Alaska Park Science

National Park Service
U.S. Department of Interior

Alaska Regional Office
Anchorage, Alaska

Connections to Natural and Cultural Resource Studies in Alaska's National Parks

June 2009

Table of Contents

Cover photo: Aurora over Klondike Gold Rush National Historical Park and Skagway, Alaska.

Photograph courtesy of Michael Klensch

This project is made possible through funding from the National Park Foundation. Additional funding is provided by the National Park Service and other contributors.

Alaska Park Science is published twice a year. Recent issues of Alaska Park Science are available for sale by Alaska Geographic (www.alaskageographic.org). Charitable donations to help support this journal may be sent to: Alaska Geographic Association, 810 East Ninth Avenue, Anchorage, AK 99501 ATTN: Alaska Park Science.

ISSN 1545-4967 June 2009

Alaska Park Science

http://www.nps.gov/akso/AKParkScience/index.htm

Project Lead: Robert Winfree, Regional Science Advisor, email: robert_winfree@nps.gov

Editor: Monica Shah

Printed on recycled paper with soy based ink

Published twice a year in June and December by Alaska Geographic, a nonprofit partner of the Alaska Region of the National Park Service, supporting educational programs through publishing and operation of visitor center bookstores.

Alaska Geographic

NATIONAL PARK FOUNDATION

Photograph courtesy of G. Gusse

About the Authors

Tim Hudson is Associate Regional Director for Operations, Alaska Regional Office, NPS.

Dirk Lummerzheim, Ph.D., is a Research Professor at the Geophysical Institute, University of Alaska Fairbanks.

Frank Norris is a historian for the National Trails System Office, NPS.

Sanford P. Rabinowitch is a subsistence manager at the Alaska Regional Office, NPS.

Becky Saleeby is an archeologist at the Alaska Regional Office, NPS.

James F. Stratton is Regional Director for the National Parks Conservation Association.

Andrew Tremayne is a graduate student at the University of Wyoming.

Robert Winfree is the Alaska Regional Science Advisor for NPS.

Kenji Yoshikawa, Ph.D., is an Associate Research Professor, Water and Environmental Research Center, Institute of Northern Engineering, University of Alaska Fairbanks.

And The Wildlife Therein
Article on page 6.

US and Russian Collaboration in Park Science in the Arctic

By Robert Winfree

Science and resource conservation are rarely simple undertakings in wild Alaska, and it does not get any easier in Siberia. The joys and challenges of working to understand and preserve natural and cultural heritage on both sides of the Bering Straight were "hot" topics when scientists, scholars, educators from the United States and Russia came together in Fairbanks, Alaska, in October 2008. Their venue was the first combined meeting of the *Alaska Park Science Symposium* and the *Beringia Days International Conference*. This highly successful bilingual *Park Science in the Arctic* event was the third in what is planned as a biennial series of National Park Service scientific symposia. Each of the symposia in this series has focused on specific geographic areas that encompass national parks and their associated programs in Alaska. The *Alaska Park Science Symposium* series attracts people with diverse knowledge and interests in scientific and scholarly topics relevant to these areas.

While 2008 marked the first time that these two NPS conferences came together as one, the *Beringia Days International Conferences* have been held since 1996 to recognize and celebrate the contemporary and historic value of the region's shared ecological and cultural heritage. *Beringia Days* and the biennial *Alaska Park Science Symposia* provide important venues for cross-cultural sharing of information among scientists and scholars in multiple disciplines, educators, students, resource managers, and the interested public. Participants have consistently rated the informal opportunities for collegial networking, inter-disciplinary, and cross-cultural communication as among the most important program elements.

The theme of the fall 2008 *International Polar Year* symposium was the Natural and Cultural Heritage of Greater Beringia, a vast geographic area stretching from the Lena River in Siberia to the Mackenzie River in Canada, and from the North Pole to the Aleutian Islands. Some 200 scientists, resource managers, decision makers, educators, students, and local residents from both Alaska and Russia participated in the event. Their 100 oral and poster presentations covered a broad range of physical, biological, cultural, and social sciences and related topics that are especially relevant to the Gates of the Arctic, Noatak, Cape Krusenstern, Kobuk Valley, and the Beringian Heritage International Park Program. Numerous and diverse cultural program elements, including scholarly presentations and dances by Native performers from Fairbanks, Alaska, and Provedenia, Russia, facilitated recognition of cultural traditions, subsistence lifestyles, and ecological knowledge. Several workshops and field trips also coincided with the symposium.

Watch for a selection of summary papers from the symposium in the December 2009 issue of the *Alaska Park Science* journal. Future conferences on the natural and cultural heritage of Alaska and Russia's Far East are also intended. Discussions are underway for the next *Beringia Days International Conference* to be held in Anadyr, Chukotka (Russia) in 2009, while *Alaska Park Science Symposium* planners are focusing on coastal parks and protected areas in Southwest Alaska in 2010.

More information about the 2008 *Park Science in the Arctic* event can be found at http://nps.arcus.org.

Figure 1. Dance groups from Provideniya, Russia and Alaska gave performances of traditional Native dances during the October 2008 *Park Science in the Arctic Symposium*.

NPS photograph by Greta Burkhart

And The Wildlife Therein

By Sanford P. Rabinowitch and James F. Stratton

Over the past several years (2004-2008) the National Parks Conservation Association (NPCA) has funded several student interns working on projects to improve the quality of information available for managing wildlife in Alaska parks. The National Park Service (NPS) partnered with NPCA by providing office space, computers, and project guidance which ultimately led to two independently produced NPCA reports: *Who's Counting* and *Minding the Gap*. This is the story of that partnership.

Wildlife Management in Alaska National Parks

When Congress passed the Alaska National Interest Lands Conservation Act (ANILCA) in 1980, it provided both subsistence and sport hunting opportunities on federal land, including those managed by the NPS. In large part this was done to preserve traditional ways of life that had evolved in Alaska. Congress emphasized this point by including subsistence hunting in the purpose statements that established many park and monument units, and by allowing sport hunting in the 19 million acres of national preserves.

Managing for wildlife harvest in this country's national parks is not the norm. One of the key management-related provisions of the NPS Organic Act of 1916 is to "…conserve the scenery and the natural and historic objects and the wild life therein…" and that usually means no hunting. But in Alaska, where 96,000 hunting licenses were issued in 2008, managing hunting is an everyday task for the NPS. Alaska's physically large and ecologically diverse parks, monuments, and preserves contain about a dozen mammals that are hunted or trapped for sport and subsistence throughout much of the year. From 1980 to 1990 this management responsibility was largely accomplished through regulations instituted by the State of Alaska under the auspices of a 1982 Memorandum of Understanding (MOU) between the NPS and the Alaska Department of Fish & Game.

Although the MOU is still in effect, the State fell out of compliance with federal subsistence law in 1990, causing the federal government to reassert jurisdiction over subsistence hunting and trapping on its lands. The state still manages sport hunting in national preserves, leading the state and federal governments to manage separate hunts for the same wildlife. Thus the new era of "dual management" began. The Federal Subsistence Board consists of six voting members (of which NPS is one) who set regulations for subsistence hunting and trapping on federal lands, including all of Alaska NPS lands. In crafting these federal subsistence hunting regulations, the NPS realized it needed better basic information on how many animals, including moose and bear, were annually harvested from each park, and how recently population counts or productivity counts of those moose or bear had been accomplished.

Resolving these data gaps is necessary to ensure that, while hunting is provided for, specific ANILCA direction is also followed − wildlife is managed to sustain "natural and healthy" populations in national parks and monuments, and to sustain "healthy" populations in national preserves (*ANILCA 815(1)*). Balancing use and conservation is nothing new to the NPS, in fact, it is the defining management challenge[1].

In managing both sport and subsistence hunting, park managers look to the health of the hunted populations when review-

Figure 1. Moose are an important subsistence species for Alaska residents. Harvests on national park and preserve lands are managed by the NPS and the Alaska Department of Fish and Game.

Photograph courtesy of G. Gusse

ing any regulation change such as harvest limits, season length, age and sex restrictions, etc. Sustainably managing the relative health of bear, moose, or caribou populations is driven by population science and harvest data that are, in turn, dependant on the NPS budget (and budgets of cooperating agencies) to accomplish the work. As NPCA looked specifically into the data and science available for making determinations about various species, it learned what some NPS managers had known for years – tight budgets were impacting the amount of science and retrievable harvest data available to guide sound wildlife management decisions. As this discussion progressed, the needs very rapidly came into focus and a four-year partnership between the NPS and NPCA ensued. This partnership seeks to improve the usefulness of and support for both harvest data and the opportunity for additional science to assist the NPS in managing wildlife according to its statutory standard, maintaining wildlife populations unimpaired for the enjoyment of future generations.

The NPCA/NPS Partnership for Better Data

Collecting and analyzing harvest data for species targeted for sport hunting and subsistence hunting on Alaska national parklands had long been a desire of the NPS staff, but staff shortages made it next to impossible. Non-governmental organizations such as NPCA, however, are able to move quickly and nimbly to address these kinds of concerns by adjusting budget priorities, hiring interns to investigate what's missing, summarizing findings and making recommendations in written reports.

NPS photograph by Mason Reid

Figure 2. Michelle Kissling, a biologist for U.S. Fish and Wildlife Service, radio tracks a Kittlitz's murrelet in Icy Bay, Wrangell-St. Elias National Park and Preserve.

In summer 2005, NPCA recruited recent Cornell graduate Andy Moderow for a year-long internship. As Moderow settled into his NPS cubical, he dove headfirst into the voluminous database containing 25 years of harvest data. He quickly learned that there are two sources for harvest data: the Alaska Department of Fish & Game (ADF&G) annual Harvest Reporting Database, a voluntary submission from successful hunters detailing what was killed, when, and where, and periodic Community Harvest Surveys, which gathered similar information from one-on-one interviews with hunters in their home communities. The NPS was keen on the state's Harvest Reporting Database, so when Moderow learned to navigate the data labyrinth, he produced a user-friendly, searchable database comprised of 25 years of harvest records, by species, and by park area.

The Community Harvest Surveys, which rely on personal interviews with rural residents, are more expensive and labor-intensive, so they are conducted periodically. The State of Alaska pioneered this technique and most, if not all, of these surveys have been done by the ADF&G or in cooperation with that agency. It is widely believed that this method is much more accurate for determining rural Alaska harvests. As of August 2006, 81 rural communities had been identified in or near parks. Most surveys for these communities are quite old.

NPCA published this year-long study and analysis of both Community Harvest Data and the Harvest Reporting Database in an August 2006 report titled *Who's Counting? How Insufficient Support for Science is Hindering National Park Wildlife Management in Alaska.* To improve the quality of available data, the report's conclusions recommended additional funds and/or other measures to support Community Harvest Surveys in all villages every seven to ten years, and it recommended a new NPS staff position that would be responsible for collecting, monitoring, coordinating, and understanding wildlife harvest data from both the Harvest Reporting Database and the Community Harvest Surveys.

Who's Counting? also recommended

that the NPS obtain a better understanding of how many animals are living in its parks, preserves, and monuments in the first place. It suggested an analysis to measure the gap between current wildlife population studies and what biologists and managers feel is the minimum necessary to make good management decisions.

This "gap analysis" emerged from the continued partnership between NPCA and NPS in the spring of 2007 when another qualified intern was hired. Leif Mjos had just completed his undergraduate work at Prescott College and was primed and ready to begin the gap analysis.

Just like Moderow, Mjos had work space, a computer, and a telephone at the NPS office, an arrangement that allowed him to receive guidance as he worked with staff from the NPS and U.S Geological Survey to design a questionnaire about the history of wildlife science in each Alaska park unit where harvest of wildlife is allowed. Kenai Fjords National Park, Sitka National Historical Park, and Klondike Gold Rush National Historical Park were not surveyed because no hunting occurs there. Aniakchak was not included because of its relatively small size and remote location. All other Alaska units were included.

Due to the large number of species and the enormity of the potential material to be researched, the focus was narrowed to large hunted mammals: black bear, brown bear, caribou, moose, musk ox, sheep, and wolf. Even this was not as easy as it sounds. Wildlife biologists working for the government are involved in dozens of surveys, so Mjos's first task was to determine what kind of surveys were being done in Alaska, and reflect that in a questionnaire which made it easy for busy NPS biologists to briefly set aside their existing work and provide the needed data.

NPS biologists stepped up to the task, and the data started coming in from around the state detailing both historical efforts and the current status of wildlife science. Mjos followed up the questionnaires with a series of one-on-one interviews asking each park's wildlife biologists to recommend the minimal amount of research needed for the park to make wildlife harvest management decisions. From the questionnaires and interviews was born *Minding The Gap: Is Wildlife Research Sufficiently Funded in Alaska's National Parks?*, published by NPCA in August 2008.[2]

While *Who's Counting?* made specific recommendations for better understanding and interpretation of available harvest data, *Minding The Gap* revealed the need to improve basic wildlife research by identifying the gap between historical research levels and the suggested minimal research levels for selected species over time. The second report shied away from suggesting specific research priorities, which are best left to park managers, as they involve resource allocation and triage among all the competing demands for funds. The primary recommendation of both reports is for additional support and funding, which is included in the latest version of the NPS Alaska Regional Strategic Plan with "development of more robust wildlife data" as one of the plan's priorities.

Figure 3. Kyle Joly, of NPS, and Donald Neal, a high school student, collar a caribou in Kobuk Valley National Park.

USFWS photograph by Tina Moran

Figure 4. Paul Frame, a volunteer park biologist, tests a GPS radio collar on a grizzly bear in Denali National Park and Preserve.

