



1998

DENALI NATIONAL PARK AND PRESERVE

State of the Park Resources Report



RESOURCE CONDITIONS

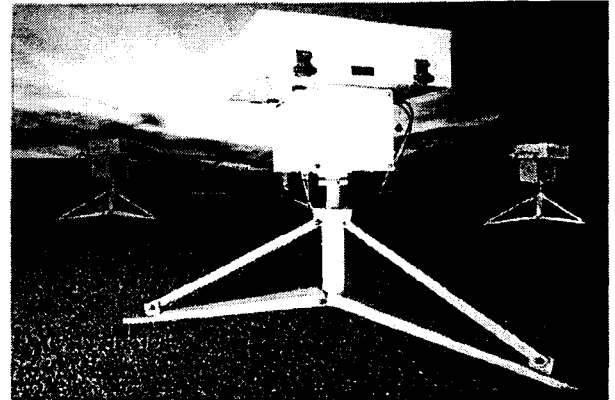
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The Brewer has landed!

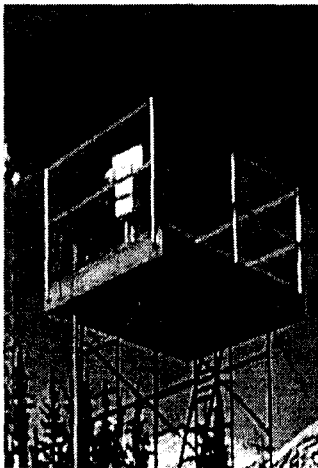
In October 1997 a Brewer Spectrophotometer (UV-B monitor) was installed at Denali National Park & Preserve (Denali) as part of the Park Research and Intensive Monitoring of Ecosystems Network (PRIMENet) to measure ultraviolet radiation, total column ozone, and other ambient gases. The instrument tracks the sun and monitors the variation in solar irradiance throughout the day. The program is set up to monitor long-term trends of these environmental stressors, and to determine how changes in irradiation may affect human health and ecosystems. The site is part of a cooperative network of the National Park Service (NPS) and the Environmental Protection Agency. UV-B monitors were installed at 14 National Parks.

The Brewer is designed to measure different wavelengths of light, especially the ultraviolet spectrum. Of most interest is the UV-B band of ultraviolet light with a wavelength between 280 and 320 nanometers. When UV-B is absorbed by organisms it can have significant biological effects. Because of this, it is often referred to as damaging ultraviolet ra-

*A Brewer Spectrophotometer*

diation, or DUV. Short and long term exposure to DUV may cause sunburn, cataracts, or skin cancer. Data collected by the Brewer UV-B monitor is used to calculate the dose of UV at the surface of the earth. This information can be used to increase public awareness about the risks of overexposure to the sun.

1998 was the first year that UV-B was measured at Denali. Stratospheric ozone layer, which acts as a natural UV shield, may be declining, allowing high levels of UV radiation to reach the earth. The depletion of the upper ozone layer is caused by air pollutants known as chlorofluorocarbons or CFCs, which destroy ozone. In 1987 *The Montreal Protocol on Substances that Deplete the Ozone Layer* treaty was signed to phase out the use of these pollutants. Monitoring the seasonal variability in UV-B and the total column ozone will help determine if ozone thinning is being reversed as a result of the treaty.

*Denali's Brewer Spectrophotometer NPS Photo***Golden Eagles Downsize**

From 1988 to 1997, Golden Eagle productivity in Denali was higher in years when snowshoe hare and willow ptarmigan populations were high. In 1998 we recorded the highest numbers of snowshoe hare and willow ptarmigan on the study area since 1989. Despite high numbers of hares and ptarmigan, Golden Eagle reproductive success in Denali decreased in 1998. While occupancy rates of territories remained high (62 of the 70 pre-selected nesting areas were occupied by territorial pairs of eagles), only 34 pairs laid eggs in 1998. Of these, only 21 produced at least one fledgling. A total of 31 fledglings were produced in the study area, nearly half the number of fledglings produced in 1997 ($n = 57$).

We suspect that unusually cold and wet weather during the early incubation stage (late April) and the nestling stage (June and July) was responsible for the low success. Some eagles may have laid eggs in early and mid-April but abandoned their nesting efforts during an extended period of snowstorms and cold weather in late April. Further, the energetic demands of nestlings may have been greater than normal due to cool and wet weather during June and July, resulting in poorer productivity than we expected. We are currently developing a weather severity index to examine the relation between weather and Golden Eagle reproductive success in Denali.

Glacial Surge Exploration Continuing

In 1998, all of the glacier monitoring sites were visited twice to record the seasonal mass balance of each glacier. Mass balance is the net change in mass (gain or loss of snow and/or ice) over a period of time. Surveys in the spring capture the 'winter balance,' or the amount of accumulation on each glacier that occurred during the previous winter. The second survey in late summer captures the 'summer balance,' after melting occurred. Taken together, the results of these surveys reveal the net mass balance of a given glacier in one year. Mass balance data were collected seasonally since 1991 at index sites on the Traleika and Kahiltna Glaciers, and also on the East Fork Toklat Glacier which was established as a benchmark monitoring glacier in 1997.

In addition to mass balance, glacier flow and surface elevation are also recorded during the surveys. Results in 1997 revealed significant and unexpected changes in Traleika Glacier. It had thickened by 25 meters (82 ft.) and the rate of ice motion had nearly doubled despite a consistently negative mass balance. (Fig. 1) Traleika Glacier is a tributary of Muldrow Glacier, which surges approximately every 50 years. Surges are periodic rapid advances of glaciers that occur when the ice breaks away from its bed and slides on sub-glacial water. Prior to 1998, pre-surge monitoring of the Muldrow had not involved its tributary glaciers, but the changes observed in 1997 prompted park staff to shift the emphasis to the Traleika Glacier. Thickening and acceleration of ice in the area of surge onset have been seen to precede advances in other surge-type glaciers. Therefore, it is likely that the next surge of Muldrow Glacier will begin in the Traleika. The long-term mass balance

monitoring project on Traleika Glacier may help glaciologists gain a better understanding of these curious and dramatic events.

Monitoring data collected on Muldrow Glacier in 1997 had indicated a 40% increase in the speed of ice motion from 1996 at the '2 Mile

sensing.

