's Resources Webpages*

Gradually, Denali's resources webpages are being reviewed and revised for updated content, new photos, and ease of navigation. Check out the new Top Ten Natural Features of Denali at [www.nps.gov/dena/naturescience/naturalfeaturesandecosystems.htm](http://www.nps.gov/dena/naturescience/naturalfeaturesandecosystems.htm). Eventually there will be links from each of the 10 features to provide more information.

## **Research Administration**

### *Research by the numbers*

As of May 1, 2012, 858 study numbers have been assigned to scientific and scholarly studies (some continuing 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 at length in this document) and park cooperators (e.g., U.S. Geological Survey, the Alaska State Department of Fish and Game), or by other investigators (e.g., from universities and 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 1900s.

### *Conducting Research*

Scientists 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). Scientists file an application using the RPRS website (<http://science.nature.nps.gov/research>).

There are new and revised pages and documents for researchers now posted on the park's website (access the Information for Researchers page via the Nature and Science page)

[www.nps.gov/dena/naturescience/research.htm](http://www.nps.gov/dena/naturescience/research.htm)

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>. Each researcher at Denali is expected and encouraged to include an educational component to their project, in addition to filing an IAR.

Study files about each research project are kept electronically and hardcopies in fireproof file cabinets in the resources building. Reports, dissertations, and publications resulting from scientific studies become part of Denali's resources technical library (hardcopy and digital). Arrangements can be made to use these materials by contacting the Lucy Tyrrell, Research Administrator at (907) 683-6352.

### *Revised Access Database about Research*

The research administrator uses an Microsoft Access database to maintain information about research studies and the library volumes that is not included in the NPS Research Permit and Reporting System website database. During 2011 and 2012, through a cooperative agreement with St. Mary's University of Minnesota, St. Mary's staff worked with Denali's research administrator to revise the database to include new information (e.g., to help with researcher logistics), delete obsolete information, and reformat the input fields into screens that are user-friendly.

# Researchers in Denali (2011)

The following researchers (non-Denali staff listed alphabetically) held research permits in 2011.

Information about their findings can be found in the researcher's Investigator's Annual Report (IAR) filed with the National Park Service Research Permit and Reporting System (RPRS) website.

**To view IARs for research conducted in Denali and in other parks (and to search IARs by park, year, investigator, or key words), visit the website:**  
<http://science.nature.nps.gov/research>

Research results may also be reported elsewhere in Current Resource Projects 2012 or has been incorporated into one or more fact sheets.

## **Layne Adams**

UGSG, Anchorage

*Dynamics of the Denali Caribou Herd*

## **Anthony Arendt**

University of Alaska Fairbanks

*The Effects of Changing Climate on Denali Park Glaciers: A Case Study on the Kahiltna Glacier*

## **Joseph Bickley**

unaffiliated

*Glacial Terminus Surveys and Photo Documentation in the Kichatna Mountains, Denali National Park and Preserve, Alaska*

## **Tim Brabets**

USGS, Anchorage

*Water quality from streams draining abandoned and reclaimed mined lands in the Kantishna Hills area, Denali National Park and Preserve, Alaska*

## **Matthew Campbell**

University of Alaska Fairbanks

*Population genetics of Denali National Park Blackfish (Esociformes, Esocidae: Dallia)*

## **Tara Chestnut**

Portland State University

*Distribution and Prevalence of the Amphibian Chytrid Fungus (Batrachochytrium dendrobatidis) in the Northern Range of the Wood Frog (Rana [Lithobates] sylvatica)*

## **Jill Crossman**

University of Oxford

*Development of an integrated catchment model for the Toklat River: a quantification of the impact of glacial retreat upon water resources and nutrient dynamics in Denali National Park*

## **Anthony Fiorillo**

Museum of Nature and Science, Dallas

*A detailed study of an ancient high latitude terrestrial ecosystem and its implications for understanding climate change: the dinosaurs and their ecosystems within the Lower Cantwell Formation in Denali National Park*