NPS photograph by Pat Own

Additionally, the hope is that the NPS will improve upon what NPCA has reported by continuing to collect information on the current status of wildlife research, keeping the harvest database updated, and continuing to ask which science initiatives park managers and biologists would like to see included to close the research gap. It is NPCA's desire to spur informed discussion about what is needed and to make the case for additional funding. And with the Centennial of the NPS just a few years away in 2016, NPCA is hopeful that these discussions will result in some creative new funding proposals, including a targeted Centennial Challenge project to increase wildlife research in Alaska.

Who's Counting? and *Minding the Gap* can be found at www.npca.org/alaska/wildlife/

Notes

1. Sport hunting is permitted by a federal regulation that says "Hunting and trapping are allowed in national preserves in accordance with applicable Federal or non-conflicting state law and regulations." (36 CFR 13.40 (d)).

2. The report recognizes its data limitations and recognizes there are differences between what was reported during Mjos's internship in 2007 and where things stand today, such as the escalating cost of aviation fuel to fly wildlife surveys. Because NPCA was not able to talk to every biologist or chief of natural resources, the report also recognizes the high probability that not all data were captured.

Tent Ring Archaeology in Gates of the Arctic National Park and Preserve

By Andrew Tremayne

Introduction

A tent ring is generally described by archaeologists as a circular pattern of stones marking the spot where a tent or tipi once stood *(Figure 4)*. These stones were placed on the edges of the tent wall flaps to keep the structure in place, much the same way tent stakes are used with modern tents. At first glance tent rings appear much the same across the landscape. Indeed, I've heard comments such as "if you've seen one, you've seen them all", and "tent rings are boring". Why then should we study such an apparently simple construction? What can tent rings tell us about the people who left them behind? This project reveals the answer is quite a lot.

Ethnographic Analogy

Archaeologists can not travel through time. A great deal of what we understand about the past comes from reasonable comparisons made with historical records and ethnographic accounts. Written records of cultural practices, food gathering strategies, clothing production, shelter construction and settlement patterns of the Nunamiut Eskimos, known as the "Inland Eskimo", give us most of our sources for comparative purposes in Gates of the Arctic National Park and Preserve. Ethnographers and historians of the late nineteenth and early twentieth century recorded Eskimo methods for constructing a domed tent, known as an *itchalik*. These tents were made by draping caribou skins over a frame of lashed willow poles *(Figure 1-2) (Campbell 1998, Lee and Reinhardt 2003)*. Researchers recorded the locations of the camps, and the time of year for tent use. Although Nunamiut people built sod-walled houses, known as *ivrulits* for more permanent winter dwellings, they still used the caribou skin tents in winter when camp relocation became necessary *(Figure 1) (Ingstad 1954)*.

Knowing how and why tent rings were formed led us to pose this most basic question: are all the tent rings in Gates of the Arctic attributed to Nunamiut occupations? We know that people have occupied the Brooks Range for over 12,000 years. Archaeologists have outlined a broad culture history that includes prehistoric groups known as Paleoindians, Northern Archaic, Arctic Small Tool tradition, and historic Gwich'in and Nunamiut peoples *(Campbell 1962)*. A critical need for surviving in the arctic is adequate shelter. Did the previous groups who inhabited Gates of the Arctic leave tent rings behind and if so, what characteristics do they have that would distinguish them from those of the most recent group?

Research Methods and Goals

To attack this problem I created a database to systematically record defined attributes of every tent ring referenced in and around Gates of the Arctic. I used the National Park Service ASMIS archaeological database to locate all the known archaeological sites that reported the presence of a tent ring. I then searched out the original references, field notes, site reports, published and unpublished articles, master's theses, and dissertations to fill in this tent ring database. From these records I found 284 known tent rings referenced, with varying levels of description. Some reports simply stated there was a tent ring present, while others were more detailed, documenting size, shape, and the number of stones used. Often cultural affiliation was assigned, and

Figure 1. A Nunamiut *itchalik* caribou skin tent winter camp.

U.S. Geological Survey photograph by E.F Leffingwell, Plate 8-B, USGS Professional Paper 109.

U.S. Geological Survey photograph by E.F Leffingwell, Plate 7-C, USGS Professional Paper 109.

Figure 2. A willow frame of a Nunamiut *itchalik* caribou skin tent.

not surprisingly, most were attributed to Nunamiut Eskimos. I compiled a list of attributes which could be used for comparison. Though not comprehensive, the table in Figure 3 offers a list of the most useful attributes for systematically quantifying differences and similarities between tent rings.

A perusal of the attributes assembled showed that many of the tent rings varied widely in size, shape, and number of stones used, and even with artifacts they were found associated. One tent ring reported from Anuktuvuk Pass was associated with charcoal dating to nearly 7,000 years old *(Campbell 1962)*. Archaeologists, however, have learned that it can be misleading to take evidence at face value. For example, a recent tent ring could have been constructed on top of a more ancient occupation that left the tools and charcoal behind. The predominant interpretations in the literature suggested uncertainty about artifact associations with most of the tent rings.

With these questions in mind, the Gates of the Arctic archaeology crew set out for two months of field work in the park. We surveyed hundreds of miles by hiking to places that looked good to camp or spot for game. We surveyed along the Nigu River, Killik River and Easter Creek, and all around Agiak Lake. This work allowed me to revisit 51 of the known tent rings to re-record them for this study. In the process, our team discovered and systematically recorded another 50 previously undocumented tent rings. The main goal of our field work was to accurately record tent ring dimensions, to determine if artifact associations were valid, and to collect bone or associated organic material, such as charcoal, from which we could obtain a radiocarbon date.

Results

Of the 334 tent rings in my database, I personally recorded 101 of them. I found a great many differences evident in the record. I first used ARCMap Geographical Information System to plot the locations and attributes of the sites with tent rings. From this I was able to note that tent rings are much easier to find above tree line, and that some sites have many more tent rings than other sites. While most sites only have one tent ring, indicating a small hunting party, some areas such as Agiak Lake have over 80 tent rings represented *(Wilson and Slobodina 2007)*.

I used the database to systematically compare each tent ring. After a series of comparative attempts I finally stumbled upon the most useful measure of difference. A quick glance at the different shapes, sizes and stone counts clued me into the wide variety of styles that exist here *(Figure 5)*. I compared the basic measurements of the structures with the artifacts and radiocarbon dates. Some immediate patterns emerged. If associated with artifacts, tent rings were either associated with stone tools or debris from producing stone tools, or were found with historic artifacts. By comparing stone count, a significant correlation between increased stone count and the presence of stone tools, and between fewer stones and historic artifacts could be seen.

Although this classified historic tent rings and pre-historic tent rings, I wanted to take the analysis further. To accomplish this I needed better chronological control over my data; I needed to know the age of the tent rings. From our charcoal and bone samples, and from samples previously collected, I was able to acquire 22 absolute dates associated with tent rings *(Figure 8)*. Along with this information, I used known ethnographic accounts of sites occupied by Nunamiut Eskimos, and diagnostic artifacts attributed to other well-defined pre-historic groups. A diagnostic artifact is a type of artifact that exhibits characteristics only associated with a specific group. With better time markers now at my disposal, I divided the tent rings into groups based on age and cultural identification. Obviously, not all tent rings have diagnostic artifacts or associated remains that can be dated, but of the ones that did, some clear patterns emerged.

Tent Ring Types Found in Gates of the Arctic

The youngest tent rings found in Gates of the Arctic can be attributed to historic canvas wall tent use *(Figure 5a)*. Gubser *(1965)* reports that canvas replaced caribou skins for Nunamiut tents in the early 1900s, and by the 1950s commercial tents stretched over spruce log frames were in common use. These stone features often have dimensions similar in size to wall tents, 3 x 4 meters. At least 34 tent rings in the dataset can be assigned to this type.

The Nunamiut *itchalik* left behind rather different rings, such as the one presented in Figure 4. They tend on average to be round or oval in shape, about 3.3 meters in diameter, and constructed of 20 stones or less, on average. The

Nunamiut *itchalik* is the most common tent ring found in Gates of the Arctic; at least 99 have been positively identified.

A third type of tent ring can be attributed to Gwich'in Athabascan construction. According to ethnographic accounts, the Gwich'in moved into parts of Gates of the Arctic in the eighteenth and nineteenth centuries before being displaced by rival Nunamiut people *(Hall 1969)*. Although historically Athabascan territory is east of Gates of the Arctic and south of the Brooks Range, 16 tent rings are attributed to Athabascans. These tent rings tend to be larger in size than Nunamiut tent rings and made of more stones. They also tend to have a formal lined hearth present in the interior *(Figure 7)*.

According to Eskimo informants, "the Kutchin were called *uyagamiut* (inhabitants of rocks) by the Eskimos because they built stone houses" *(Hall 1969)*. Nothing resembling this comment has been found and certainly attributed to Athabascans, but within the park at least one site has the most unusual tent ring of all *(Figure 9)*. This tent ring is likely not of Gwich'in construction but rather is thought to be an example of a Nunamiut *karigi*. A *karigi* is a traditional Eskimo men's house.

A fifth type of tent ring was that of the Arctic Small Tool tradition, dating between 2,000-4,000 years ago. At this time only 8 tent rings of this type have been located. They appear quite similar to the Nunamiut *itchalik* in size, shape and stone count *(in Figure 5 compare b and e)*, but associated diagnostic tools and radiocarbon dates attest to their greater antiquity *(Figure 6)*.

Another even more ancient type

ATTRIBUTES	VARIABLES	POTENTIAL PROBLEMS
Shape	Round, Oval, Rectangular, Square, U-shaped, Indistinct	Subjective
Size	Measure North-South axis, East-West axis to outside wall of feature, average diameter can be determined	Do not always know where recorded measurements were taken from
Stone Count	Count the stones	Higher number of stones used the higher the error in count
Stone Type	Cobbles, Boulders, Slabs	Don't know size ranges used by past investigators
Door	Yes, No	Sometimes subjective
Hearth	Inside, Outside, Undetermined, No	Some tent rings have evidence of fire (i.e. charcoal) but no obvious hearth feature
Artifacts	Lithics, Historic Artifacts, Diagnostic artifacts	Association is not always clear; multiple occupations
Ethnographic Information	Determine if the site is known and recorded ethnographically	Recent occupations could obscure older tent rings
Radiocarbon Dates	Determine if dates are associated with the tent ring	Association

Figure 3. This is a list of the attributes used in this study including the variables and problems associated with them.

Figure 4. A typical Nunamiut type tent ring, the remains of an *itchalik* caribou skin tent, located in the Killik River Valley.

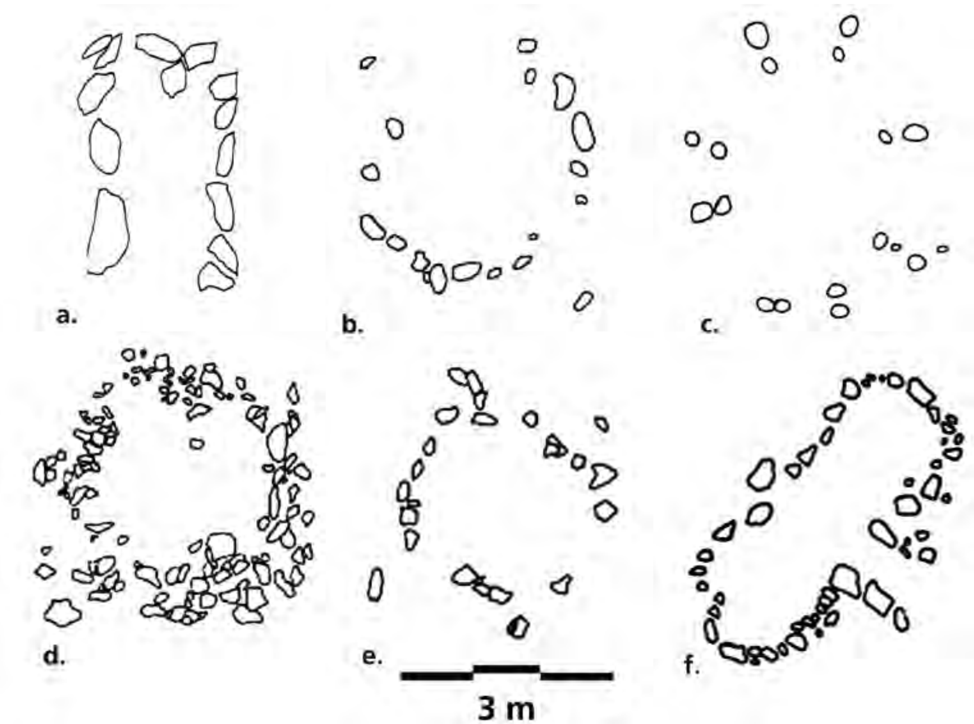


Figure 5. A sample of tent ring types found in the Gates of the Arctic National Park: a. Historic wall tent; b. Nunamiut *Itchalik*; c. Nunamiut winter tent; d. Northern Archaic; e. Arctic Small tool tradition; f. unknown.

NPS photograph by Andrew Tremayne

Figure 6. An Arctic Small Tool tradition tent ring found buried near Etivlik Lake.

can be attributed to people of the Northern Archaic tradition *(Figure 5d)*. These tent rings, 61 of which are thought to be present in the Brooks Range, tend to be round or oval, very large and comprised of on average 50 or more stones.

Conclusion

This study illustrates an important point about archaeology in Gates of the Arctic; mainly that there is much we still do not know about the cultures who occupied this region over the past 12,000 years. By looking at this seemingly unimportant feature in closer detail I have learned that tent rings hold a great deal of information about the people who constructed them. We can address issues of group size, sedentism, and also work to understand differences and changes that occurred with the various groups who lived here in the past.

NPS photograph A. Wilson

Figure 7. A 340-year-old square tent ring with an interior hearth.

Acknowledgements

Thanks to the National Park Service, The Geist Fund and the University of Alaska for funding this project. Thanks to Jeff Rasic, Dan Odess and the field crew, Aaron Wilson, Natalia Slobodina, Jay Flaming and Cassie Flynn.