The changes observed on East Fork Toklat Glacier in 1998 were more extreme than expected. At lower elevations near the glacier's terminus, melting caused the ice surface to drop approximately 4.5 meters. Consequently, index stakes (reference points for repeated

measurements) that had been installed to a depth of six meters in the ice had to be reset to at least nine meters in September to avoid melting out of the ice completely in 1999. Though the amount of melting that took place near the glacier's terminus was greater than anticipated, the large amount of snow accumulation at the head of the glacier was equally unexpected. Due to heavy snowfall in late April at the higher elevations, many index stakes never melted out during the summer. Index stakes that did emerge from the snowpack

had to be lengthened by three to six meters to ensure relocation in 1999. Was 1998 an anomalous year for snowfall and summer melting? Only subsequent years of measurements will reveal the long-term trend in the mass balance, the resulting changes in ice thickness and flow, and their relationship to climate variables.

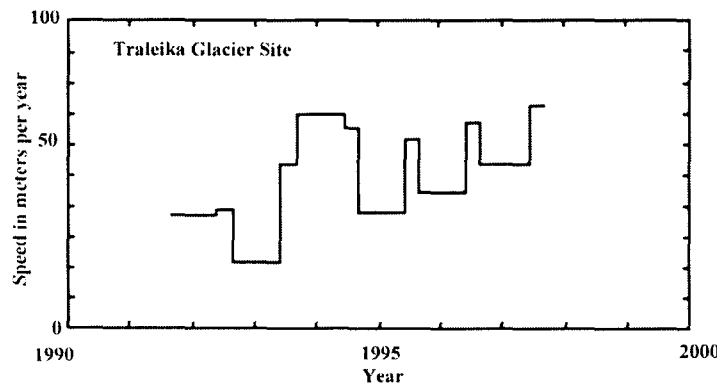


Figure 1. Speed of ice motion for Traleika Glacier at the long-term index measurement site showing that velocity has nearly doubled since 1991. An increase in velocity is consistent with an increase in ice thickness.

Moraine' target established by Bradford Washburn in 1976. It was thought that this acceleration might also be a precursor to a surge of the Muldrow. The trend, however, did not continue in 1998 as the speed of ice motion decreased. The absence of a meaningful trend in the behavior of Muldrow Glacier confirms the importance of increased monitoring of Traleika Glacier for signs of an impending surge.

1998 was the first year of data collection on the East Fork Toklat Glacier; a small glacier in the northeast corner of Denali that was established as a benchmark monitoring site in 1997. The purpose of benchmark monitoring is to collect seasonal mass balance, surface elevation, and ice flow data in much greater detail than can be achieved on the larger glaciers where the index sites are maintained. Measurements on benchmark glaciers will provide important base line data for observations of other glaciers in the future, which will be made only by satellite remote

Traleika Glacier may be more important to the Muldrow Glacier's surge pattern than previously thought.

Climatic Conditions

In 1998, weather data were collected with all 11 of the automated stations that operated the previous year. The core of the weather monitoring consists of six automated stations in the Rock Creek drainage. These six stations have been operating since 1993. Data were collected at each station throughout the year except during downtime due to damage or malfunction.

Denali's extended network of weather stations consists of four Remote Automated Weather Stations (RAWS) that are maintained in cooperation with the National Interagency Fire Center, the Bureau of Land Management (BLM), and the Alaska Support Office of the NPS. These stations gather data for the BLM, the National Weather Service (NWS) fire weather monitoring and prediction, NWS weather forecasting, and long-term monitoring for Denali. The stations at Wonder Lake and McKinley River required many repairs and replacement of components in 1998. The station formerly located at Tokositna River on the south slope of the Alaska Range was moved to a new site near the Ruth Glacier. The new location has better sun exposure that will help to keep the station running during winter months. All annual maintenance tasks on the RAWS in Denali was shifted to the Alaska Support Office of the NPS and to the BLM in 1998. Park staff has retained responsibility for the day to day troubleshooting and maintenance that is often needed.

Two stations on Mt. McKinley were added to the Park's weather network in 1998. One station was permanently

installed at 14,200 feet at a location known as the "Edge of the World" along the popular West Buttress climbing route. It was funded jointly by Denali's Monitoring Program and the park's mountaineering safety program. The station was installed for the dual purpose of aiding mountaineering rangers during the climbing season and providing year-round climatic information at high altitudes in Denali. The second station installed at base camp on Kahiltna Glacier at an elevation of 7,200 feet, will be used only during the climbing season. A better understanding of weather patterns on McKinley may help NPS climbing rangers with planning and decision-making during rescues or other operations, and enhance the park's database on regional climatic conditions.

Denali's weather database may be a valuable record of climatic trends. The park intends to study how climate may be changing in the region. A weather/climate researcher is needed to analyze the data and serve as principle investigator for the project.

In 1998 most measured parameters fell within their average range. Although July had the most precipitation in 12 years with 4.53 inches of rainfall (1.67 inches above the average). April had the most precipitation since 1981 with 11 inches of snowfall that was equivalent to 0.83 inches of rainfall

(0.41 inches above the average).

Monthly snow surveys were continued in 1998 in cooperation with the USDA Natural Resources Conservation Service (NRCS). Snow surveys are conducted each winter at the beginning of the month between December and May. The NRCS Cooperative surveys were carried out at five ground survey snow courses on the north side of the Alaska Range, and at five aerial snow depth observation markers on the south side. Snow depth and density was measured at the two snow courses located at different elevations near Denali headquarters and three snow courses distributed throughout the northwest portion of the park. Snow depths were observed at each of the five aerial markers that are distributed along the southern flanks of the Alaska Range in the southeast portion of Denali. Snow depths and densities were near

Snow in April above average!

Rain in July above average.

average throughout the year with the greatest total accumulation of snow

occurring in December 1997. The most unusual occurrence was a springtime snowfall of 5.6 inches of snow at Denali headquarters on April 30th. This occurred after several weeks of unseasonably warm weather during which daytime temperatures ranged into the mid-50's (Fahrenheit). The same storm was reported to have deposited several feet of snow at higher elevations near Mt. McKinley and throughout the Alaska Range.

Breeding Bird Surveys

The North American Breeding Bird Survey (BBS) is the most widespread program for monitoring the continent's breeding bird populations. The main purpose of the BBS is to detect changes in populations of all bird species encountered to determine trends. The survey produces an index of relative abundance rather than a complete count

of breeding bird populations. The BBS has undergone rapid expansion in Alaska recently to better monitor long-distance migrants that have the majority of their North American population occurring in the state.

Each survey route is 25 miles long and consists of 50 stops, one every half mile. At each stop the observer exits their vehicle and records the number of each species either seen or heard within a three minute period.