## **Peter Fix**

University of Alaska Fairbanks

*Monitoring Indicators of Visitors' Backcountry Experience in Denali National Park*  
and

*Estimating Recreation Visits in Denali National Park and Preserve*

## **Jeffrey Freymueller**

University of Alaska Fairbanks, Geophysical Institute  
*Repeated Global Positioning System (GPS) and Absolute Gravity Measurements to Measure Active Crustal Deformation in Southern Alaska*

## **Roger Hansen**

Alaska Earthquake Information Center  
*Denali Seismic Monitoring Sites*

## **Larry Hinzman**

University of Alaska Fairbanks  
*Meteorological station on Mt. McKinley*

## **Rachel Isaacs**

Pennsylvania State University

*Rising temperatures and the influence of nonlinear thresholds on forest expansion in Denali National Park and Preserve, Alaska*

**Michael Jackson**  
UNAVCO, Inc.  
*Plate Boundary Observatory (PBO) component in Denali National Park to monitor tectonic and magmatic process using high precision Global Positioning Systems (GPS)*

**Martin Jeffries**  
University of Alaska Fairbanks  
*Lake ice and snow studies at Horseshoe Lake, Denali National Park and Preserve: Scientific research contributing to science education*

**Ron Karpilo**  
Colorado State University  
*Reconstructing and Mapping the Historic Geoscience Exploration of Stephen R. Capps in Denali National Park and Preserve, Alaska*

**Corrine Knapp**  
University of Alaska Fairbanks  
*Understanding Change: How Communities Perceive Climate Change at a Local Level*

**Rich Koehler**  
Alaska Division of Geological and Geophysical Surveys  
*Geologic hazards study of Denali National Park*

**Chris Larsen**  
University of Alaska Fairbanks  
*Airborne surveying of glacier surface elevation change*

**Lena Le**  
Park Studies Unit, University of Idaho  
*Visitor Services Project- Visitor Study*

**Michael Loso**  
Alaska Pacific University  
*Trajectory and fate of human waste on the Kahiltna Glacier*  
and  
*A field assessment of Focus Glaciers for the "Alaska NPS Glacier Inventory and Change Assessment" project*

**Maggie MacCluskie**  
Central Alaska Network, NPS  
*Monitoring of Small Mammal Populations in Denali National Park and Preserve*

**Joshua Miller**  
Wright State University  
*The bones of Denali: Historical ecological insight and the identification of past caribou calving grounds*

**Alexander Milner**  
University of Alaska Fairbanks, Institute of Arctic Biology  
*Long term ecological monitoring of streams*

**Rainer Newberry**  
University of Alaska Fairbanks  
*Geologic mapping exercises in Central Denali Park*

**Peter Newman**  
Colorado State University  
*Social Normative Study of Backcountry Visitor's Acoustic Expectations and Experiences in Denali Park and Preserve*

**Edwin Pfeifer**  
USGS, Tucson  
*Effects of climate change, glacial retreat, and snowfield loss on habitat condition and the affect on wild sheep populations and distribution in polar and high mountain ecosystems in Alaska, Russia, and Asia*

**Chuck Podolak**  
USGS, Anchorage  
*Geomorphic Evaluation of the Toklat River, Alaska near Mile 53 of the Park Road, Denali National Park*

**Glenn Shaw**  
University of Alaska Fairbanks, Geophysical Institute  
*Long term trends and spatial variability in arctic haze at four sites in western Alaska*

**Trey Simmons**  
Central Alaska Network, NPS  
*Implementation of a long term ecological monitoring program for the streams and rivers of Denali National Park and Preserve*

**Don Spalinger**  
University of Alaska Anchorage  
*Protein and Tannins in Summer Browse May Limit Productivity Of Moose in Interior Alaska*

**Henry Sun**

Desert Research Institute, Las Vegas

*Rock-colonizing algae*

**Justin Teisberg**

Washington State University

*Developing a more efficient and reliable immobilization protocol for grizzly bear managers and researchers*