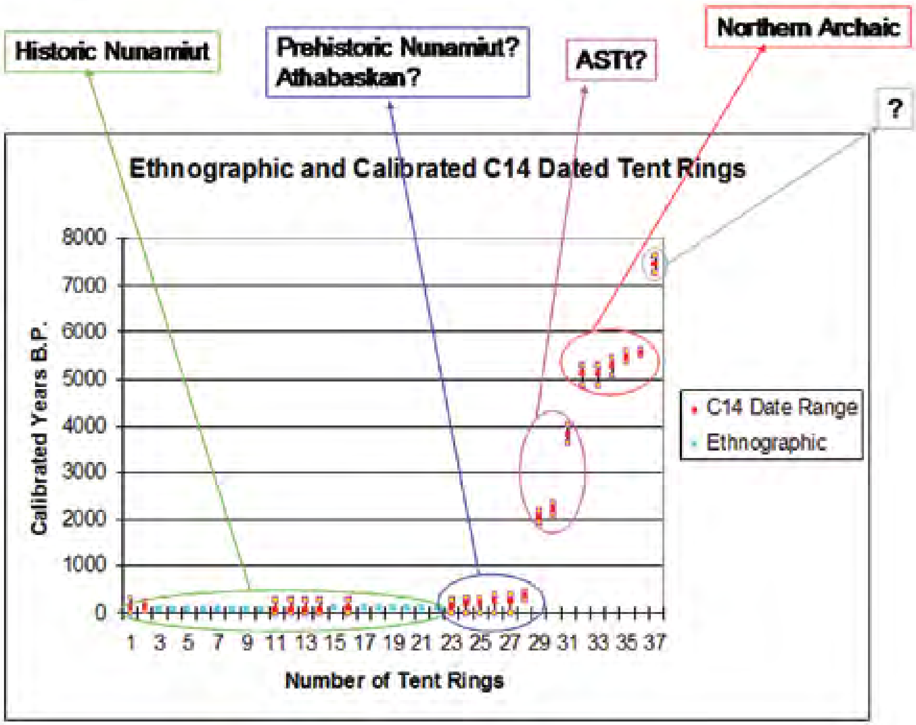


Figure 8. Graph showing the relative ages of ethnographic and radiocarbon dated tent rings and some possible cultural groupings used in my study. (BP: before present; ASTt: Arctic Small Tool tradition).

NPS photograph by Pete Christian

Figure 9. An example of a presumed Nunamiut *karigi* located in the Itkillik Valley.

REFERENCES

Campbell, John. M. 1962.
Cultural succession at Anaktuvuk Pass, arctic Alaska. In *Prehistoric Cultural Relations Between The Arctic And Temperate Zones Of North America*, edited by J.M. Campbell, pp. 39-44, vol. 11. Arctic Institute of North America. Montreal.

Campbell, John M. 1998.
North Alaska Chronicle: Notes from the End of Time. Museum of New Mexico Press. Santa Fe.

Gubser, Nicholas J. 1965.
The Nunamiut Eskimos: Hunters of Caribou. Yale University Press. New Haven and London.

Hall, Edward S. 1969.
Speculations on the Late Prehistory of the Kutchin Athabaskans. Ethnohistory 16:317-333.

Ingstad, Helga. 2006 [1954].
Nunamiut: Among Alaska's Inland Eskimos. Commemorative edition. The Countryman Press. Woodstock, Vermont.

Lee, Molly, and Gregory A. Reinhardt. 2003.
Eskimo Architecture. University of Alaska Press. Fairbanks, Alaska.

Wilson, Aaron, and Natalia Slobodina. 2007.
Two Northern Archaic Tent Ring Settlements at Agiak Lake, Central Brooks Range, Alaska. Alaska Journal of Anthropology 5(1): 43-60.

Figure 1. National parks and permafrost monitoring sites. Yellow dots indicate Permafrost/Active Layer Monitoring Program borehole locations. Red lines show snowmobile trip routes for borehole installation and community outreach. NPS units are shown in blue.

Permafrost/Active Layer Monitoring Program: Involving Remote Villages in Permafrost Drilling for Operational and Scientific Applications in Alaska

By Kenji Yoshikawa

Overview

The Permafrost/Active Layer Monitoring Program is an ongoing project which builds on work begun in 2005 to establish long-term permafrost and active layer monitoring sites adjacent to schools in Alaska and in the circumpolar permafrost region. Monitoring stations in Alaska are located in communities near national parks and their headquarters, such as Kotzebue, Nome, Fairbanks, Eagle, Circle, Northway, Glennallen, Healy, Cantwell, Anaktuvuk Pass, Noatak, Shishmaref, Ambler, Kiana, and Igiugig. Currently, there are 120 schools in Alaska involved in the project including also Denali National Park and Preserve. The project has both a scientific and outreach component. The monitoring sites collect temperature data on permafrost and the length and depth of the active layer (the layer above the permafrost that thaws during summer and freezes again during winter).

Most of the monitoring sites are located in remote communities, where the majority of residents depend on a subsistence lifestyle. Changes in climate, length of seasons, and permafrost conditions directly impact natural resources and subsistence activities. Changes in permafrost conditions also affect local ecosystems and hydrological regimes, and can influence the severity of natural disasters. In addition to extending our knowledge of the arctic environment, the program involves school-age students in hopes of inspiring a new generation of scientists to continue this study.

The data gathered from these stations are shared with other schools and made available to the public through our web site (http://www.uaf.edu/permafrost). The data contribute to several widely used science databases, including the permanent archive at the National Snow and Ice Data Center in Boulder, Colorado. In addition to working with local borehole data, teachers can compare their data with that from other participating schools at the website. Through this project, students in remote communities learn more about science in a way that is meaningful to their daily lives. In addition, they experience research participation within a larger scientific community, expanding their worldview. This project involves more than 10,000 students and 500 teachers across Alaska.

As part of this project, specialists in outreach education are developing a classroom lesson unit, Permafrost/Active Layer in Alaska, which will be included in a movie series titled "Tunnel Man."

The Science

Permafrost regions occupy about one-quarter of Earth's land surface. Permafrost is one of the most important components of the arctic terrestrial system, and this physical element of the landscape is one of the most sensitive to climatic change. Therefore, observing the interactions between permafrost and other components of the arctic system (climate, hydrology, biogeochemistry, vegetation), especially during a period of possible climatic warming, is among the most important aspects of arctic research. The changing properties of permafrost play an important role in driving the ecosystem balance, as well as affecting carbon and water cycles *(Oechel et al. 2000)*. Additionally, man-made structures built on or near ice-rich permafrost can suffer severe damage from thaw-induced ground settling, which will accelerate if mean annual temperatures continue to rise *(Osterkamp et al. 2000, Romanovsky and Osterkamp 2001)*.

Within the sensitive permafrost region, the discontinuous permafrost zone

Figure 2. (Left) Traveling by snowmobile to Anvik during Iditarod race, about 900 miles in spring 2007, hauling gear and equipment for the research.

Photograph courtesy of K. Yoshikawa

Photograph courtesy of K. Yoshikawa

Figure 3. Ice exposed at Marshall on the Yukon River, March 2007.

COUNTRY	REGION	PERMAFROST TEMPERATURE TRENDS	REFERENCE
USA	Trans-Alaska pipeline route (20 m), 1983–2000	+0.6 to +1.5°C	Romanovsky and Osterkamp 2001
	Barrow Permafrost Observatory (15 m), 1950–2001	+1°C	Our ongoing research
Russia	East Siberia (1.6–3.2 m), 1960–1992	+0.03°C/year	Our ongoing research
	North of West Siberia (10 m), 1980–1990	+0.3 to +0.7°C	Pavlov 1994
	European North of Russia, continuous permafrost zone (6 m), 1973–1992	+1.6 to +2.8°C	Pavlov 1994
Canada	Northern Mackenzie basin (28 m), 1990–2000	+0.1°C/year	GSC data
	Central Mackenzie basin (15 m), 1985–2000	+0.03°C/year	GSC data
	Alert (15 m), 1995–2000	+0.15°C/year	Geological Survey of Canada (GSC) data

Figure 4. Recent trends in permafrost temperatures measured at different locations *(Romanovsky et al. 2002).*

is the most likely to respond to climatic warming. Most national parks in Alaska are located in this zone. Throughout the circumpolar North, the boreal forest widely overlaps the area of discontinuous permafrost *(Péwé 1975)*. Thermal conditions of discontinuous permafrost are quite unstable, as the ground is close to thawing, with temperatures often hovering at 30°F (-1°C) or warmer.

The table in Figure 4 is an overview of the principal permafrost monitoring programs in the circumpolar North, with major findings and results summarized. Most notable is the evidence of a warming trend, even with few permafrost monitoring sites.

For maintenance purposes and educational outreach, the majority of our monitoring sites are located at or near schools or national park headquarters *(Figure 1)*. This allows easier accessibility to equipment, provides educational opportunities by involving students and teachers in research, and facilitates data collection.

Classroom Activities and Lessons

The classroom activities developed for the Permafrost/Active Layer Monitoring Program are differentiated by age group. The program offers teachers unique opportunities to integrate research and education by offering students a chance to work with and learn from experienced permafrost scientists; provides classroom lessons on permafrost and the active layer, an important part of Alaskan geoscience; and distributes by DVD and Internet an entertaining educational movie series called "Tunnel Man." Educational activities include the following:

(1) To help students understand permafrost and its impact on the environment, permafrost monitoring sites are established and boreholes are drilled. Scientists introduce the project and guide student discussion, focusing on the question, "Why do we need to monitor permafrost?"

(2) To demonstrate scientific methodology, design, and fieldwork, frost tubes are installed, data loggers are set up, and scientists calibrate temperature sensors with assistance from students. Students and teachers explore the following questions with scientists' guidance: "What kind of sensors and instruments are we using?" and "How do these instruments work for us?" We provide teachers with a set of classroom lessons *(Figures 5)*.

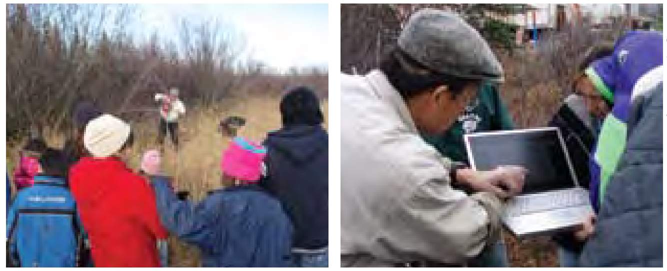
(3) About a year later, during the scientists' return visit, a second set of lessons is developed in partnership with the teachers and is used to explore the temperature data. After one year of data collection, students use the data to investigate permafrost and frozen ground, climate change impact on permafrost stability, and methods of monitoring changes in permafrost. Teachers download the data and use an Excel spreadsheet to plot monthly profiles, calculate the average temperature for each depth, and estimate active layer thickness. At this point, students focus on the following questions: "What is going on in our village?" and "What is most likely to happen in the future in our village?" *(Figures 6-7)*.

(4) A model predicting changes in local permafrost is developed and used by students in the classroom. Students share data, comparing their data with that from different areas all over the world. Our hope is that by this point students will understand many of the issues related to permafrost and how it affects the world around them. Teachers supplement the curriculum with an entertaining and instructional movie, "Tunnel Man."

(5) For the upper grades and national park visitors, more advanced classroom lectures and demonstrations are available, which offer opportunities for a more complex understanding of the interactions between permafrost and climate change. One example of the effects of natural phenomena is the impact of forest (or tundra) fires on permafrost. Fire has a strong impact on permafrost degradation; fires burn away the insulation layer, which changes the thermal condition of the permafrost. Students measure and simulate the impact that wildfires of varying severity can have on permafrost.

Summary

The intellectual merit of this research is that it will advance knowledge of our climatic system and the thermal state of permafrost as a complex process that is spatially and temporally quite variable. The arctic climatic system has an important influence on global climate. Monitoring the thermal state of permafrost by measuring borehole temperatures is one of the methods that can be used to understand climatic trends. The degradation of permafrost is triggered by the length of the active layer freezing period; that is, seasonal lengths are an important factor. Implicit in many climatic change reports is the desire to develop a sustainable scientific infrastructure to adress needs, among which is the establishment and maintenance of long-term observational networks. The Permafrost/Active Layer Monitoring Program provides opportunities for field experience and educational participation at levels ranging from elementary school to high school. It will help to provide high-resolution spatial distribution of the thermal state of permafrost, especially in Alaska, and will improve the general knowledge of Earth's climatic pattern. It also offers an opportunity for students to take part in understanding climatic systems. This project highlights the interaction between permafrost, the active layer, hydrology, and the arctic climate system, and provides a strong educational outreach program involving remote communities.



Photograph courtesy of K. Yoshikawa

Figure 5. Students watch borehole installation (left) and experience communicating with the data logger via laptop computer (right).

Photograph courtesy of K. Yoshikawa

Figure 6. Students measure active layer depth (left) and look at physical details of frozen soil composition (right).

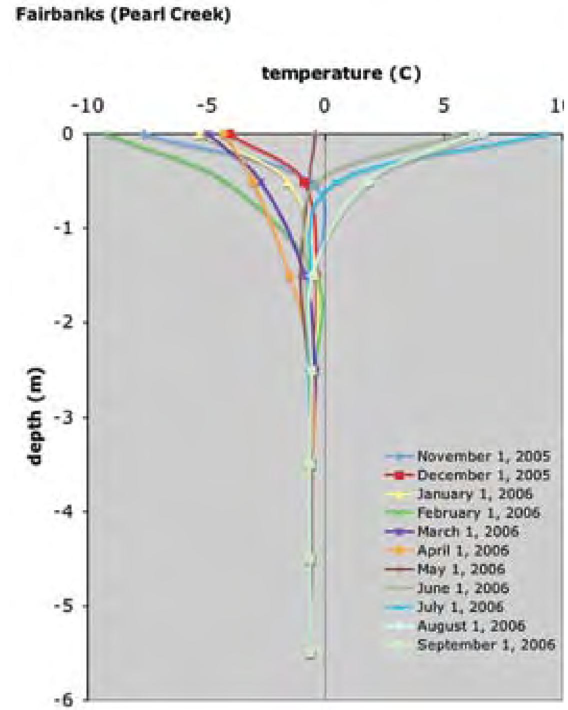


Figure 7. Demonstrating for students the seasonal variations of ground temperature using obtained data.