Weather observations consisting of temperature, sky condition, precipitation, and wind speed are recorded at the start and end of the route. The survey starts a half hour before official sunrise and should be completed in a four to five hour period as bird activity changes dramatically after that time. Routes must be run under satisfactory weather conditions: good visibility, little or no precipitation and light winds.

(Continued on page 5)

Fire Conditions at Denali



The 1998 fire season began with anticipation that the "el niño" weather event would bring Alaska either one of the highest, or, one of the lowest acres burned, on record. It proved to be one of the lowest acres burned on record for

the state. Although the rains came and came we did have two fires start by lightning. The total size of both fires amounted to five acres burned before being extinguished by rain. Both fires were in limited suppression zones.

The most action was from a third fire, a tour bus that caught on fire on July 2nd. Although the bus was completely destroyed only .1 of an acre of vegetation was burned.

Our monitoring efforts continued

around the McKinley River RAWs to validate the Canadian Fire Danger Codes. The objective of the study is to compare the actual fuel moisture values against those produced using the Canadian Forest Fire Danger Rating System, (CFFDRS). The two values are then compared against real fire behavior. Without any fires, this was not possible. We are optimistic that the data collected will have value when looking at long term trends. The project is an inter-agency effort and will continue in 1999.

Hydrology of Rock Creek

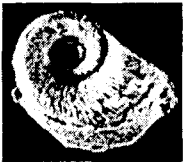
Site-intensive water quality monitoring is a fundamental unit of long-term ecosystem monitoring in Denali. Water quality and stream morphology are monitored at two stream channel reference sites within the Rock Creek watershed near park Headquarters. During the 1998 summer, bi-weekly sampling of major ions, selected nutrients, alkalinity, pH, and total organic carbon was conducted. To date, analyses indicate a geochemical dominance of the stream water chemistry.

Annual monitoring of stream morphology provides insights into the ecological hydrology of Rock Creek. Such analyses provide

important linkages to other aspects of the entire ecological system including vegetation, soils, and climate. Peak discharge normally occurs in Rock Creek between early May and mid June, and represents melt of snowpack storage during a spring leafless period, before trees and shrubs begin to transpire. Frozen soils, combined with near maximum incoming solar radiation, induces the quick and flashy nature of the spring runoff. Throughout the relatively cool summer, precipitation is the dominant hydrologic influence. In 1998, precipitation totaled 11.75 inches between May 1 and September 30, while pan evaporation totaled only 3.64 inches.

Precipitation and evapotranspiration combined to account for virtually all runoff, signifying the lack of importance

that soil recharge plays in the hydrologic ecology of Rock Creek. The type of storage at Rock Creek (snowpack versus groundwater or canopy), and the timing of storage release, have important implications for streamflow, availability of water to vegetation, and other key feedbacks to watershed ecology. For example, dominant storages such as snowpack are considered to have rapid rates of turnover, which reflects on a landscape which has little 'memory' from year to year. Conversely, a ground-water dominated system may transmit the effects of surplus or deficit for a number of years. This is an example of how the understanding of relationships between hydrologic, climatologic, and ecologic processes can be improved through this type of analysis.



Paleontology

Paleontological investigations in and adjacent to the park increased. This recent work is providing a much better understanding of the suites of marine fauna, the paleoenvironments they lived in, and the seaway/landform associations that existed in the given time periods. Numerous species and associated age refinements for Middle Cambrian trilobites, Upper Ordovician, Silurian, and Lower Devonian brachiopods, Silurian sponges, Triassic corals, hydrozoans, and bivalves, and Permian brachiopods, radiolarians and plants, are refining views of the tectonic history of Denali and central Alaska. Currently, seven different paleontology specialists associated with several universities, including universities in Korea and Great Britain are involved in unraveling rock units or terranes within the park.

Prior interpretations based on gross lithologies (rock types), stratigraphy (layers of rock over time) and fossil affinities had suggested that most of southern Alaska consists of discrete "terranes" (small tectonic plates of the crust) that were separated or fractured from the continuous 48 states or Canada. These terranes were then transported by Pacific plate tectonic movement from their southern latitudes to become accreted to the ancestral southern coastline of Alaska. Some Triassic fauna still suggests a possible southerly source for some portions of some terranes.

Many of the newly acquired biotic and lithologic data suggest that at least some of the Alaskan Paleozoic margin originated from the circumpolar or Siberian vicinity, rather than from northwestern North America. Portions of the Chulitna terrane (on the easternmost (southern boundary of the park) contain Permian flora and fauna that appear to associate well with the "Arctic Permian," and other fossils (most notably Devonian brachiopods and Silurian sponges) from the base of the Mystic terrane near Shellabarger Pass are of Siberian and/or Uralian affinities, suggesting the Mystic terrane may be a rifted sliver of the Siberian Continent. Many new results are expected in the near future on the fossil content and paleohistory of Denali.



Breeding Birds

(Continued from page 3)

For the data from any route to be pooled with the national data, the route must be monitored by the same observer at least two consecutive years. Survey routes in Denali have been conducted since 1982 but only since 1993 has the

data meet the standards required.

Two breeding bird survey routes have run in Denali since 1994. The Toklat route runs from the Toklat ranger station to approximately mile 79 and was conducted on 18 June starting at 0328 hours and ending at 0747 hours. Weather conditions for the route were calm and clear. 330 individuals of 31 different species was recorded.

The Savage route runs from the Savage river bridge to Sable Pass and was conducted on 17 June. The route was started at 0301 hours and ended at 0720 hours. Favorable weather conditions with calm to light winds and overcast to partly cloudy skies were encountered. 311 individuals of 22 different species was recorded.

Avian Productivity

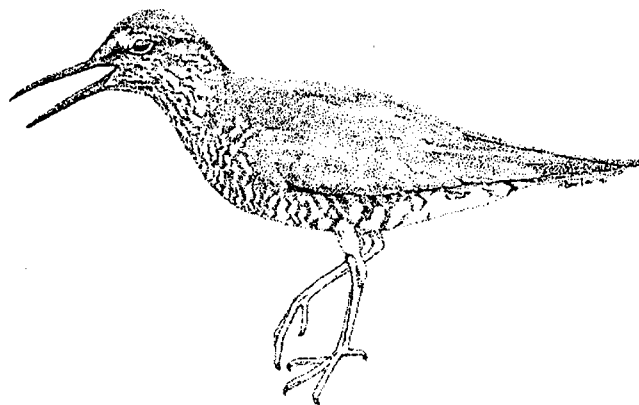
Since 1989, The Institute for Bird Populations (IBP) has administered the Monitoring Avian Productivity and Survivorship (MAPS) program, a cooperative effort by public and private agencies and bird banders to maintain North American stations where birds are captured with mist nets and banded. MAPS provides indices of population size and post-fledging productivity and estimates of adult survival and recruitment into the adult population for many land bird species. The estimates and indices are to be used to investigate temporal and spatial patterns of demographic parameters to identify causes of population changes and to evaluate the effectiveness of management actions.