**Jeffrey Trop**

Bucknell University, Pennsylvania

*Geochronology of the Colorado Creek basin, Denali National Park, Alaska: improved constraints on Oligocene environments, climate, and tectonics*

**Victor Van Ballenberghe**

University of Alaska

*Ecology of Moose in Denali National Park and Preserve*

**Cameron Wake**

University of New Hampshire

*Drillsite Reconnaissance and Snow Chemistry Survey in Denali National Park*

# Murie Science and Learning Center

*“Your connection  
to northern Alaska park science”*

## Background

Located at the entrance to Denali National Park and Preserve, the Murie Science and Learning Center (MSLC) combines science, education, and partnerships to protect areas of national significance. Although it is located in Denali, the MSLC works with seven other national parks and many partners to reach the goals of increasing research, science-based education, and science-informed management decisions for these special places. Visit the MSLC website at <http://www.murieslc.org>

Established in 2005, the MSLC has given Denali the capability to effectively communicate park research to broad audiences and increase the number and quality of research projects. A special combination of science, education, and partnerships has created new ways of connecting people to their national parks. The MSLC also supports the National Park Service mission by leveraging partnerships and collaborating to achieve fiscal efficiency in generating high-quality scientific information and products for park management.

## Partners

The MSLC consists of a primary partnership between the National Park Service and Alaska Geographic. For more than 50 years Alaska Geographic has been fostering stewardship for Alaska’s public lands through compelling publications, experiential education programs, and fantastic bookstores where all proceeds benefit Alaska’s public lands.

The MSLC serves Denali and seven other national parks across two NPS Inventory & Monitoring Networks. Partner parks are Cape Krusenstern National Monument, Noatak National Preserve, Kobuk Valley National Park, Wrangell-St. Elias National Park and Preserve, Yukon-Charley Rivers National Preserve, Bering Land Bridge National Preserve, Gates of the Arctic National Park and Preserve



*The Murie Science and Learning Center is a warm haven in both winter and summer.*

The area covered by these parks represents more than 50 percent of the lands administered by the National Park Service nationwide.

Other MSLC partners include the Denali Education Center, Doyon- ARAMARK Joint Venture, Denali Borough School District, University of Alaska Fairbanks, and the Upper Susitna Soil and Water Conservation District.

## *Facilities and services for guest researchers*

The Murie Science and Learning Center has four facilities available for use by guest researchers:

- The MSLC Visitor Facility provides a classroom, exhibit area, and office space for education staff and guest researchers. Researchers are encouraged to host educational programs and events in these spaces. Internet access and videoconferencing technology is available for use by guest researchers.
- The MSLC Dining Hall is shared with the park concessioner and provides meals for guest researchers.
- The MSLC Field Camp is located at the Teklanika River (Mile 29) and consists of six tent cabins (24 beds), a yurt, and a food and equipment storage shed.
- The MSLC Yurt, located near the MSLC Dining Hall, provides housing for guest researchers and educators.

## Programs

In 2012, the MSLC programming includes citizen science programs; curriculum-based education programs for K-12 grades; school-to-work experiential learning programs; electronic field trips; internships; multi-day accredited field seminars and teacher trainings; youth camps; science presentations; and research fellowships.

### *Citizen Science*

*Alaska Lake Ice and Snow Observatory Network (ALISON) Project.* Starting in 2004, students from Denali Borough School District have hiked to Horseshoe Lake multiple times each winter to measure and record lake ice and snow data. The Horseshoe Lake site is one of many across the state that make up the Alaska Lake Ice and Snow Observatory Network. Data collected by these students may be used to help detect long-term changes in ice and snow levels associated with climate change.