REFERENCES

Oechel, W.C., G.L. Vourlitis, S.J. Hastings, R.C. Zulueta, L.D. Hinzman, and D.L. Kane. 2000.
Acclimation of ecosystem CO_2 exchange in the Alaskan Arctic in response to decadal climate warming. Nature 406: 978-981.

Osterkamp, T.E., L. Viereck, Y. Shur, M.T. Jorgenson, C. Racine, A. Doyle, and R.D. Boone. 2000.
Observations of thermokarst and its impact on boreal forests in Alaska, USA. Arctic, Antarctic, and Alpine Research 32: 303-315.

Pavlov, A.V. 1994.
Current changes of climate and permafrost in the Arctic and Sub-Arctic of Russia. Permafrost and Periglacial Processes 5: 101-110.

Péwé, T.L. 1975.
Quaternary Geology of Alaska. US Geological Survey Professional Paper 835.

Romanovsky, V.E., and T.E. Osterkamp. 2001.
Permafrost: Changes and impacts. In: *Permafrost Response on Economic Development, Environmental Security and Natural Resources*, edited by R. Paepe and V. Melnikov. Kluwer Academic Publishers. Pages 297-315.

Romanovsky, V., M. Burgess, S. Smith, K. Yoshikawa, and J. Brown. 2002.
Permafrost temperature records: Indicators of climate change. EOS, AGU Transactions 83(50): 589-594.

The Cooperative Park Studies Unit: Dynamic University-Based Research in the Parks

By Frank Norris and Becky Saleeby

On December 18, 1971, President Richard Nixon signed the Alaska Native Claims Settlement Act (ANCSA) into law. This act contained a specific clause, known as "d-2," that commenced a chaotic, nine-year-long "land rush" of unprecedented proportions. What ensued was a frantic period of study, evaluation, and advocacy that would forever transform Alaska land ownership patterns. The National Park Service was at the vortex of much of this chaos, because a variety of advocacy groups (plus many in the organization itself) recognized that millions of acres of federally-owned Alaska land had the potential to be part of national park units – and, indeed, tens of millions of acres would, in December 1980, become absorbed into various national parks, monuments, and preserves.

Soon after Nixon signed ANCSA, NPS leaders concerned about Alaska drew up a list of potential park areas and began the process of gathering resource information about those areas. At first, they had little information upon which to draw, and more help was needed. As the accompanying interviews illustrate in greater detail, a major instrument for gaining new knowledge about Alaska's existing and potential parklands was the Cooperative Park Studies Unit (CPSU), which was established at the University of Alaska Fairbanks (UAF) in the spring of 1972. This research unit consisted of the Biology and Resource Management Program, headed by Dr. Frederick Dean, and the Anthropology and Historic Preservation Program, headed by longtime NPS anthropologist Zorro Bradley.

Research up until 1972

In December 1971, however, all that was in the future. At that time, the NPS had just four units in Alaska: Sitka National Monument in southeastern Alaska, Glacier Bay National Monument also in the southeast, Mt. McKinley National Park between Anchorage and Fairbanks, and Katmai National Monument at the base of the Alaska Peninsula.

Except for Sitka, the reasons for establishing each of Alaska's park units had been purely scientific. In 1917, Congress had passed the bill establishing Mt. McKinley National Park in order to protect the area's remarkable sheep, caribou, and other megafauna populations. A year later, President Wilson had proclaimed Katmai National Monument in order to protect the area surrounding the massive volcanic explosion that had wreaked such havoc in June 1912. And in 1925, President Coolidge had set aside a large area of tidewater glaciers and surrounding countryside, forming Glacier Bay National Monument. The establishment of each of these areas had been sponsored by influential national organizations, and in most cases these groups sponsored significant studies. But information about the broad array of natural and cultural resources in the various parks and monuments, as originally designated, was sorely lacking. And given the fact that the acreage of these units was substantially expanded over the years (Mt. McKinley had expanded twice, and Katmai three times), the lack of basic knowledge further exacerbated the NPS's inability to manage the agency's resources.

Given its perennial fiscal strait-jacket, the NPS did what it could during these early days to gather information about natural and cultural resources. Mt. McKinley, because it was a national park, had garnered the lion's share of attention. During the 1920s and early 1930s, the park

Figure 1. CPSU anthropologist David Libbey in front of Old John's cabin at Old John Lake, near Arctic Village in 1979.
Photograph courtesy of David Libbey

Figure 2. Two women and sod house – CPSU anthropology research near confluence of Itkillik and Colville Rivers.

had attracted well-known government scientists Joseph Wright and George Dixon; in addition, researchers from the University of California, University of Wyoming, and other venues made summer-long research trips. And beginning in the late 1930s, the park had the good fortune to obtain the services of biologist Adolph Murie, to work on the vexing wolf-sheep controversy. Murie enjoyed the park and its wildlife so much that he remained at the park, off and on, until the late 1960s to study bears, birds, small mammals, and vegetation.

The University of Alaska's Fred Dean, working through the Alaska Cooperative Wildlife Research Unit, began studies in the park in 1957. Park rangers and park naturalists also played a valuable research role through their day-to-day observations of the park's common and unusual mammals, birds, and plant life, and some of these observations formed the basis for ongoing reports to Washington. Cultural resource investigations were almost entirely ignored during the park's early years, but in 1960 a chance discovery by a geological field crew brought forth the first archeological work, by University of Alaska experts, along the Teklanika River *(Norris 2005)*.

Alaska's two large national monuments, by contrast, were subject to far less scientific scrutiny. This was primarily because both Glacier Bay and Katmai, being largely inaccessible by most common-carrier transportation, were monuments in name only. Until 1950, they had no budget, which also meant that they were not staffed, either in winter or summer. Therefore, no ongoing agency research took place. At Katmai, the monument received an extended 1930 visit from biologist Robert F. Griggs, who observed plant succession patterns on the margins of the Valley of Ten Thousand Smokes and appraised the area's brown bear habitat. Griggs recommended that Katmai's boundaries be expanded, primarily to ensure high quality bear habitat. The Interior Department agreed and drew up a presidential proclamation that more than doubled Katmai's acreage. In April 1931, President Herbert Hoover signed it into law.

At Glacier Bay National Monument, the major scientific presence during this period was William O. Field, a Harvard glaciologist. Field first visited the bay in 1926 and returned every few years for another forty years. In 1932, the agency sent wildlife biologist Joseph Dixon to the monument, and six years later he returned with the NPS's chief forester, John D. Coffman. Both visits were aimed at collecting bear habitat data. After the 1938 trip, a proclamation to expand the monument was forwarded to Interior Secretary Harold Ickes, and in April 1939, President Franklin Roosevelt signed the measure into law.

During the early 1950s, NPS officials organized the Katmai Project, an interdisciplinary study effort funded primarily by the Defense Department. Scientists from universities as well as public agencies fanned out across the monument and produced a series of papers related to a wide variety of scientific fields. Among their findings, scientists discovered that the site of the June 1912 eruption was Novarupta, not Mount Katmai; another key contribution was Victor Cahalane's biological survey. Beginning in 1960 and for more than a decade thereafter, Katmai was the scene of studies for both natural and cultural resources. They included seismic and volcanic investigations by personnel from the University of Alaska's Geophysical Institute; bears in the Brooks Camp area by Fred Dean of the University of Alaska; and archeological reports of the Brooks River and Shelikof Strait areas of the monument by Don Dumond *(1965, 1971)* and his crews from the University of Oregon.

CPSU and post-1972 research

In 1972, NPS administrators stepped up research in the parks with a dynamic university-based program, the CPSU. The Biology and Resource Management arm of the program was established when there were few NPS scientists in Alaska. It operated out of Fred Dean's office on the UAF campus and was staffed mostly by graduate students and other faculty members. Although Dean had a wide interest in plants, insects, fish, and birds, he eventually shifted more toward mammals, particularly bears. Dean's bear research began in Denali, when it was still Mt. McKinley National Park, and he and Adolph Murie clashed over Dean's suggestion to use transmitters to track these animals' movements. Over the years, he co-authored several CPSU publications on a project to compile exhaustive bibliographies of the literature on black and brown bears, in the hope that this data would prove useful for the management of bears in the parks.

Most of the CPSU research of Dean and his colleagues was tied to resource concerns of several park units, including the need to better understand hunting and harvesting in the Wrangell-St. Elias region. Besides the focus on the interactions between humans and individual species, such as wolves, caribou, Dall sheep, harbor seals, and humpback whales, there was also a push for broad biological surveys of the soils, flora and vegetation, birds, terrestrial mammals, and aquatic systems in two proposed national monuments: Bering Land Bridge and Kobuk Valley. Resulting reports were not widely distributed except within the parks and the NPS Alaska Regional Office, but are still available at University of Alaska (UAA and UAF) libraries.

The Anthropology and Historic Preservation Program arm of the CPSU operated separately from the natural resources program, and had a different scope of duties. As discussed in Zorro Bradley's interview, his team was originally charged with identifying cultural resources to be included in the new park areas. However in 1974, Bradley managed to secure funding to help Native Regional Corporations, established under ANCSA, to survey and inventory abandoned villages and camps, archeological sites, and cemeteries that they were allowed to claim under Section 14(h)(1) of ANCSA *(Libbey 1984)*. Implementation of these duties involved three federal agencies (NPS, Bureau of Land Management, and Bureau of Indian Affairs) and 12 Native regional corporations *(Williss 2005)*. Bradley cast a wide net in recruiting staff for the formidable amount of work to be accomplished, including field documentation of sites, interviews, archival research, and the preparation of National Register of Historic Places nominations for many of the sites.

Bradley was adamant about getting the results of CPSU fieldwork and research in print. He established a series of Occasional Papers of the Anthropology and Historic Preservation CPSU, published between 1976 and 1983. Among the 37 publications on this list are some which pertain to nationally significant cultural resources (National Historic Landmarks) within park boundaries, such as Melody Webb Grauman's paper on the Kennecott Mines; Robert Spude's paper on the Chilkoot Trail; and Alice J. Lynch's publication about Qizhjeh (Kijik), the large Dena'ina settlement in Lake Clark National Park and Preserve. Also included are regional overviews, such as an eight-volume set about the early days on Norton Sound and Bering Strait by Kathryn Koutsky. Archeological site reports and subsistence studies are other publications in the Occasional Papers series. Perhaps the most widely distributed of them was *Tracks in the Wildland*, a detailed portrayal of Koyukon and Nunamiut subsistence.

In 1982, NPS Alaska Regional Director, John A. Cook, wrote to inform researchers at UAF that due to budgetary constrictions, there would be no more funding for the CPSU in the next fiscal year. In his letter (Cook 1982), Cook praised the CPSU for being "highly productive and … turning out quality research products." Bruce Ream, who became project leader for the Anthropology and Historic Preservation unit after Zorro Bradley retired in 1981, has said, "CPSU was a wonderful concept because of its flexibility. It was ultimately beneficial for the parks." The legacy of the CPSU has been passed to natural and cultural resources staff now in the Alaska Regional Office and in parks units across the state, as well as to the Bureau of Indian Affairs who continues to administer the ANCSA section 14(h)(1) program *(Pratt 2004)*. During a decade of fieldwork, CPSU biologists, anthropologists, archeologists, and historians covered little-known territory and investigated a breadth of topics that still serve as baseline for research and have enduring relevance to Alaskans today.

Acknowledgements

Assistance in locating CPSU photos was generously provided by Robert Drozda, David Libbey, Karl Gurcke, Ken Schoenberg, and A.J. Lynch. The assistance of former CPSU researchers Bruce Ream and Ken Pratt is also gratefully acknowledged.

See complete list of CPSU reports at www.nps.gov/akso/documents/AKcpsubiblio.pdf

REFERENCES

Cook, John E. 1982.
Letter to Dr. John Bligh, Director, Division of Life Science, UAF. On file at NPS, Alaska Regional Office, Anchorage.

Dumond, Don E. 1965.
Archaeological Survey in Katmai National Monument, Alaska. Final Report to the National Park Service (Contract 14-10-0434-1492). Department of Anthropology, University of Oregon, Eugene.

Dumond, Don E. 1971.
A Summary of Archaeology in the Katmai Region Southwestern Alaska. University of Oregon Anthropological Papers No. 2. Department of Anthropology, University of Oregon, Eugene.

Libbey, David. 1984.
CPSU – Its Birth, Death, and Distribution. Alaska Anthropological Association Newsletter 9(2): 5-10.

Norris, Frank. 2005.
A History of Science in Alaska's National Parks. Alaska Park Science 4(2): 6-12.

Pratt, Kenneth L. 2004.
Observations on Researching and Managing Alaska Native Oral History: A Case Study. Alaska Journal of Anthropology 2(1-2): 138-153.

Ream, Bruce. 2008.
Notes from interview by NPS staff. Anchorage, Alaska.

Williss, G. Frank. 2005.
Do Things Right the First Time: The National Park Service and the Alaska National Interest Lands Conservation Act of 1980. Second edition. National Park Service. Denver, Colorado.

Zorro Bradley Interview

Conducted by Frank Norris

In early 2005, historian Frank Norris asked Mr. Bradley a series of questions about his career as it related to the Anthropology and Historic Preservation (AHP) Program at the University of Alaska Fairbanks' Cooperative Park Studies Unit. The questions and answers below have been edited for clarity and brevity.