IBP operated six constant-effort mist-netting and banding stations in Denali in 1998. 1138 birds (31 species) were banded and 417 previously banded birds were recaptured. Overall, adult captures increased from 1997 to 1998 by 12.4%.

Significant changes in adult captures, however, were recorded for only three species: an increase for Orange-crowned Warbler (*Vermivora celata*) and decreases for Arctic Warbler (*Phylloscopus borealis*) and Savannah Sparrow (*Passerculus sandwichensis*). In contrast to indices of population size, indices of productivity (proportion of young captured) remained virtually unchanged.

Seven-year trends in adult population size indices for nine species were calculated using constant-effort

between-year changes. Swainson's Thrush (*Catharus ustulatus*) and Common Redpoll (*Carduelis flammea*) continued to show overall declines, although both population size and productivity indices increased for each of these species in 1998. In contrast, population trends for Yellow-rumped (*Dendroica coronata*) and Orange-crowned warblers both continued to increase. Population trends for the remaining species appear rather stable, although there is annual variability.



Alaska Bird Observatory

The landbird-monitoring program in Denali quantifies interannual variation in relative abundance of migratory and resident species. Since 1992 Alaska Bird Observatory has developed and refined techniques for using point counts to survey landbirds in Denali.

In 1998, nine off-road routes and two on-road routes surveyed since 1993 were repeated. As in previous years, species richness was greatest near the west portion of the park where there is a diversity of habitats. Frequency of occurrence of most species remains relatively constant among years.

Off-road surveys were conducted exclusively in spruce-dominated forest stands from 1993-1997. Using current protocol, twelve species of birds are monitored in this habitat: Gray Jay (*Perisoreus canadensis*), Swainson's Thrush (*Catharus ustulatus*), American Robin (*Turdus migratorius*), Varied Thrush (*Ixoreus naevius*), Orange-crowned Warbler (*Vermivora celata*), Yellow-rumped Warbler (*Dendroica coronata*), Wilson's Warbler (*Wilsonia pusilla*), American Tree Sparrow (*Spizella arborea*), Savannah Sparrow (*Passerculus sandwichensis*), Fox Sparrow (*Passerella iliaca*), White-

crowned Sparrow (*Zonotrichia leucophrys*), Dark-eyed Junco (*Junco hyemalis*), and Redpoll spp. (*Carduelis* spp.).

During 1998, two off-road routes were added, one in alpine tundra and one in riparian habitat. Off-road surveys in riparian habitats included high detection's of Blackpoll Warblers (*Dendroica striata*). This species was not commonly detected elsewhere on bird surveys in Denali. Several other species would be encountered more if the number of point counts in shrub, alpine tundra, and mixed riparian habitats were increased.

Small Mammals

The 1998 field season of small mammal monitoring was virtually identical to 1997. Emphasis was placed on adding a seventh year to the monitoring of the Rock Creek watershed to further examine changes in small mammal populations over time. Additional sampling in the surrounding watersheds continued the spatial expansion begun in 1997. This report provides a brief overview of the estimates of small mammal abundance from 39 plots sampled.

A total of 48,000 trap checks were conducted in the 4 study areas during the summer, yielding a total of 1719 captures, or approximately 1 capture for every 28 traps checked.

1998 abundance levels for both Red backed vole (*Clethrionomys rutilus*) and all other voles (*Microtus sp.*) populations are suspected to be some of the lowest in the past seven years in Denali. The 1997 studies showed a severe reduction in abundance for *Clethrionomys*, while *Microtus* populations maintained a reasonable level, higher than that of *Clethrionomys* for the first time. In 1998, however, both genera experienced extremely low population levels, with *Clethrionomys* abundance on the Rock Creek plot remaining at the same level as in 1997, and the *Microtus* abundance falling to levels previously seen in 1994.

Biological Resources Division (BRD) produced a model of small mammal population dynamics based on spring weather conditions. Warm, dry springs tend to produce large populations of *Clethrionomys*, whereas cool, damp springs produce suppressed population levels. The spring of 1998 was cool and damp, and population levels were suppressed, although abundance was even lower than predicted by the model.

Moose

During 1998, BRD researchers began studies of moose population biology and predator/prey relationships as part of the wolf/prey research program. This work is being conducted in collaboration with Alaska Department Fish & Game personnel. To date, 68 moose cows (48 adults, 8-1997 calves, and 12-1998 calves) have been captured and radiocollared. These moose are being regularly monitored to determine their calf production and survival patterns. While handling these animals, we are using ultrasonography to determine their backfat depth, as a measure of nutritional condition, and reproductive status of adult cows. The cows handled to date carried an average of 22 mm and 38 mm of backfat in March and November, respectively, indicating that moose in Denali are generally in excellent nutritional condition. In addition, 6-month-old and 10-month-old calves, that were captured, averaged 196 kg and 207 kg, respectively and were about 20 kg heavier than calves of similar age weighed from the Tanana Flats and Nelchina Basin moose populations.

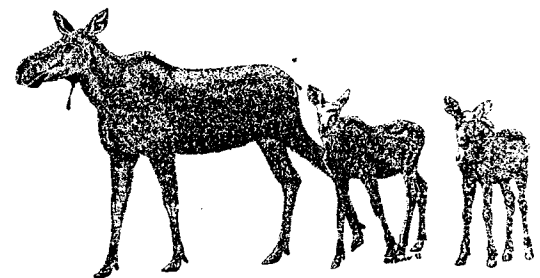
In May and early June, 37 adult cows were located daily to determine their productivity. Indicative of their good nutritional condition, their productivity was high with at least 30 (81%) producing calves, including 16 sets of twins (53%), for a total of 46 calves (1.24 calves/cow). Of particular note, 3 of 5 two-year-olds produced single calves. For other studied moose populations on the Tanana Flats and Nelchina Basin, two-year-olds are generally not pregnant.