### *Youth Programs*

*Videoconferencing Technology.* Soon, classrooms nationwide will be able to bring a Denali ranger to their classroom using videoconferencing technology. We will offer two curricula starting in 2012: *The Science of Sled Dogs* uses the furry inhabitants of Denali's sled dog kennels to teach concepts of anatomical, physiological, and behavioral adaptations. *Denali Rocks* teaches concepts of plate tectonics and weathering processes using North America's tallest mountain as an enormous prop. These curricula and others will have written lessons and activities for teachers available for download at [www.nps.gov/dena/forteachers](http://www.nps.gov/dena/forteachers)

*Denali Days.* MSLC educators also connect elementary students to Denali by teaching about park resources in local schools. During Denali Days, students explore current research being done in the park, and how curiosity leads scientists and students to better understand the world. Programs include an in-class component and a Denali visit when possible. The MSLC runs Denali Days as a partnership between the Denali and Matanuska-Susitna Borough School Districts.



*Education specialist Kristen Friesen leads a team of youth on a practice dog-team run.*

*Denali Discovery Camp.* Denali Discovery Camp provides children from the Denali Borough School District with quality learning experiences through hands-on adventures and fun in the park. Developed in partnership with the Denali Education Center, the camp curriculum engages participants in hands-on science activities as they learn about sub-arctic ecology, the national park mission, and preservation and protection of park resources. Many park resource staff members meet with groups of campers in the field to talk about ongoing research projects. Depending on their ages, participants spend one to three nights in the park during camp week (June 11-15, 2012). For more information, visit: [www.denali.org/youth](http://www.denali.org/youth)

*Denali Backcountry Adventures.* Denali Backcountry Adventures is a quality backcountry learning experience for high-school students. The program develops participants' outdoor and leadership skills while they explore Denali as members of a fieldwork team monitoring human impacts in wilderness areas. Indicators selected for Denali Backcountry Adventures includes monitoring soundscape qualities, visitor observations and contacts, wildlife observations, and backcountry impacts. MSLC runs Denali Backcountry Adventures as a partnership between the National Park Service and Denali Education Center. In 2012, the camp will take place from August 7 – 11. For more information, visit: [www.denali.org/youth](http://www.denali.org/youth)

*Denali-Susitna Exploration Camp.* Exploration Camp offers high-school students from the Northern Susitna Valley the opportunity to explore the natural and cultural history of the Denali area. During the week-long camp (June 25-29, 2012), participants learn science, education and technology skills that they employ by serving as youth leaders for a second week-long camp (July 9-13, 2012) for elementary school students later in the summer. Denali-Susitna Exploration Camp is run as a partnership between the Upper Susitna Soil and Water Conservation District and Talkeetna Ranger Station with oversight by the Murie Science and Learning Center.

*Alaska Summer Research Academy* is an intensive, two-week science camp for high school students offered by the University of Alaska Fairbanks. One group of students will have the opportunity to spend a week in Denali this summer (July 19 – 25, 2012) learning about geology and geography from Denali’s physical science researchers. For more information visit: [www.uaf.edu/asra](http://www.uaf.edu/asra).

### *Field Seminars and Teacher Training*

*Field Seminars.* The MSLC offers 15-20 field seminars in Denali each summer season. Alaska Geographic coordinates these active learning multi-day seminars. Topics include geology, wildflowers, birds, paleontology, glaciology, botany, large mammals, bears, science of fly fishing, painting and music composition. Most courses are based out of the MSLC field camp, located within the park near the Teklanika River at Mile 29 of the Park Road. Many park research staff members serve as content experts for the seminars. All field seminars are available for optional university credit through the University of Alaska.

*Teacher Trainings.* The MSLC annually offers 2-4 teacher trainings in Denali each summer season. Alaska Geographic coordinates these three- to four-day courses focusing on topics such as science writing; mammals, paleontology; and climate change. All teacher trainings include one to three credits through the University of Alaska.



*Youth survey and measure dinosaur tracks on a paleontology field trip.*

### *Day Programs*

*Denali-ology Short Courses* are mini-seminars (for adults or for families) of 4-8 hours in length that delve into unique and fun science subjects of Denali. Denali-ology is the study of all things Denali. These Alaska Geographic courses are announced each May on the Denali-ology page of the MSLC website.