What brought you to Fairbanks and the university campus?

I began my NPS career as a seasonal ranger archeologist at Canyon de Chelly in 1948, and in 1953 I accepted a permanent position at Tuzigoot [both in Arizona]. Beginning in 1963, I worked in Washington, D.C., as the agency's Assistant Chief Archeologist and Chief of Park Archeology under John M. Corbett. But as time went on, I tried to get transferred back to the field, and in 1972, I was finally transferred to Alaska as head of the Cooperative Parks Study Unit at the University of Alaska. Several circumstances came to a head to hasten that transfer. First of all, it was recognized that with the discovery of oil on the North Slope that there were going to be lots of changes in the state, so in 1970, several teams were sent to Alaska to check out cultural resources that the service might be interested in. One of those teams consisted of me and two historians, Merrill Mattes and Reed Jarvis. After spending most of the summer in Alaska I fell in love with the country and asked Assistant Director Ted Swem for the chance to return.

More specifically, I came to Alaska because of the actions of NPS's director at the time, George Hartzog. At some meeting in Washington, Hartzog ran into Vide Bartlett, the widow of Alaska Senator "Bob" Bartlett. Vide served on the University of Alaska's Board of Regents and she handed him a torn piece of paper on which she had written in pencil, "The University of Alaska needs an archeologist in its anthropology Department. Can you supply one?" Shortly afterward, I was on my way to Alaska.

When did you arrive in Fairbanks, and did you begin to organize the CPSU right away?

I arrived on campus in the spring on 1972 and immediately got the CPSU Archeological and Historic Preservation (AHP) program going. I brought my family up later. Getting the program underway wasn't much of a chore since I had arranged for the transfer of sufficient funds to ensure some field work and to make sure that the other Federal land managing agencies knew there was an office in Alaska to handle their archeological problems. (At this time other agencies did not have their own staff archeologists and relied on the NPS.) Part of the agreement I worked out with the university, and which was approved by the regional office in Seattle, included the arrangement that I would serve as an adjunct professor and would teach classes on cultural resources management at their request as payment for office and laboratory space they would provide. But before long, my teaching load was limited to field techniques for site survey and excavation as we went into our summer activities, so 95% of my time was related to the NPS.

At first, I had to share an office in the Anthropology Department until the new Gruening Building was completed. I then got not only office space for my crew, but lab space as well.

When you arrived at the University of Alaska, were there CPSUs at any other schools?

The CPSU at the UAF was a new creation as far as the name goes… There were no other CPSUs. However, the NPS Division of Archeology did have several associations with various universities such as the Southeast Archeological Center which I had set up at Florida State University for underwater archeology. We also had the Midwest Archeological Center associated with the University of Nebraska, and the University of Arizona helped operate a Ruins Stabilization Unit and associated archeological activities.

For the life of me, I can't remember where the name "CPSU" came from. Somehow, I think it was Director Hartzog.

Was everyone that was funded by a CPSU contract a University of Alaska student, or were there students from other schools (or from outside of academe) as well?

The Department of Anthropology/Archeology at the UAF couldn't supply the necessary personnel to carry out the programs so I recruited far and wide. Historians Robert Spude and Melody Webb, for example, were NPS employees; Melody, in fact, was my new hire.

There was no problem recruiting faculty and/or students to work on projects. Word was passed out to anthro departments all over the country, and I was inundated with applications. I had grad students and seniors from Arizona State, Colorado State, Washington, Oregon, UCLA, New Mexico, North Carolina, Evergreen College and other institutions, and of course UAF. More than 120 people participated in the AHP program over the years, almost all of whom went on to professional positions in either state or federal offices. But not all of my field researchers were out of academia. Bob Uhl, living a subsistence lifestyle in the Noatak area with his Eskimo wife Carrie, took on two research projects in the Cape Krusenstern/Noatak area. And both Ray Bane, a Bureau of Indian Affairs (BIA) school teacher in the village of Hughes, and Nita Sheldon, a Native Alaskan from Shungnak, helped with the Kobuk subsistence study.

How were the CPSUs funded? Were there line-item NPS budget items that were directed to UAF (and to other universities that had CPSUs)?

I don't know about the other, later CPSUs, but I was recipient of line item funding that I arranged before leaving the Washington office. There was little or no overview of my function by outsiders; both Washington and the regional office left all arrangements to me.

What were the initial studies undertaken as part of the Anthropology and Historic Program?

Some of the first work in the program was part of the team I led, called Team 5, that looked into the cultural resources that could be included in potential new park areas. Our team consisted of a crew of four archeologists (Bob Nichols, Fred Bohannon, Gilbert Wenger, and Charles Voll) and one biologist (Bruce Moorehead); we worked with the other four teams supplying them with needed information. I also worked at Cape Krusenstern to get all the major archeological sites identified so we could get them in the proposed new park. I also had excavations going on, through UAF contracts, at Dakah De'nin's Village on the Copper River, to ascertain its value for inclusion in Wrangell-St Elias; work also took place at Point Hope, and with Don Dumond from the University of Oregon salvaging a site in Katmai. Later we were asked to do a lot of work under the so-called 14(h) program, which identified historic and cemetery sites significant to Alaska Native peoples. One of the first major contract studies was with Brown University for the subsistence study along the upper Kobuk River; this study, *Kuuvanmiit: Traditional Eskimo Life in the Latter Twentieth Century*, was headed by Dr. Richard Nelson and was published in 1977. Other historical, archeological, and subsistence studies came later.


NPS photograph by Becky Saleeby

Figure 1. Gathering in honor of Zorro Bradley with former CPSU researchers in November 2008. Seated: Zorro Bradley. Standing from left to right: Richard Caulfield, William Schneider, Richard Nelson, Sverre Pederson, David Libbey, Grant Spearman, and David Anderson.

How long did the UAF CPSU last, and when was it most active?

The CPSU lasted from 1972 thru 1983. I retired in 1981, but the unit was ably run by Bruce Ream for more than a year after that on monies that had been stockpiled in the UAF bank. I don't remember the year of greatest funding but it must have been in the late 1970s, when my budget reached almost $3 million, and I had some twenty-three to twenty-five individuals in the field.

I hasten to add that not all funding of CPSU projects came from federal funds. On one occasion at least I got a National Geographic Society grant for early man studies in Bering Land Bridge and at the Dry Creek Site beside Denali. This work was carried out by Roger Powers from the UAF Anthropology Department. The fact that Connie Wirth (an ex-NPS Director) served on the NGS board didn't hurt.

Given the funding levels you received, how were projects selected?

For the most part I selected the projects and secured the funding. The only exception was the 14(h) program. For 14(h) there was a line item in the park service budget for, I think, about $800,000, approximately three-quarters of which was available for use in the field. Congress had originally put 14(h) in the budget of BIA, but when they learned that there was no professional anthropological or historical staff in BIA, they quickly put the program in our laps.

Were most of the studies that were funded by the CPSU an important part of a graduate student's academic program?

In a 1980 report I co-authored with Fred Dean for

Photograph courtesy of David Libbey

Figure 2. CPSU anthropologist Bill Schneider and informants on Meade River 1979.

the university, we stated that there were 7 master's degrees that came out of the CPSU program, and 12 other individuals were working toward degrees at that time. I can't remember how many of these students were in my program or in Fred Dean's, but my best recollection is that few if any of the AHP students performed their studies as part of higher degree work. However, all archeology students had to have at least one season of field work, under a professional, before they graduated with a BS degree.

It appears that there were some 35 to 40 published studies that were completed by the CPSU's Anthropology and History Preservation program. Were there any other end products from this program?

Yes, there were dozens of other studies that were never published or distributed for one reason or another. For instance, under 14(h), we produced over 8,000 reports of historic sites and cemeteries that Native corporations could select as part of their land holdings. Besides written materials there were also dozens of tape recordings of Native myths, religious stories and other ethnological materials. I should also mention that we put out a monthly, widely-distributed newsletter called "Z's Briefs" reporting on research activities and results. A couple of years ago I received a letter from the UAF stating that they had at long last catalogued all the materials from CPSU and that they took up 28 linear feet of shelf space in the Alaska and Polar Regions section of the library.

Given the enormous public lands issues going in Alaska during the 1970s, did some of the studies you produced have a political purpose? Were they read by Congressional staffers, by NPS leaders in Washington, and others who were fighting for, and trying to justify, the various proposed park boundaries? Or were they primarily of scientific/academic interest?

The NPS used the documents to show the diversity of cultural resources in the proposed park areas, but they were not used in the real political sense of pushing for the inclusion of the areas in the park system. It was more like introducing members of Congress and the Interior Department personnel to what we had in Alaska. They were documents primarily of scientific interest.

Photograph courtesy of David Libbey

Figure 3. Setting up camp on Meade River during field work in the Barrow-Atqasuk Area.

Considering all the fieldwork involved, was safety ever an issue?

In eleven years of field work in often rugged conditions, the most serious injury we suffered was a badly sprained ankle and several heavy bruises. This was despite a float plane that flipped while landing in a lake in the Bering Land Bridge area and a chopper that went down in the Seward Peninsula with several people on board. There were several close encounters with bears. But there was only one fact-to-face challenge. In Southeast Alaska, one crew member climbed a tree to get away from a black bear; the bear came up behind him, but the worker ran it off by firing a flare in its face. Some people also got dumped out of a boat, but they only got wet.

Did the direction of the CPSU change after ANILCA was signed?

Actually there was very little change in CPSU funding after December 1980, when ANILCA became law. There was still a basic need for archeological and historical information. One change was a slow down in requests for help by other federal agencies, because at long last they were getting their own professional archeological and historical staffs.

Why was the CPSU at UAF terminated?

The end of CPSU was brought about primarily by John Cook, the NPS's Alaska Regional Director. John, as a former assistant director, had close ties to the program. So it was a big surprise one day when I learned that John had rejected receipt of the 14(h) funds and instead directed them back to the BIA, even though the agency didn't have the professional staff to carry out the program. The loss of this funding was not the end of the UAF CPSU per se, but after this action, I decided to take my retirement after some 35 years of federal employment. And after I did so, he canceled all funding for the UAF operation and instead directed these funds over to the regional office where a Division of Cultural Resources was being formed.

To see all 38 reports pubished by the Anthropology and Historic Preservation Unit, go to www.nps.gov/akso/documents/AKcpsubiblio.pdf

Fred Dean Interview

Note: Dr. Frederick Dean was a career wildlife biologist at the University of Alaska in Fairbanks. He conducted wildlife research at Mount McKinley National Park during the late 1950s and at Katmai National Monument during the 1960s. He also headed the Cooperative Park Studies Unit's Biology and Resource Management Program between 1972 and 1983, and in that capacity he spearheaded a variety of studies of both existing and proposed national park units. Jane Bryant and Frank Norris interviewed him at his Fairbanks home on April 14, 2005.

What brought you to Alaska?

I was born in Boston and spent most of my early life in Connecticut, Vermont and upstate New York, in the Adirondacks. I did my Bachelors and Masters at the University of Maine in Orono; I finished up the masters in '52 and [then] went over to [the] College of Forestry at Syracuse [for the Ph.D.]. I worked on muskrats; in the Adirondacks [there were] lots of muskrats. I finished up class work and field work in '54. Then along came an opening, and subsequently an offer, from the University of Alaska Fairbanks as an assistant professor.

What were you teaching at UAF at the time?

Wildlife. I was the only person teaching undergraduate wildlife courses at that point. Back then the university was on [an] eight month salary, and you were on your own in the summer. And the eight months salary was not that great.

In June of 1957, you arrived at the park, and you began a long term study of the distribution, abundance, and habits of the Toklat grizzly. Did you consult with the NPS on this?

At the time there was very little formal work [being] done on them. Ade Murie had done some really great work as background stuff, but his approach was, I think, a very necessary ground work. But it didn't go the next step in terms of quantitative data and analysis. So I was hoping that I could build on what he'd started. I talked to people at the park at the time [about it], and they said, "Fine. Come." And they made cabin space available. I shared a cabin at Igloo with Harry Merriam, a seasonal ranger. The previous winter, I had put in a proposal to the Arctic Institute of North America, and I got probably five or six thousand dollars from them. That went pretty much into family living and fuel for the car, and the cost of getting the car down there, which [involved] putting it on the train and so forth. But the fact that the park was willing to have me do the work and to make the cabin space available was great. I stayed at Igloo for [awhile] and then went over to the ranger cabin at Toklat. And [his wife] Sue was out at Camp Denali that summer with two of the kids.

At this time, you were working with the Alaska Cooperative Wildlife Research Unit. What was this unit?

It was one of a whole series of units that had started up in the late '30s. [Jay N.] "Ding" Darling [the head of the U.S. Biological Survey from 1934 to 1936] got the program up and running. These units are basically as a result of a memorandum of understanding between the Fish and Wildlife Service, the University, and [various] state fish and game departments. And the University usually provides some salary. In this case here [in Alaska], it's been salary for support staff and [for] space. [The] Fish and Wildlife Service details one of their biologists to run the operation. And [at Maine] I had experienced the real benefit of being connected [with this] program. Later on, I used a lot of the background with respect to [the] wildlife unit in developing the nature of the [Cooperative] Park Studies Unit.

When you showed up at Mount McKinley for your initial summer of study, was Adolph Murie there?

No. He came in '59. And I actually shared a cabin with him at Igloo for part of [that] summer. He was one of [my] idols, right from the word go, when I first ran into his work.

Did you two have a fairly collaborative relationship?

Yes and no. In '59, he actually began talking a little bit about maybe [doing] a joint publication and that sort of thing, on the bears, because by then he was focusing pretty much on bears. [But] at some point the whole thing kind of cooled off. I had proposed that we do some tagging of bears in the park [and] use a subdermal transmitter that wouldn't show. And [we would be able to] get that information without intruding more than necessarily on the whole wilderness notion of things. [Ade, however,] just was absolutely against it, and wrote some fairly long letters about it. He just didn't think that there was a need to do it with respect to what he saw being lost in terms of the wilderness character of the area.