Although calf production was high, calf survival was poor. Of the 46 calves produced by our radiocollared cows, only 6 calves survived to early November (0.18 calves/cow) or 13% survival. We have also noted surprisingly high mortality of adult cows with 5 of our 37 cows radiocollared in March dying over the summer (13.5% mortality).

Caribou



Researchers from BRD, in cooperation with park staff, completed the 15th year of long-term studies of caribou population biology. Since 1986, this effort has been closely linked with the wolf research and has provided many new insights on caribou reproductive performance, calf survival patterns, and wolf/caribou relationships. Caribou numbers increased steadily from a fall herd size of 2,200 to about 3,200 in 1989. During the severe winters from 1988-89 to 1993-94, the caribou herd declined precipitously to about 2,000 animals by fall 1993. This decline was the result of high losses of calves to predation (primarily wolves and grizzly bears) following the severe winters and was linked to the poor nutritional condition of these calves and their mothers, as shown by lower birthweights. Mortality of adults also increased substantially during the high snowfall winters. Although winter snowfall has declined to more average conditions since 1993-94 and the nutritional condition of caribou has improved, recruitment of calves has continued to be poor compared to the 1980s and herd size has stabilized at about 2,000 caribou. However, because of the low calf recruitment for most of the last decade, the cow segment of the herd has aged substantially. The median age of cows in 1998 was 9 years, compared to 5 years during 1987-89. With the aging of the cows in the herd, we expect to see increased mortality of cows and therefore, additional declines in herd size over the next few years if calf recruitment does not improve.



Northside Grizzly Bears

Denali supports one of the few naturally-regulated grizzly bear populations in the world. Intensive population studies west of the Muldrow Glacier began in 1991. Bears are monitored at least monthly during the non-denning period to determine their survival. Grizzly bear density (excluding dependent young) in this portion of Denali is about 27 bears/1000 square kilometers. Annual survival of young bears is low. For example, cubs of the year experienced the lowest annual survival rates at 37% during the last eight years. Yearling survival was 45% and that of dependent 2-year-olds was 79%. However, survival is high once bears become independent. Subadult survival was at least 94% and adult survival was about 97%. Average age of first reproduction for adult females was 7.6 years and varied from 6-10 years. Average litter size of cubs-of-the-year at the time of den emergence was 2.1. Dependent bears separated from their mothers at an average age of 2.9 years.

Adult females increase their spring weight by about 50% in preparation for cub production and the long winter hibernation. That females and subadult males lose 18-20% of lean body mass, primarily skeletal muscle, in addition to most of their fat reserves during winter emphasizes the marginal nutritional condition of this population. Starvation loss and poor physical condition associated with some dependent bear mortality suggests that nutrition plays a role in the high mortality rates of dependent bears. Overall, high density, high independent bear survival rates, and lack of human interference during the past 80 years suggests the Denali population is likely at carrying capacity. High dependent mortality coupled with periodic recruitment may cause the population to fluctuate around a mean density, but in the long term, the population is probably stable.

Southside Bear Study

As a result of increased demand for visitor access to Denali, the NPS led a multi-agency planning team to create a Development Concept Plan/Environmental Impact Statement for the portion of Denali south of the Alaska Range, Denali State Park, and adjacent areas. That planning effort resulted in identification of various resource information needs. In cooperation with Alaska Department of Fish and Game, Denali State Park, University of Alaska, and the Alaska Biological Science Center, the NPS initiated the first year of a four year study of brown and black bears in this area. The overall goal of the project is to determine important habitat for brown and black bears and estimate the effects of proposed human development on these habitats.

Twenty bears (11 brown, nine black) were captured during 1998. Six females of each species received a Global Positioning System (GPS) collar that was programmed to collect location data every five hours. Remaining bears received standard radio collars. Aerial telemetry flights were conducted every two weeks from mid-May through early November. In 1998, we received almost 3,400 locations from five black bears and six brown bears with GPS collars. Current analyses include determining home range size and habitat use for each species. GPS collars will be placed on bears in May 1999 to collect additional habitat data.



Bear - Human Interactions

Denali's bear/human conflict management plan has been in place since 1978 and is known throughout the country as one of the most successful programs. Much of its success hinges on the intensive training programs on bear ecology and safety in bear country provided to visitors by park staff.

During 1998 there were a total of 224 documented bear-human interactions between 11 May and 12 September. Overall, these numbers compare with bear-human interaction data from recent years. These interactions were classified as 199 encounters, 16 incidents (11 general incidents which are bluff charges and close approaches, four cases of bears obtaining anthropogenic food, and 1 case of property damage), and nine control actions (bears were hazed). There were 180 interactions reported in the backcountry and 50 in the frontcountry. Ten of the incidents occurred in the backcountry and 6 occurred in the frontcountry (3 each at Toklat Road Camp area and Kantishna). Backcountry units 8-10 and 32 had the highest number of encounters. There were 10,545 user-nights recorded in the backcountry (2,202 user-nights less than in 1997).

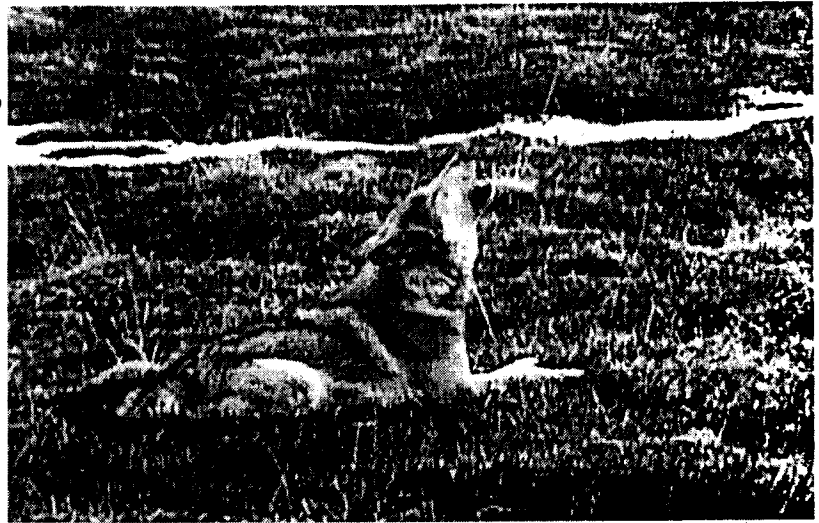
Of particular interest during 1998, park staff instrumented a sow grizzly bear and her three male three-year old cubs after they received food from two backcountry camps and they did not respond to aversive conditioning. They will be monitored during 1999 and it is expected that the cubs will separate from their mother. Black bear incidents and encounters in the Kantishna area were up from 1997 levels.