*Murie Excursion.* This program, coordinated by Alaska Geographic, allows visiting groups to explore wildlife and wildlife research in Denali through small-group outdoor-based activities with MSLC science instructors. Participants learn about different habitats, take a short walk, participate in hands-on activities, and travel by bus to the Teklanika Rest Area. This program returns all proceeds to the Murie Science and Learning Center operations, and is available for advanced group booking with the MSLC.

*Discover Denali.* Developed to provide a meaningful park experience for Royal-Celebrity Tours passengers, this fee-based program is offered up to 5 times a week, May – September in partnership with the Denali

Education Center. The program consists of a lecture in the MSLC classroom, a skins-and-skulls hands-on session, an interpretive walk through an area significant in early park history, and a ranger-introduced viewing of the film Heartbeats of Denali. A portion of the proceeds support the Discover Denali Research Fellowship Program (approximately \$20,000 annually).

*Running with the Pack: Family Excursion.* This Alaska Geographic program was developed to provide an educational front-country hiking experience for family groups visiting Denali. The program consists of a guided hike in the entrance area with a focus on wolf ecology and current research. The program returns all proceeds to the Murie Science and Learning Center operations, and is available for advanced group booking with the MSLC.

*Daily 'Science at Noon' Presentations.* Daily presentations and films at the MSLC provide a regular educational service to Denali visitors. Alaska Geographic instructors give presentations and show films on subjects such as climate change and park wildlife studies. This free program is offered every day at noon in the MSLC facility.

*Evening Speaker Series.* The MSLC and Alaska Geographic host guest speakers throughout the summer. Guest speakers include park researchers, visiting researchers and conservationists, writers, artists, and adventure travelers. This free program is offered twice weekly at the MSLC facility, usually on Monday and Thursday evenings at 7 pm.

### *Special Programming*

*Education Internships.* Whenever possible, the MSLC offers summer education internships. These 14-18-week internships expose interns to all facets of education programming, experiential education, research, and park management. Internships are created through a number of partnerships involving the National Park Service, Alaska Geographic, GeoCorp, GeoHeritage, and the Student Conservation Association.

*Custom Education and Facility Services.* The MSLC coordinates the needs for visiting science and education groups. The MSLC arranges special programs, food services, transportation services and meeting space to

these groups. Inquiries should be directed to the MSLC at (907)683-6432 or david\_tomeo@murieslc.org.

### *Research Awards*

*Researcher-in-Residence Program.* The MSLC is hosting a Researcher-in-Residence Program in partnership with the North and West Alaska Cooperative Ecosystem Studies Unit (<http://www.uaf.edu/snras/cesu/>) over the course of the next two years. This program is designed to increase the opportunities for researchers to work in the park and increase the opportunities for visitors to learn about current science occurring in the park. The MSLC will host three researchers. For more information on this program visit <http://murieslc.org/static/1615/researcher-in-residence-program>

#### MSLC Researchers in Residence

**Jessica Rykken (in 2012 at Denali)**  
Research Associate, Museum of Comparative Zoology, Harvard University  
*Insect pollinator diversity and distribution in Denali National Park and Preserve*

**Link Olson (in 2013 at Denali)**  
Curator of Mammals, University of Alaska Museum; Associate Professor, Department of Biology and Wildlife, University of Alaska Fairbanks  
*The effects of a century of climate change on Denali's small mammal fauna*

**Melinda Laituri (2012, MSLC Parks)**  
Professor, Department of Ecosystem Science and Sustainability, Colorado State University  
*Science and space: visualizing science with maps and GIS*  
*Discover Denali Research Fellowship Program.*

2012 is the seventh year of the Discover Denali Research Fellowship Program. Recipients are awarded grants up to approximately \$8,000 for research, especially for projects that will assist park managers with critical resource issues. Discover Denali Research Fellowships are made possible by the Denali Education Center through the MSLC. The Denali Education Center is an NPS park partner that fosters understanding and appreciation of Denali through informative and inspiring programs. This year the awards total \$22,000.