Let's talk about CPSUs for a while. How did the CPSU in Alaska get started, and how did you get involved with it?

I don't remember exactly, but I think it was something that Jim Larson [the NPS's regional chief scientist] proposed, or that he and I, in discussing work I'd been doing at Denali [sic], at some point he mentioned that there was a CPSU program, and that it seemed like a good idea to try and get going up here. Larson, for a while, was working out of Seattle. But, I thought that he'd been in Anchorage for a while too. I think Jim was probably the one that got the thing working up here. I think that ... UW [University of Washington, along with] ourselves, and Hawaii were among the very first in the country.

My experience with the wildlife unit structure, I think, had a fairly strong influence in the way it was set up, with a memorandum of understanding, and the contribution from the university and from [the] Park Service. [The] Park Service paid half of my salary on a twelve month basis. The other half of my time was [spent in] a combination of departmental administration and teaching. But the whole situation left me with a lot less teaching responsibility than I had had, and in some ways [the arrangement] benefited both the teaching and the CPSU and research side of things. And that was some of the most productive time I ever had, because I not only had that salary, but I had the administrative help. Given some good assistants, you can get a lot done. And if you get a grad student, for instance, [like] Debbie Heebner [who was] doing her vegetation work, [then] she and the unit's administrative assistant [were able to] spend two weeks almost full time doing nothing but proof her data. And I had the administrative assistant generally do most of the data entry for things like the big bear bibliographies. On the bibliographies, Diane Tracy collected the basic information and gave it to the assistant. So it was a pretty productive time as far as I was concerned.

So, how did the CPSU work? Did the Park Service approach you about having these various projects done because it didn't have its own people on the ground in Alaska?

That's a part of it. [The NPS] didn't have the staff of scientists that they do now. There was some level of credibility given to having a third party do some of the stuff. And there was the [previously-established] model of the fish and wildlife units [at UAF, for example] that had been so successful. I [helped] convince people up here that it would benefit the parks if they had that opportunity to access the unit with requests for work. It was a two way thing; sometimes we had park people come and say "would you do this?" and other times we would come up with a proposal and sell it. [The CPSU projects were] not related to immediate management problems in the park, but certainly related to understanding the Park System. But I think we made a pretty conscious effort to try to keep almost everything tied to [NPS] concerns and needs. And when we wanted to get the cabin built out at the East Fork [of the Toklat River, the park] was very definitely supportive of that.

Who was your primary NPS contact – was it Jim Larson or the Alaska-based biologist John Dennis?

I think of Jim Larson as having a lot more interaction administratively than John. But neither one of them was in Fairbanks a lot; maybe two or three times a winter. Most of my interaction would have been [with] people at the park level, and most of that was clearly at Denali. At Glacier Bay, I got involved a little bit when they were doing some science planning for the area, and I went down [to Gustavus] to sit in on a couple of meetings. They already had a pretty good science program going before we got involved. I think the other [Glacier Bay] work was either marine or geological.

Physically, did the CPSU program operate out of the Irving Building [at UAF]?

Yeah, it was operated out of my office and one room in front of it. [Chuckle] But our gradate students, and the faculty members that were working with the unit, were all either faculty members of the department, or associated with it, or in the case of students, they were all graduate students within the department. We did hire some people [such as] Herb Melchior, who worked on the Chukchi-Imuruk program, and a few others that were CPSU employees that were not formally faculty members of the department.

UAF Archives, Alaska and Polar Regions Collections

Figure 1. CPSU biology field work

When a typical CPSU study was completed, how many copies would be made and [where] would they go?

Generally there was not a big stack of publications made. [For] most of that stuff, it went to the park areas [and] the [NPS] Regional Office. I think [that for] things like the annual reports, I [probably] sent those to all of the park areas in the state. But on things like the bear bibliography, we made a lot of copies of that, and [for] that whale report, there were quite a few copies made. We did try to have a supply for at least limited distribution after that.

I understand you worked with the Jurasz's on a controversial whale study. [Chuck and Virginia Jurasz, from Juneau, completed a 1977 CPSU study which assessed the impact of cruise ships on whale behavior in Glacier Bay National Monument.]

The park people had some uneasy feelings about that whale job. And the Jurasz's admitted that they did

UAF Archives, Alaska and Polar Regions Collections

Figure 2. CPSU biology field work in northern Alaska

Photograph courtesy of A.J. Lynch

Figure 3. CPSU archeologist, A.J. Lynch, softening tendon for use in replication of a prehistoric spear.

Photograph courtesy of A.J. Lynch

Figure 4. Archeologists Wayne Howell and Michael Elder document a site near Arctic Village, 1983.

not know how to plan their work ahead of time or how to analyze it. [So] I got asked to come in [and] "please do what you can to tighten it up." They did demonstrate some statistically significant differences with and without disturbance [to the whales]. But what they had was not a randomized sample. And I think some people dismissed the whole thing a lot more than it should have been dismissed. There was some real stuff there, [and] I think [that their findings were] inconvenient for some people.

And that same sort of thing has been a problem, I think, for some of the Denali stuff. Chief Ranger Gary Brown asked us to do some work when [the park] first started up the bus system, and Diane Tracy responded. [This study, completed in 1977, was called "Reactions of Wildlife to Human Activity Along Mount McKinley National Park Road."] We had, I think, a good [research] design; it was randomized, riding the bus, making observations [at] different times of day, different days of the week, the whole thing. It would have been nice if she'd had much larger samples. But she had enough on the caribou to demonstrate statistically significant differences in behavior with differences [such as] distance from the road. [But] there have been a couple of studies since then [where there was] basically collecting information from drivers that is not collected in a systematic, randomized fashion. And those more recent studies haven't come close to [Tracy's], I don't think.

Regarding funding, the Park Service must have liked the work that the CPSU did during the 1970s, because each year your budget went up, from $150,000 at first to, at one point up to $550,000.

I know that some of the projects, particularly the Chukchi-Imuruk [now Bering Land Bridge] one, got fairly expensive. Particularly as [we] got involved [in] ANILCA issues, there was quite a lot of work there that added up.

Many of the reports that were completed through your Biology and Resource Management Program dealt with the existing parks and monuments. But [for] several of them—the Chukchi-Imuruk vegetation study, a sport hunting study out in the Wrangells, [and] perhaps two or three others—dealt with areas that were being proposed for new parks. Were these studies of purely scientific interest? Or do you think they were designed with a political purpose in mind – to help, on a scientific basis, determine where boundaries might be?

No, I think that they were requested by the Service as good background information for the proposed areas. And, particularly the work in [the] Wrangells was strictly to do with the hunting in the area and the immediate portions of that area that were being used by sheep and [other megafauna].

Would this study help to determine which parts of the new proposed park should be open to sport hunting and which parts shouldn't?

Yeah, and also where to draw the boundaries in order to include the land that that population needs on a year round basis.

Were there particular people that went out of their way to lobby for greater funds?

Well, I think that the situation went through a change. Dennis and Larson both, I think, really supported the program very strongly. I know Gary Brown really supported the program from Denali. And the superintendents at the parks; for quite a long time, I had a really good relationship with them. [I could] walk in and say hi whenever I came through, and chat about things, and they seemed to really support it. [But] at some point, after a number of changes of park people, the relationship that I had with [the parks] began to sort of dissolve.

I think the biggest change came after Al Lovaas got involved. [Al was the first Regional Chief Scientist in the NPS's Alaska Regional Office, which began in late 1980.] He was supportive up to a point, but he told me fairly early on that he'd had some bad experiences with [the] CPSU in the Midwest; I think he was in [the] Omaha [regional office].

It was kind of interesting in a way, and frustrating at times, because I felt that the people at Denali and some of the people at Glacier Bay seemed to really understand what we were trying to do and to appreciate what we were doing. But, I often had a feeling, especially in the later years, that the people in Anchorage did not really see much gain from having the unit there. For example, I went on sabbatical and set up a program where I was talking with people in Norway, Sweden, and Finland about the way that they were handling Suomi [Lapp] people inside their national parks, [establishing] what were the conflicts [and] how did they handle them. When I came back, I went down to Anchorage and presented a seminar and suggested [that] the main point of it all was that here is the time to start getting people together and talk[ing] about some of these problems that are going to come up about the use of legal wilderness areas with respect to subsistence and changing technology in particular. And, you know, people were pretty darned unresponsive to this. I think it was not very popular to suggest any regulation of activity by Alaska Natives.


Photograph courtesy of A.J. Lynch

Figure 5. CPSU archeologists document a collapsed cabin near Arctic Village, 1983.

At the same time, a couple of other factors were involved I believe. One of them, during the [early 1980s], the Interior Department advisors wanted to control Alaska from D.C. And this was something I was told over and over again, that that they were really trying to keep a tight hand on things. Top-down and with control of the information that shows up. Right about the same time as that, there was apparently an agency change in philosophy, and they began building science programs in the regional offices. It was clear that [Al] was very interested in building up the science staff in Anchorage. When that group of people began to increase and take on more responsibility, the amount of interest in the CPSU was going down. [So] the big factors were the Reagan policy and the development of the science group within the Service in Anchorage.

To see all reports published by the Biology and Resource Management Program, go to www.nps.gov/akso/documents/AKcpsubiblio.pdf


A


FISH OIL
UniSea @ Dutch Harbor, AK
January 2004
BIODIESEL
Pacific Biodiesel, Honolulu,
February 2004
B


C


ABSOLYTE
GNB
D

Figure 1 (left). (A) Shishmaref fuel and communication; (B) raw fish oil and biodiesel oil made from a fish oil feed stock; (C) wind farm near Kotzebue; (D) battery bank for the hybrid power system at Eielson Visitor Center.

(A) NPS photograph by R. Winfree
(B) Alaska Energy Authority photograph
(C) NPS photograph by R. Winfree
(D) NPS photograph

Alternative and Sustainable Energy Sources for Alaska's National Parks

By Tim Hudson

Development and infrastructure are spread over a wide variety of landscapes in Alaska, often in a very discontinuous manner, and energy use and transportation are very much in that mode. Understanding the challenges of alternative and sustainable energy in Alaska's national parks requires an understanding of how energy is produced, utilized, and transported in Alaska. While we often say that "we are different" in Alaska, the energy infrastructure is much different than in states outside of Alaska – a situation that gives us our greatest challenge and our greatest advantages in finding, developing, and utilizing alternative and sustainable energy in our national parks. Alaska's largest energy uses are for electrical power generation, heat, and transportation, such as on and off-road vehicles, planes, and snow machines (*Szymoniak 2008, USDOT*).

NPS photograph

Figure 2. Solar and wind system at the Toklat rest area in Denali National Park and Preserve.

NPS photograph by R. Winfree

Figure 3. A fuel delivery to the village of Anuktuvuk by airplane.

Development, supply and distribution of energy in Alaska

The development, supply, and distribution of energy in Alaska, with the notable exception of facilities along the limited road system, are almost entirely a series of independent electricity, fuel storage, and distribution systems. There are no electrical connections to grids outside of Alaska, and the grids that do exist in Alaska are not connected to each other. There are a series of small electrical grid systems serving parts of Southeast Alaska and one larger grid that follows the road system from Fairbanks to Homer, (www.seconference.org/inter.html). The only natural gas grid of any significance centers around Anchorage in Southcentral Alaska, and uses mostly locally produced gas from wells in Cook Inlet and the Kenai Peninsula. The other natural gas grid serves only Fairbanks and currently uses natural gas that is produced and trucked from Southcentral Alaska. There is no significant natural gas grid in Southeast Alaska. The rest of the state depends on local power generation, fuel storage, and distribution. Over 200 villages and towns produce their own power and heat, mostly from diesel fuel for which a large infrastructure of storage tanks has been set up in the villages *(see Figure 1A)* (*Szymoniak 2008*). The magnitude of this is such that the diesel fuel used for the production of electricity and heat in Alaska at least equals all of the diesel fuel used in all of the road vehicles in the state (ISER, USDOT). In the rural areas of the state, where most of the national parks are located, only 14% is used for transportation and the rest is almost evenly split between heating (45%) and electrical production (41%) (ISER). There is typically some propane use in the villages, but it is usually used for cooking and comes in small tanks rather than in combined tank systems.

The national parks of Alaska are situated throughout the state, but only four connect to one of the grids. Sitka National Historic Park is the only one with "commercial" power available to the entire park, although it is available in most of Klondike National Historic Park. The headquarters at Denali National Park and Preserve and Kenai Fjords National Park are on the electrical grid, but major infrastructure and uses are off of the grid. Some park areas, including some headquarter areas located outside of the park, are connected to the electrical systems of the villages and towns which produce their own power. In other areas, however, the National Park Service may be the sole provider of electricity. The parks or parts of parks that exist on a grid typically have lower costs per unit of energy (*e.g., Kwh, BTU*), but the source of the power needs to be evaluated as to how sustainable it may be. The park areas on village electrical systems typically have higher unit costs (*AEA 2008*),

NPS photograph

Figure 3. Eielson Visitor Center solar panels.

but the source of the power is more easily evaluated. The parks that produce their own power typically have the highest energy costs, but also have the opportunity to change or modify their energy source and usage by themselves.

The lack of permanent infrastructure also manifests itself in the large costs of energy storage, usually in the form of diesel storage tanks. Most off-road communities have to store large amounts of energy because the transportation of the energy is weather-limited to very short times of the year. That is particularly true with the villages above 60 degrees north latitude where sea ice prevents barges from making deliveries during the winter *(Figure 3)*. Some villages have to fly in all of their fuel. A few have some access to ice roads for the transportation of fuel, but their need for storage is similar, since they cannot be resupplied by trucks during the summer. Again, our parks face these same issues.