Park staff began working cooperatively with the Denali Foundation and the Alaska Natural History Association (ANHA) to develop a community bear information resource. The objective is to provide information about safe food and garbage handling and bear safety training to interested businesses and community members. A brochure for the program was designed and a grant was established by the Denali Foundation to print educational materials and to construct bear-proof garbage storage containers.

Denali Bear Population most likely stable for the ecosystem.

Wolves

Research on the wolf/prey community of Denali continued during 1998, its 13th consecutive year. BRD scientists, in cooperation with park staff, are studying the population dynamics and predator/prey relationships of wolves, caribou and moose. To date, the studies have provided new information on the population dynamics, predation behavior, social structure and genetic relationships of wolves; population dynamics, reproductive performance and calf survival patterns for caribou; and the influences of weather and landscape use on wolf/caribou relationships. During our studies wolf numbers throughout Denali increased from about 60 wolves in late winter 1986-87 to a high of 135 wolves in late winter 1991. This doubling of the wolf population resulted from the increased vulnerability of their prey brought on by higher than average snowfalls during several consecutive winters beginning in 1988-89. After adjusting to the new levels of prey vulnerability, the wolf population stayed high through late winter 1993, then as snow fall patterns returned to average



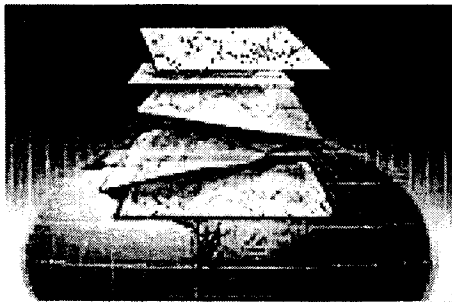
A Wolf howling at Thorofare Pass.

NPS Photo

conditions, the wolf population declined. Since late winter 1993, the number of wolves in Denali has declined from 119 to 82 wolves in late winter 1998, the lowest estimate in a decade.

RESOURCE STEWARDSHIP ACTIVITIES

Geographic Information Systems



Capabilities of the park's Geographic Information Systems (GIS) continued in 1998. Work both in-park as well as by the support office GIS staff has helped to make this technology more accessible to park users.

A number of new themes were added to the park dataset and existing themes were updated and improved. One acquisition of note involved the reception of a complete set of 1:250,000 and 1:63,360 scale USGS topographic quadrangles in digital format. These files are geo-referenced so that the quads can be 'tiled' to form a continuous coverage of an area. They have been extremely useful for preparation of maps and carrying out day-to-day park activities. At this point the most commonly requested themes are readily available. More attention is being devoted to making the data available to park users.

One such effort to make the technology more available was delivered to the mountaineering staff at the Talkeetna Mountaineering Center. This project integrated GIS with the Case Incident Reporting System used by the staff to document search & rescue, and other activities in the district. Another project to develop a GIS-based interface for viewing cultural datasets was nearing completion at the end of 1998.

Numerous map products were developed throughout the year for all park divisions. This included a variety of base maps, South Side Study maps, Spruce 4 EIS graphics, a revised trail map for the Alpenglow, a number of maps for the Concessions Division, and numerous maps for Resource Management use.

The GIS was used extensively by the park Wildlife Biologist to analyze several year's worth of moose population data in the Headquarters area. A paper discussing the findings of the study is in preparation. The on-going bear population study on the south side of the Alaska Range has produced a large amount of data for current analysis using the GIS.

Park staff continued to benefit from the efforts of support office GIS staff who have been working to develop customized extensions to Arcview that make many of the more common tasks more user-friendly. The park received a number of updates to this browser during the year. The complete GIS and AutoCAD dataset has been provided to the park on CD-ROM as well. Much of the dataset is available to the general public on the INTERNET (agdc.usgs.gov).

Mine Claims in Kantishna

Numerous mining claim owners in Kantishna have taken advantage of a federal legislative act passed on November 12, 1997, involving the taking of claims. This act allowed claim owners to initiate contest proceedings in federal district court for just compensation for their loss of property and livelihood. This act streamlines the "takings" issue so that claim owners can establish a date of taking, and ultimately establish the economic value and loss as determined in court.

Three cases are to appear before the court during the summer of 1999 in Fairbanks; *Kantishna Mining Company v. Babbitt*, involving claims on upper Caribou Creek, *Howard v. U.S.*, involving claims on lower Caribou Creek, and *U.S. v. 191.1 Acres of Land*, involving claims on Glacier and Friday Creeks. Additional claims are expected to follow suit.



Data Management

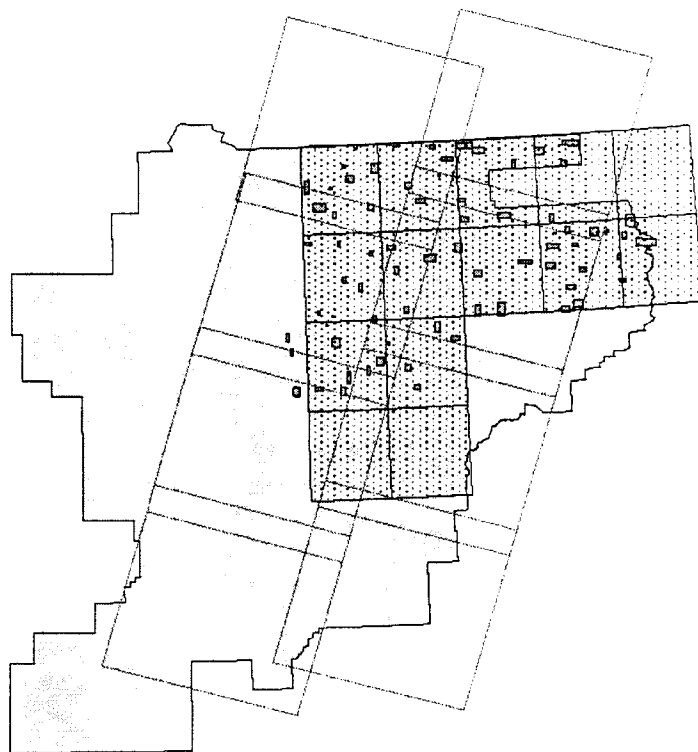
Complete Federal Geographic Data Committee (FGDC) compliant metadata was prepared for all LTEM datasets under an agreement with NASA. Documentation of all long-term monitoring sites continued during the summer season with the information incorporated into the park's GIS.