*Tamara Harms, a 2011 Research Fellow takes samples from a permafrost site near Eight Mile Lake.*

The 2012 Discover Denali Research Fellows and their topics are:

Sam Coffman

University of Alaska, Museum of the North  
*Sand-dune formation and human land use of Beaverlog Lakes, Denali*

Sara Federschmidt

University of Kentucky (Masters student)  
*Paleoseismic and structural characterization of the Hines Creek/Park Road fault at Denali*

Ron Karpilo

Colorado State University, Department of Geosciences  
*Documenting natural and cultural resource change using repeat photography in Denali*

Margie MacNeille

University of Alaska Anchorage (Masters student)  
*Dynamics and red senescence in three northern plants*

Ricardo Santos

Instituto Superior Tecnico, Portugal  
*Giardia and Cryptosporidium in surface and treated water of Denali*

Kelly Sivy

University of Alaska Fairbanks (Masters student)  
*Monitoring mesocarnivore community change in response to wolf presence, fluctuating prey, and snowpack*

*Murie Science and Learning Center – Research Fellowship Program.* In 2012, for the fifth year, financial support was awarded for research projects in any of the eight arctic and subarctic Alaska national parks (across two NPS Inventory & Monitoring Networks—Central Alaska Network or Arctic Network). These research awards are provided by Alaska Geographic, the nonprofit organization created in 1959 to help connect people to Alaska’s public lands.

In 2012, the following five researchers are recipients of Murie Science and Learning Center Research Fellowship Awards (a total of \$20,000 awarded):

The 2012 MSLC Research Fellows and their topics are:

Katie Christie

University of Alaska Fairbanks (Ph.D. student)  
*The importance of herbivory in rapidly changing arctic shrub communities* [working in Noatak and near Gates of the Arctic]

Margot Higgins

University of California, Berkeley (Ph.D. student)  
*Understanding changes in the land using phenological observations by local residents in Wrangell-St. Elias*

Amanda Koltz  
Duke University, North Carolina (Ph.D. student)  
*Effects of climate-induced changes in generalist  
predators on the structure and function of Arctic  
food webs* [near Gates of the Arctic]

Simon Pendleton  
State University of New York, Buffalo (Masters  
student)  
*Holocene glacial variability, Arrigetch Peaks,  
Alaska* [Gates of the Arctic]

Short biographies and photos of this year's research fellows are posted on the park website at [www.nps.gov/dena/naturescience/2012fellows.htm](http://www.nps.gov/dena/naturescience/2012fellows.htm).

For more information about these research project and the researchers, see the Denali website: <http://www.nps.gov/dena/naturescience/fellows.htm>

For more information about research fellowships, contact Denali's Research Administrator, Lucy\_Tyrrell@nps.gov or the MSLC Education Coordinator, Sierra\_McLane@nps.gov.

# E-Resources

## Links to Information

The following links provide more information about Denali's natural and cultural resources and recent research results.

### Denali's Nature and Science Webpage

<http://www.nps.gov/dena/naturescience/>

Access many other useful pages, including the other links listed here.

### Current Resource Projects

<http://www.nps.gov/dena/naturescience/researchresults.htm>

Link to the electronic version of Current Resource Projects 2012 and archives from previous years.

### Fact Sheets about Denali Science

<http://www.nps.gov/dena/naturescience/factsheets.htm>

Access dozens of two-page printable color fact sheets about research, monitoring, and resource management at Denali (a list of fact sheets is posted on this webpage; see also pages 57-58).

### Alaska Park Science

<http://www.nps.gov/dena/naturescience/park-science.htm>

View the Denali issue of Alaska Park Science, plus links to other issues with Denali articles.

### Climate Data

<http://www.wrcc.dri.edu/NPS>

Data summaries and data analysis tools about Denali's weather and climate.

### Fire Information

<http://www.nps.gov/akso/Fire/firehome.htm>

Access information about current fires, fire ecology, fire weather and danger, and fire management in Alaska.