What to do about increasing the alternative and sustainable energy systems, as outlined above, is heavily dependent upon the circumstances of how power, heat, and fuel storage is accomplished locally. The solution, then, has to be largely on the local level and can take many forms. There is no single solution or "silver bullet" that is going to solve every problem. There can be an overall strategy of education and demonstration projects, as well as solutions that make economic and ecological sense, but they have to be tempered with the local facts and reality. We also know that we have the enviable position of being able to work with issues in different ways and different partners to try and come up with these transferable solutions. This is the challenge that we face.

The Alaska Region's focus on reducing our carbon footprint will be successful only if we tackle the specific energy issues that affect each park and determine where we can make the most progress in reducing energy and showing that these efforts, often in technology, can be transferable to other parks and communities in Alaska. We have started to do this in some areas and are building upon that knowledge to take it further. As in all new endeavors, there are calculated risks of success and setbacks that must be taken as a learning experience. We have had both in recent years in Alaska, but are still planning for the future.

Increasing use of alternative and sustainable energy may not end our use of fossil fuels right away, but instead working towards reduction in the short term, and elimination in the long run. Many alternative energy sources do not function reliably 24 hours a day or in all months of the year (e.g., solar and wind) but are available some of the time *(Figure 1D)*. There are also renewable alternatives that can reduce the amount of energy used (biodiesel). We have taken on three long-term efforts, along with a number of related projects, to try and reduce and eliminate use of fossil fuels.

Hybrid Power Systems

The Alaska Region replaced many of our diesel generators with hybrid systems which consist of different combinations of solar, hydro, and wind power, often combined with propane generators. This has resulted in reduced generator run times, reduced energy usage, reduced air and noise pollution, and reduced maintenance service intervals *(Figure 2)*. Some areas that ran generators 24 hours a day are down to two to six hours a day by using batteries to store energy (Denali National Park and Preserve Facility Manager, personal communication.), often in conjunction with an alternative energy source. The initial application of this was at the old Eielson Visitor Center in Denali in the late 1990s, with a hybrid diesel and solar system. Since that time, hybrid systems have been installed in Denali at Wonder Lake (propane and solar) and at the new Eielson Visitor Center, where a replacement system generates hydroelectrical power using the same water as the domestic water system, supplemented with a propane generator. A battery hybrid system was installed at Exit Glacier in Kenai Fjords National Park in conjunction with a propane generator that has reduced the run time by about 70%. Installation of a solar and battery hybrid system is in progress at Wrangell-St. Elias National Park and Preserve in the Kennecott area, which will provide quiet power to that National Historic Landmark. A similar installation is planned for Brooks Camp at Katmai National Park and Preserve, which will also replace much of the diesel heating fuel with propane. There is a solar diesel hybrid system working at the Coal Creek area of Yukon-Charley Rivers National Preserve, and plans to replace diesels with hybrids at Lake Clark and Glacier Bay.

A wind turbine is also being installed at Anaktuvuk Pass in Gates of the Arctic National Park and Preserve that will feed power into the village power grid.

Fuel Cell

A partnership between the National Park Service, the Alaska Energy Authority, the Arctic Developmental and Testing Laboratory at the University of Alaska Fairbanks, and the Denali Commission installed and enabled the operations of a 5 Kilowatt Solid Oxide Fuel Cell at the Exit Glacier area of Kenai Fjords National Park. This fuel cell is the only one in the country that runs without benefit of on-line monitoring and powers actual electrical loads rather than just contributing to the electrical grid. This is an off-grid installation that utilizes hydrogen reformed from propane to operate. The fuel cell is situated right in the Nature Center at Exit Glacier to demonstrate hydrogen technology potential to the public in an actual operating condition. It has provided electric power to the Exit Glacier area for five summers. The heat from fuel cell operations also heats the Nature Center, demonstrating the co-generation abilities of this technology. This project has been a success in showing people what a fuel cell looks like, and how it can quietly produce both electricity and heat. We have modified and adjusted the operating parameters of the fuel cell each year and contributed information about a fuel cell operating in actual field conditions. However, we do not feel that hydrogen fuel cell technology is yet reliable enough for placement in remote areas *(Energy Alternatives)*.

Biodiesel

The National Park Service has partnered with the Alaska Energy Authority and the Arctic Developmental and Testing Laboratory at the University of Alaska Fairbanks, to demonstrate the use of biodiesel produced from a local by-product of a major industry in Alaska, fish oil *(Figure 1B)*. The biodiesel was made from fish oil from the pollock fishery near the Alaska Peninsula and used in vehicles and a diesel generator at the Toklat area of Denali National Park and Preserve in place of diesel fuel. The generator ran much of the summer of 2006 on 100% fish oil biodiesel and some vehicles ran on a 30% blend of fish oil biodiesel and diesel fuel. The generator ran successfully on 100% biodiesel fuel at the first part of the summer, but it soon became apparent that the fish oil feed stock was degrading fairly rapidly and was starting to coat some of the parts of the generator with a hard film that caused parts of the generator to fail. We have since been working with the other partners to stabilize the fuel, so that we can continue its use. There are millions of gallons of fish oil potentially available and a biodiesel fuel market could reduce the dumping of fish parts into the oceans, improve the economics of producing fish oil and other fisheries byproducts, and reduce the cost of diesel fuel in the remote parts of Alaska. The ultimate use of this fuel would be at a reduced percentage, replacing 5% - 20% of the diesel fuel in the parks and villages near the production of the fish oil. This is a long-term project that is transferable to the remote parts of the state as it uses local products. Ideally, it could be used for all of the energy in a place like Brooks Camp, where spill potential is reduced or where energy is produced in villages adjacent to the park.

Wind and Hydropower

There are considerable wind resources available in Alaska, and we have begun to look at using those in an efficient and aesthetic manner, such as with the village of Anaktuvuk and small turbines in Denali, as well as utilizing village power produced by wind turbines in Kotzebue *(Figure 1C)*. The small hydro project at the Eielson Visitor Center that combines the use of potable water and energy production without dams or impairing a stream underscores the innovative thinking that must occur to match the area with the need. Wrangell-St. Elias has been studying a stream at Kennecott so that a historic hydro system can be rebuilt that will help power the area in conjunction with fire protection. This project also has the potential to produce hydrogen by electrolyzing water from the excess energy produced by the hydro system. This could be utilized to run vehicles and potentially make the Kennecott area free of hydrocarbon energy for electricity, heat, and vehicles. Klondike Gold Rush National Historic Park is utilizing some electric vehicles for their maintenance needs. This is a particularly effective use of energy at Klondike since the electrical power in Skagway comes from a renewable hydro system that has been in place for about 100 years. Other areas are looking at electric vehicles that can be powered up at night or low use times when power is wasted because the grid cannot go down. This will take some agreements with the power company to provide interruptible power so that the vehicles will only charge when that power would otherwise be wasted. The region is also looking at run of the river and tidal projects that can be done without affecting the environment – either in partnerships with villages or as demonstration projects.

There are many possibilities for alternative and sustainable energy sources in Alaska, but it will continue to take a concerted effort on the part of the Region and the parks to fit each individual situation. As can be seen, we have started down that path. We need to continue, realizing that not everything will work; however, success can only occur by trying.

REFERENCES

Alaska Energy Authority (AEA). 2008. *Alaska Energy Plan*. State of Alaska.

Energy Alternatives. Unpublished data. Palmer, Alaska.

Szymoniak, Nick. 2008. *Direct Fuel Use in Rural Alaska*. Institute of Social and Economic Research (ISER). University of Alaska, Anchorage.

U.S. Department of Transportation, Research and Innovative Technology Administration, Federal Highway Administration.

The Colors of the Aurora

By Dirk Lummerzheim

Abstract

The aurora has fascinated observers at high latitudes for centuries, but only recently have we begun to understand the processes that cause it. This article discusses the mechanisms that are responsible for the colors of the aurora. Observations of color balance in aurora can provide us with information about the physical processes in the near Earth space that cause aurora. High-resolution spectral observations let us understand how the upper atmosphere is affected by aurora.

A Brief History of Understanding the Aurora

Descriptions of aurora, or the northern lights, go as far back as written history. 2,300 years ago, Aristotle saw curtains of light in the sky and called the phenomena "chasmata" to indicate that the cause was cracks in the sky, allowing in light from beyond the heavenly sphere. In his book *Majestic Lights*, Eather (*1980*) presents several quotes from the Bible that most likely refer to aurora.

The first recorded use of the words "northern lights" to describe the aurora was in 1230, in a book titled *The King's Mirror*. The author wrote the book to prepare Norwegian King Magnus Lagabøte for his duties as a ruler.

The term aurora borealis originated in the 1600s, when Galileo combined the word "aurora," the Latin word for "dawn," with the term "boreal," the Greek word for "north." Aurora also appears in the southern hemisphere, where it is called the "aurora australis." Since there is very little populated landmass at high southern latitudes, there are no known historical and mythological references to the southern aurora. Although the native people from New Zealand must have seen aurora on occasion, Captain Cook is considered the discoverer of the aurora australis; he saw it in 1773 on his voyage around the southern tip of South America.

At mid-latitudes, people rarely see the northern lights. Aurora is visible at mid-latitudes during the largest magnetic storms, but it is dominated by red colors. In ancient times when the aurora appeared overhead, people often associated the aurora with good or bad omens and sometimes considered it a manifestation of activities of heavenly spirits or gods. The peoples who lived at high latitude and who had a regular display of the aurora held similar beliefs.

In the Middle Ages, scientists came up with other guesses as to what was behind the northern lights: they suggested that the light of the aurora was sunlight reflected by ice crystals in the air, the glow of glacier ice near the pole, or a light emanating from the edge of Earth. In the eighteenth century, scientists discovered a connection between the aurora and disturbances in Earth's magnetic field and associated aurora with sunspots. But it took until the end of the twentieth century before a satisfactory explanation of the aurora, its colors, and the mechanisms behind it emerged.

The Processes that Cause Aurora

The light of the aurora is generated by atoms and molecules of the air when they are struck with energetic particles from space. These energetic particles come from the volume of space just above the aurora, and are accelerated by plasma physics processes that are still under investigation. But we do have a fairly good understanding of the general processes and the flow of energy that feeds these processes. We can model the aurora and are now gaining the understanding to forecast its appearance (*Lummerzheim 2007*).

Charged particles, like those that cause the aurora, can generally only travel along the direction of the magnetic field. This shapes the aurora into curtain and ray-like structures (*Figure 2*). Following the magnetic field up from the aurora, we

Figure 1. Multi-colored aurora over Klondike Gold Rush National Historical Park near White Pass in Southeast Alaska.

Photograph courtesy of Michael Klensch


Photograph courtesy of D. Lummerzheim

Figure 2. Green curtains and rays above the Brooks Range and Gates of the Arctic National Park.


Photograph courtesy of Poul Jensen

Figure 3. Small-scale structure in aurora shows as thin curtains and small rays and curls over Fairbanks, Alaska. This structure is related to the auroral acceleration process directly above the atmosphere.


Photograph courtesy of Carl Johnson

Figure 4. Large-scale structure in aurora shows as large folds and parallel curtains over Gates of the Arctic National Park and Preserve. This structure reflects the processes in the magnetosphere where large currents transport energy into the auroral region.


Photograph courtesy of Michael Klensch

Figure 5. Several parallel curtains above Rock Creek in Denali National Park and Preserve. Note comet Hale-Bopp in the lower right hand corner.

get to the auroral acceleration region, about 620-6,200 miles (1,000-10,000 km) above the earth. The smaller scale structures like rays, small curls, and thin curtains shown in Figure 3 represent structures in the acceleration processes. This region is connected to the outer magnetosphere by electric currents. Large-scale structures, like multiple parallel arcs (*Figures 4-5*) and spirals that fill almost the entire sky (*Figure 6*) show the spatial pattern of these currents. The magnetosphere is the region of space around Earth that is controlled by Earth's magnetic field. Its diameter is about 30 Earth radii, and outside of the magnetosphere is the solar wind. The magnetosphere forms an obstacle for the solar wind, which has to flow around it. This interaction of the solar wind with the magnetosphere provides the energy that eventually accelerates the auroral electrons in the inner magnetosphere. Strong solar activity causes strong variations in the solar wind; byproducts of this space weather are therefore geomagnetic storms and aurora.

Light Emission in Aurora

When energetic electrons strike an atom or molecule, they slow down and transfer some of their energy to that atom or molecule. The molecules can store this energy only for a very short time, and then radiate the energy away as light. Some molecules get dissociated into atoms in this process, and some molecules and atoms get ionized. At the altitude where aurora occurs, above about 62 miles (100 km), the air is thin enough that oxygen can exist in atomic form, while the air that we breathe contains only molecular oxygen.

During the day, the ultraviolet sunlight splits the molecular oxygen into atoms, while at night the aurora continues this process.

When an atom or molecule emits light as a photon, to rid itself of its excess energy, that photon has a wavelength that is characteristic for that atom. We perceive wavelength as color. Laboratory experiments can reproduce these light-emitting processes by forcing a current through an evacuated glass tube that contains a small amount of a selected gas. The study of these light-emitting processes led to the understanding of atoms early in the twentieth century, and to the discovery of quantum mechanics. Because each type of atom or molecule emits colors unique to it, we can use the colors of the aurora to determine the atmospheric composition at the auroral altitude.

The time that a molecule or atom can store the energy that it gained in a collision is very short, typically between 1/1000 and less than 1/1,000,000 of a second. Atomic oxygen is one notable exception, and the excited state that causes the most common auroral emission, the green line, has a lifetime of 0.7 seconds. When an excited atom takes that long to radiate away the internally stored energy, other processes, chemical reactions or collisions, compete with the radiation process for that energy. The denser the air is, the more frequent are the collisions between the atoms and molecules. Below the altitude of about 59 miles (95 km), collisions are so frequent that the green oxygen line has no chance to be emitted. All the energy that is put into the oxygen atom is lost before the 0.7-second lifetime allows radiation. This determines the bottom edge of the green emission in aurora.