A winter seasonal employee cleaned up and documented the Kennels weather station dataset. This dataset dates from 1924 to the present and represents the longest running data collection in the park. Work was completed in the spring.

Mapping Denali's Vegetation and Soils

The Vegetation/Soils Mapping Project has been ongoing in Denali for two field seasons. During this time approximately 800 sample locations have been visited and preliminary soils mapping has been completed for twelve 1:63,360 quad areas. These quads represent the northeastern area of the Park, extending west from Headquarters to the Kantishna Hills and south from the northern park boundary to the Alaska Range. The results of the 1997 mapping have been compiled on CD in map form with the associated databases. This information is available through the Denali GIS facility. It is expected that preliminary products from the 1998 field season will become available in May of 1999. There are four more years of mapping effort required to complete the soils map for Denali.

Vegetation mapping has adopted an accelerated schedule. It is hoped that the entire Park can be mapped using SPOT satellite imagery over the next year. An enhancement of the SPOT images for the central area of the park has been prepared and is available to researchers through the Denali GIS. This image has been registered to USGS 1:63,360 maps and therefore can be used as a mapping base for other projects.



 Draft Soils Survey Complete
 1997-1998 NRCS Field Sites
 SPOT Scene Coverage

Reclamation of Slate Creek Continues

Abandoned lode and placer mining claims on Slate Creek, in the Kantishna Hills area of Denali, presented a serious threat to water and upland resources. This site was mined for antimony from 1910 through 1983; additionally, gold mining was conducted on two placer claims, which partially overlap the lode claims. As a result, this site was severely disturbed, and was recently listed on the State of Alaska's 303-d listing of impaired waterbodies. In addition to eroding channels and slopes, acid mine drainage (AMD) from an open shallow pit was measured at a pH of 2.5 (extremely acidic). Habitat degradation, impaired water quality, visually offensive views, and visitor accessibility combined to place this abandoned mine site at the top of park priorities for restoration activities.



A two-year reclamation project (1997-98) focused on treating the AMD and improving the drainage away from the mined area. An anoxic limestone drain (ALD) was constructed on-site to treat the acid mine drainage. An underground geotextile curtain was installed to capture and direct subsurface drainage to the ALD, which was constructed in a 2-cell configuration using 25 tons of 2" limestone rock. Effluent from the ALD feeds into a small riparian wetland complex before draining into Slate Creek. Approximately 300 feet of upper Slate Creek received bank stabilization treatments, including the use of coir bio-logs and fabric-encapsulated soil lifts. Finally, 1,000 alder seedlings were planted around the mine site area. Monitoring of the site will be conducted to determine the effectiveness of the reclamation techniques.

Air Quality Network up and running

In July 1998 a small network of five air quality monitoring sites was established to compare conditions at the northeast corner of the park against regional conditions. Mitigation agreements signed during the permitting for the Healy power plant, located four miles north of the park boundary, call for the three-year study.

The stations match the Environmental Protection Agency's Clean Air Status and Trends Network (CASTNet) sites. Air is filtered at the top of a 10-meter tower for a week, then the filters are analyzed for sulfur and nitrogen compounds. The towers tilt down to the ground so researchers can change the filters without having to climb them. The flow of air across the filters is controlled at 3.00 liters per minute, so we can calculate the total volume of air that is sampled each week. This allows us to compare concentrations of pollutants between the sites. Results from the first year of sampling will be reported in January 2000.



Long Term Ecological Monitoring Program

1998 was a mixed year for the Long-Term Ecological Monitoring Program. Scientifically the program grew substantially but, administratively, progress was slowed somewhat.

In partnership with the Environmental Protection Agency, a spectrophotometer was placed in operation to monitor ultraviolet radiation. Park staff also worked with the Water Resources Division, USGS to institute water quality monitoring on the south side of the Alaska Range in coordination with their Cook Inlet Watershed Monitoring Program. Both of these programs are regarded as adjuncts to the park's core monitoring program but have been successful because of park staff's demonstrated commitment to monitoring.

1998 marked the first year that large mammals (wolves and caribou) and Golden Eagles were fully incorporated into the core program. This was a significant turning point.

Furthermore, the Biological Resources Division, USGS, successfully introduced new specialists into the monitoring program. These specialists added expertise on statistical design, cost-benefit analyses, and ecosystem modeling. Major strides were made in obtaining the services of a Plant Ecologist to work with the vegetation component of the program and a modeling workshop was sponsored.

Unfortunately the park's program manager accepted a transfer to another park in Alaska about mid year. While park staff and cooperating investigators continued field operations, many planning and administrative tasks related to the program came to a standstill. Despite this loss, park staff coordinated and hosted the annual meeting of the monitoring prototype parks. This meeting was outstanding and provided much needed perspective on monitoring in Alaska to the members of this group. It is hoped that the position will be refilled during 1999.

Subsistence

Denali's Subsistence Resource Commission continues to meet on a regular basis. For the past year (1998), the Commission has been heavily involved in the development of a Subsistence User's Guide for Denali. The Guide is nearing completion and will be a very useful and easy to use tool for those involved in subsistence. Reviewing Subsistence Management Plans and responding to Regulatory proposals remains an important function of the Commission.

A task force was established to evaluate and recommend subsistence research needs in NPS units throughout the state. Subsistence uses and needs are defined by both cultural and natural resources. To insure an understanding of subsistence issues, the task force was created to identify topics and areas for which research is lacking and develop projects to collect needed information.

In addition to the task force, a Regionwide Subsistence Advisory Council (SAC) has also been recommended. The SAC would function in the Alaska Region much like the Natural Resource Advisory Council (NRAC) and the Cultural Resource Advisory Council (CRAC).

An Environmental Assessment for ATV access for subsistence use was drafted for the Cantwell area by park staff. The Federal subsistence registration permit hunts in the Denali region for both moose and caribou were managed.

Ethnographic Overview

The Ethnographic Overview and Assessment and the Native Place Names Mapping projects provide information for park staff to understand the significance of the park to the surrounding Native cultural groups and communities. Through a cooperative agreement with the Alaska State Department of Fish and Game, Subsistence Division (ADF&G), the Ethnographic Overview and Assessment will provide NPS personnel and the public with a synthesis of information chronicling the contemporary and historical use of resources in the Denali area. Included in the project are village histories which are being prepared by several villages as a cooperative effort between the villages, NPS, and ADF&G. The University of Alaska Fairbanks and the NPS have also entered into an agreement to produce a Native Place Names Map of the Denali region. This project will help identify traditional native territories and use areas through the identification, inventory, and documentation of Native place names.