### Podcasts about Denali Science

<http://www.nps.gov/dena/photosmultimedia/dne.htm>

Several podcasts are now available in the "Denali: New Expeditions" series.

### Central Alaska Network

<http://science.nature.nps.gov/im/units/cakn/>

Links to resource briefs (for Denali and the other CAKN parks), monitoring reports, and more information about the Inventory and Monitoring Program.

### Murie Science and Learning Center

<http://www.murieslc.org>

More about the Murie Science and Learning Center and its northern Alaska parks, partners, and programs.

# DENALI NATIONAL PARK AND PRESERVE

## Resources Staff FY2012



**Phillip Hooge**  
Assistant Superintendent  
for Resources Science and Learning



**Andrew Ackerman**  
Social Science



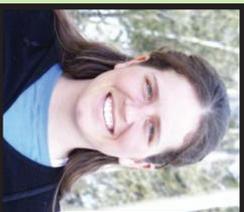
**Jennifer Barnes**  
Fire Ecology



**Dayd Betchkal**  
Soundscapes



**Andrea Blakesley**  
Air Quality



**Bridget Borg**  
Road Study Technician



**Jane Bryant**  
Cultural Resources



**Rob Burrows**  
Backcountry Resources/Glaciers



**Denny Capps**  
Geologist



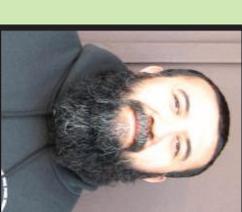
**Amy Craver**  
Cultural Resources & Subsistence



**Kirk Dietz**  
Museum Curator



**Forrest Ford**  
Fire Management



**Gilbert Garcia**  
Fire Management



**Phoebe Gilbert**  
Archaeologist, Section 106



**Carol Michtyre**  
Birds, Small Mammals



**Wendy Mahovic**  
Revegetation



**Tom Meier**  
Wildlife



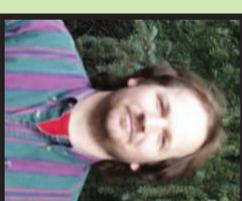
**Susanna Nancarrow**  
Fire Management Admin Assistant



**Pat Owen**  
Wildlife



**Jon Paynter**  
GIS



**Carl Roland**  
Plants



**Suann Sauvey**  
Budget



**Dave Schirrkauer**  
Physical Sciences



**Melissa Snover**  
Ecologist, Road Study



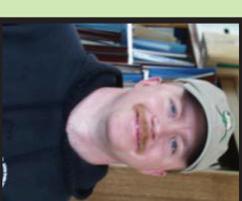
**Pam Sousanes**  
Weather, Snow /Physical Resources



**Sarah Stehn**  
Botany (CAKN)



**Lucy Tyrrell**  
Research  
Administration/Communications



**Larry Weddle**  
Fire Management



## Selected Resource Highlights from 2011-2012

- Completion of Natural Resource Condition Assessment (page 1)
- Successful 3-D digital photography of dinosaur trackway at Cabin Peak (pages 41-42)
- Arrival of new resources staff (pages 22, 36, 52)
- Completion of comprehensive survey of visitors to improve estimates of park visitation (page 48-49) as well as a new Visitor Services Project (VSP) Survey (page 50)

## Looking Ahead - 2012 and Beyond

- Creation of maps that show spatially the measures of wilderness character for Denali
- Completion of the protocol for monitoring permafrost for three Central Alaska Network parks
- Integration of the Western Boreal Landscape Conservation Cooperative (LCC) charter and research plan with the involved land management agencies (State of Alaska, FWS, BLM, NPS)
- Implementation of Denali's Vehicle Management Plan with associated "road study" monitoring
- Creation of a long-term, comprehensive strategy for the Toklat River system



*Sharing information about the natural and cultural resources of Denali opens the door to park stewardship.*

*If you have comments or suggestions about Current Resource Projects 2012, or ideas for additional resource Fact Sheets, please contact [Lucy\\_Tyrrell@nps.gov](mailto:Lucy_Tyrrell@nps.gov).*