Cultural Program in Full Swing

The Cultural Resource Management Program in Denali was greatly expanded during 1998. More projects were funded in the program than ever before. Of these projects, the most comprehensive is the Cultural Thematic Contexts which are being developed parkwide. Draft contexts have been written for Native Culture/Subsistence, Exploration, Transportation/Communication, Mining, Mountaineering, Science, Conservation, and Tourism. The thematic contexts for Park Administration and Community/Commerce are the final two needing to be researched and written. The Thematic project has and will continue to be useful in the completion of other cultural projects, including the Ethnographic Overview and Assessment, Native Places Names Mapping, Administrative History, and Volume II of the Historic Resource Study, as well as providing background information for interpretation, preservation, and management issues.

Research has begun for the park's Administrative History and is almost complete for the Historic Resource Study, Volume II. The Administrative History will be a single source document providing significant legislative information about park establishment, boundary changes, legal mandates, management issues and decisions. The inventory in the Historic Resource Study will provide preservation and protection recommendations for management of the park's historic resources, as well as in-depth historical context.

A Cultural Landscape Report is currently being prepared for the Park Headquarter's Historic District and the road corridor by Historical Research Associates. This report will provide information regarding the "character" of the park road and associated rustic characteristics including its gravel construction, lack of guardrails, low traffic volume, roadside cabins and the Headquarter's Historic District. Identification and analysis of elements within the road landscape will help determine management strategies to preserve the character of the road and park headquarters.

Restoration work was implemented at the Barn, the Superintendent's house, the Quigley cabin, and the Wonder Lake Ranger Station. Work on the barn included a new foundation and floor system. Repairs were made to the log portions of the structure, the site was re-graded and insulation was installed and the interior walls finished. When finished, the building will be used as office space. The Superintendent's house was re-roofed and insulated to diminish icing problems. The front log entrance was reconstructed and rough site re-grading was completed. The Archeological Clearance for the Quigley cabin was conducted and the site was brushed. The Historic Structure Report for the cabin has begun. Geotechnical testing was conducted at the Wonder Lake Ranger Station to determine permafrost conditions. A foundation plan and contract were completed.

RESOURCE EDUCATION

Golden Eagles as Guides to the World of Bird Migration



Carol McIntyre & Sonja Schmidt with the 1998 Tri-Valley sixth grade class. NPS Photo

Sixth-graders at Tri-Valley School in Healy, Alaska are exploring the world of birds and bird migration using Denali's Golden Eagles as their guides. During the school year students are monitoring the movements of radio-tagged Golden Eagles from Denali via satellite telemetry and learning about birds and bird migration through a curriculum developed by Denali biologist Carol McIntyre and Tri-Valley teacher Sonja Schmidt. Through a series of lesson plans and hands-on challenge projects, students are exploring a wide range of subjects including the origins of bird migration, evolution and development of flight, flight and migration strategy, and bird anatomy and physiology. They visited the University of Alaska Museum where the students toured the ornithological lab and collections with Dr. Kevin Winker, curator of birds at the museum. This year's project concludes in mid-May with a school-wide Bird Fair organized by the students. Our project will continue next year and Carol and Sonja are already planning activities and lesson plans for the coming school year.

Middle School Job Shadows

Park staff, including members of the Division of Research and Resource Preservation, hosted a small group of middle school students from local schools for a day. This gave students an opportunity to learn about various career fields involved in management of a major National Park. Students who worked with the division were exposed to fire management, wildlife management, and curatorial operations.

Resource Apprentice Program Student

Renà Nicklie returned for her second season as the Resource Apprentice Program Student in 1998. Renà continued with some of her 1997 tasks such as stream and dust monitoring. She also assisted Carl Roland with spruce seed counting for the LTEM Program and Carol McIntyre for a day of eagle research. Renà worked closely with the interpretive staff presenting cultural highlights as a member of one of Cantwell's founding families to some of the park visitors. Renà completed her program studies and broadened her knowledge by attending ethnographic training in Fairbanks and by attending the Denali Subsistence Resource Commission meeting in Cantwell. We were happy to have her in the division and wish her the best in the future.

Information Technologies

Staff from the Biological Resources Division, USGS, initiated work on the development of a website at which information on the Long-Term Ecological Monitoring Program would be posted. By year's end the site was running in a preliminary, skeletal form but will provide an excellent foundation for future growth and development.

ADMINISTRATIVE PROGRESS

Divisional Changes

Personnel changes in 1998 were varied and many. Penny Knuckles transferred to Lake Clark as the Resource Management Specialist, leaving the LTEM Program Manager position vacant. Pam Sousanes was hired as the Ultra-Violet Radiation Monitoring Technician for a two-year term appointment. Carl Roland was selected as a one-year term Botanist at the end of the summer season. Ken Stahlnecker transferred to Black Canyon of the Gunnison in the fall, leaving the Wildlife Branch Chief position vacant. Kahlil Wilson was hired as a General Biologist in the spring through the Student Co-op Program. Carol McIntyre was moved into a full time position. Kristin Griffin returned in the fall on a two-year term appointment to write the second volume of the Administrative History of Denali. During 1998 the Plant Ecologist and the Environmental Specialist positions remained vacant.

Financial Trends

Funding to support research and resource preservation activities at Denali came from a variety of sources in 1998:

Park Funds:	\$1,408,550.00
Other NPS Funds:	1,068,350.00
Other Agency Funds:	497,120.00
Donations:	33,000.00
Total:	\$3,007,020.00

Resource Management Plan Now Available

Park staff completed a nearly eight year effort to revise and update the park's Resource Management Plan. The document is several hundred pages long and is substantially more comprehensive than the original version which was completed in 1987 but many resource and visitor use issues have emerged in the intervening years. The 1998 version of the plan now addresses those and stands as an administrative record of actions taken to protect park resources.

BRD Field Station Changes

Dr. Jeff Keay, Research Wildlife Biologist and the Denali Field Station Leader for the Biological Resources Division, USGS, accepted a transfer within his agency to the Eastern Regional Office in Leetown, West Virginia. The Director of the Alaska Biological Science Center of BRD has decided not to refill Dr. Keay's position so the Field Station was officially closed. Park staff will assume responsibility for the study animals that Dr. Keay was working with. Pat Owen, an NPS Biological Technician who assisted Dr. Keay remains on the park staff and will continue her work with wildlife programs.





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