However, the auroral electrons sometimes have enough energy to give them the punch to penetrate deeper than that into the atmosphere. When that happens, only emissions with a much shorter lifetime are possible. The most abundant gas is molecular nitrogen, and it radiates promptly in deep blue and red colors. Mixing these together gives purple. The bottom edge of a green auroral curtain gets this purple color when auroral electrons are accelerated to very high energy (*Figures 7-8*).

On occasion the aurora gets a deep red color. This comes from higher altitudes, around 120-180 miles (200-300 km). It is again the oxygen atom that is responsible for this color. The oxygen atom has an excited state for this red line emission with a mean lifetime of 100 seconds, and only at very high altitudes are collisions infrequent enough to allow this radiation to be emitted (*Figure 9*). Since the long lifetime of the oxygen red line also allows the aurora to move before it radiates, the detailed structure in auroral curtains is also washed out in these emissions (*Figure 10*).

Relating the Color to Physical Processes

The energy of auroral electrons determines how deep into the atmosphere these particles penetrate. Since auroral emissions are characteristic of the altitude where they originate, we can use the color balance of the aurora to determine the energy of the auroral electrons. The auroral brightness depends on the rate of incoming auroral electrons. In analogy to electric currents we can say that the color tells us the voltage, the brightness tells us the current.

During very large magnetic storms the aurora is visible from mid and low latitudes. It is common to have very bright red auroral displays during such large storms. Notable were the magnetic storms on Halloween and late November in 2003, when red aurora was seen above the Mediterranean, Florida, and the entire U.S. The outstanding brightness and dominance of high altitude red oxygen emissions indicate that during such storms the magnetosphere has very large currents flowing, while the auroral acceleration only produces low energy electrons.

In addition to looking at the color balance and brightness, we can measure the wavelength of individual emission lines in the aurora with very high accuracy. This allows us to determine the Doppler shift of emission lines. The Doppler effect for light emission causes a shortening of the wavelength of the emission if the emitting atom or molecule is moving toward the observer, and a lengthening of the wavelength if it is moving away. A shorter wavelength means a color closer to the blue end of the spectrum; longer wavelength means a shift to red. In aurora, these shifts are miniscule, but can be observed with high spectral resolution instruments, in particular Fabry-Perot interferometers (FPI). Because the red and green line emissions from atomic oxygen are so long lived, they are good candidates for FPI observations. The long lifetime ensures

Photograph courtesy of Poul Jensen

Figure 6. A large spiral that fills a large portion of the sky in this extreme wide-angle photo from Ester Dome near Fairbanks, Alaska.

Photograph courtesy of Poul Jensen

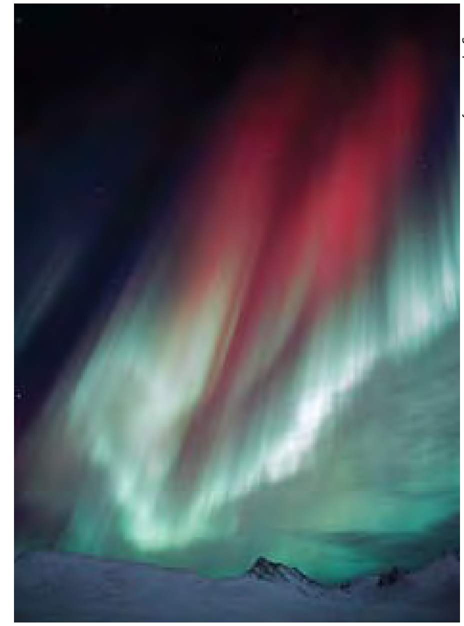
Figure 7. Intense aurora develops a purple border below the green curtains in this fish eye view of almost the entire sky above Fairbanks, Alaska. Note the Big Dipper near the zenith.

Photograph courtesy of Poul Jensen

Figure 8. High-energy auroral electrons above Fairbanks, Alaska penetrate deep enough to cause the purple lower border of the green curtains. High-energy aurora also produces highly structured and very thin curtains that move fast. Short exposure times are necessary to resolve these structures.

Photograph courtesy of Michael Klensch

Figure 9. Red aurora above the Sawtooth Mountains near Klondike Gold Rush National Historical Park and Skagway, Alaska



Photograph courtesy of Michael Klensch

Figure 10. The diffuse looking red aurora above Klondike Gold Rush National Historical Park near White Pass comes from long-lived oxygen atoms at high altitudes. The structure of the curtain below is lost in the red aurora because the excited atoms can move with the wind before emitting light.

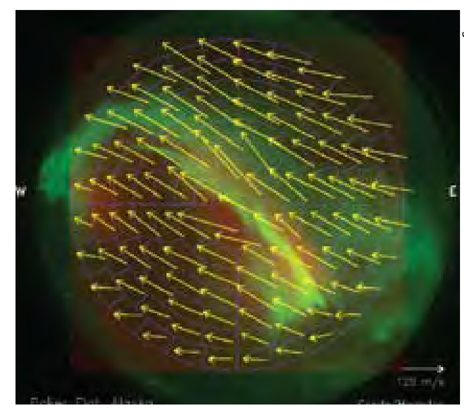


Image from Conde et al. 2008

Figure 11. The wind vectors at 150 miles (240 km) altitude drawn over a composite all-sky image of the green and red oxygen emission. Through its interaction with the atmosphere, the aurora modifies the wind direction and speed in the upper atmosphere.

Photograph courtesy of Michael Klensch

Figure 12. Aurora over Klondike Gold Rush National Historical Park as seen from Yukon, Canada.

that the atoms are drifting with the wind, and their velocity is not affected by the collision with the auroral electron that caused the excitation in the first place. The small shift in wavelength can thus be used to measure the ambient wind at the altitude of the aurora.

These FPI wind observations only give the component of the wind velocity along the line of sight, the component toward or away from the observing station. By using model constraints or by placing three such instruments in separate locations we can reconstruct the actual wind vector by measuring three components of it. Figure 11 shows a composite of the auroral brightness with the deduced wind vectors at 150 miles (240 km) altitude superimposed. This example (*Conde et al. 2008*) shows that the wind is affected by the aurora as the direction and speed changes right at the position of the auroral curtain.

The top end of the auroral curtains and rays sometimes show a deep blue color. This is indicative of still another light emission process. The auroral electrons not only produce light emitting excited atoms and molecules, they also ionize some molecules. These ions can then be pulled upward by electric fields in the aurora and reach altitudes high enough that under some conditions they will be exposed to sunlight. This sunlight then scatters off these ions. There exists a blue emission of the molecular nitrogen ion that is particularly strong in scattering sunlight, which is why we see a blue upper end of the auroral curtains (*Figure 13*).

Putting it all Together

The observations of the colors of the aurora, either in a broader sense by looking at the overall color balance, or by detailed spectroscopic methods, can teach us much about the physical processes that cause aurora and the effects that aurora has on the upper atmosphere. The color balance tells us the altitude of aurora. We can relate that to the processes that accelerate auroral electrons in the near earth space, and we can see the evolution of electric currents that flow in the magnetosphere. High-resolution spectroscopy lets us see the wind in the upper atmosphere and how it is changed by the aurora. High altitude blue aurora tells us that ions that are generated in the aurora are pulled out of the atmosphere into space. And the colors themselves tell us the composition of the atmospheric gas at the altitude of the aurora.

Acknowledgements

I would like to thank Mark Conde for suggestions and comments, and the people who have provided the photographs of the aurora for this article: Poul Jensen at the Geophysical Institute at the University of Alaska Fairbanks; Michael Klensch from Skagway, Alaska; Carl Johnson from Anchorage, Alaska; and Jan Curtis from Oregon. More aurora photos by these photographers can be found at their websites:

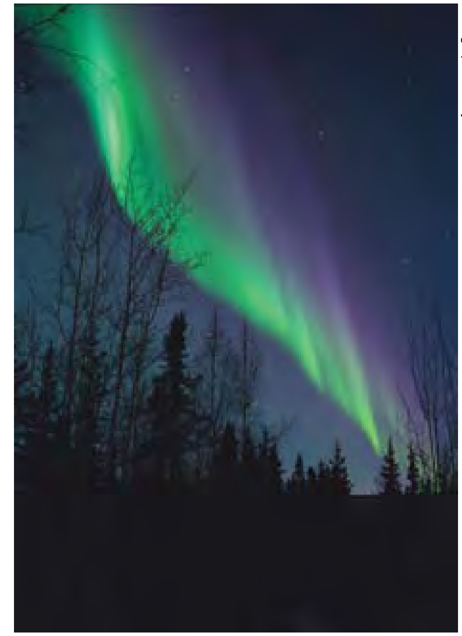
www.gfy.ku.dk/~flyvholm (P. Jensen)

www.muk.uni-hannover.de/~theusner/polarlicht/ (M. Theusner)

www.alpenglowphoto.net (M. Klensch)

climate.gi.alaska.edu/Curtis/aurora/aurora.html (J. Curtis)

www.carljohnsonphoto.com (C. Johnson)



Photograph courtesy of Jan Curtis

Figure 13. This photo is taken shortly after sunset, when the sun illuminates the upper part of the aurora. Ions that are produced by the aurora at these altitudes scatter the blue part of the sunlight, causing the upper edge of the aurora to look blue.

REFERENCES

Conde, M.G., C. Anderson, and C. Anderson. 2008.
New results from the Poker Flat all-sky imaging Fabry-Perot spectrometer. CEDAR workshop, Zermatt, UT.

Eather, R.H. 1980.
Majestic Lights: The Aurora in Science, History, and the Arts. American Geophysical Union. Washington DC.

Lummerzheim, D. 2007.
Modeling and forecasting aurora. Computing in Science and Engineering 9(5):53-61.

Cape Krusenstern Human-Environmental Dynamics Project

An interdisciplinary crew of scientists and students will be returning to Cape Krusenstern National Monument in June 2009 to continue archeological and paleoenvironmental research at the Cape Krusenstern beach ridge complex. This project was initiated by the NPS in 2006 and continued by the University of Washington and Antioch University of New England in 2008. In order to gain a better understanding of how the dynamic interactions between humans and the environment has shaped 4,000 plus years of human occupation at Krusenstern, we are gathering new paleoenvironmental data and archeological information on human settlement and subsistence patterns. Our focus is on potentially significant periods of environmental change, such as the Little Ice Age. Key to this research is the use of high resolution Global Positioning Systems units to precisely and quickly record spatial data and to integrate paleoenvironmental and archeological data collected as part of this first systematic survey of the beach ridge complex.

Photograph courtesy of Shleby Anderson

In 2008 a crew of six archeologists mapped and tested hundreds of both previously known and new archeological features, including some sites that date to less well understood periods of human settlement at Krusenstern. Highlights include the discovery of an intact hearth likely dating to the earliest occupation of the beach ridges and linear-marked pottery from several sites across the complex. This pottery is probably between 3,600 and 2,500 years old and dates to a period of change in Northwest Alaska, when people increasingly focused on marine resources, and new technology, including pottery, was introduced to the region from Northeast Asia. Blue glass trade beads found during site testing are evidence of more recent cultural interaction. These beads likely traveled to the region with Russian explorers or traders, or through the extensive native trade networks that crossed the Bering Strait and beyond. Results of radiocarbon dating and artifact analysis from 2008 are forthcoming and fieldwork will continue through 2010. More information can be found at: http://students.washington.edu/shelbya/CAKR_Project.shtml

By Shelby Anderson

Alaska and the Pacific West Regions Collaborate on Three Themes

Interpretive professionals and partners from the Alaska and Pacific West Regions are forging strong alliances to meet the vision of the NPS Centennial. As a means to focus their combined efforts, a joint workshop was held in Vancouver, WA, to share best practices and enhance the opportunities for collaboration between parks. During the workshop, three critical issues were targeted that comprise many serious challenges facing these two regions. The three themes are 1) Taking actions that address mitigation and adaptation to the many impacts and implications of changing climate, 2) taking actions that increase and enhance stewardship of the oceans and the diverse marine resources that depend on healthy seas, and 3) forming actions that strengthen and encourage an enduring connection between our youth and the parks, their resources, and their significance to our combined heritage. 180 participants, including 20 students from the California State University at Chico, spent three days developing collaborative approaches for projects currently underway or being planned in the two regions. Best practices and examples resulting from their work include the design and development of a web-based portal for climate change research, the development of a basic training film dealing with climate change in parks, and adopting the "Class

of 2016" at multiple parks where students will have grade-specific curriculum-based activities provided each year from now until they graduate in 2016. Completion of these and similar projects will advance the NPS Centennial and lay a foundation for sustainable and successful operations at parks in Alaska and the Pacific West.

Murie Science and Learning Center

The Murie Science and Learning Center's (MSLC) mission of supporting research and education efforts continues to improve and expand with the help of partner organizations. In 2006, with Alaska Geographic and Princess Tours, the MSLC developed the Experience Denali educational program as an alternative to the current park tours and to help alleviate pressure on the park road. This four-hour hands-on program introduces visitors to the Denali region and highlights current research in the park. In 2008, Experience Denali received an 88% approval rating from Princess Tours guests, one of the highest ratings for a short tour activity in Denali.

All revenue from Experience Denali supports the MSLC facility and its mission. Not only contributing to general overhead, the program annually funds approximately $20,000 in research fellowships, $10,000 in science education grants in the eight partner park units, as well as $10,000 for teacher scholarships and $40,000 for youth education programs in Denali.

In 2009, Alaska Geographic will offer 30 multi-day seminars and teacher trainings in Denali, Kenai Fjords, and Yukon-Charley Rivers national park units, and in Chugach and Tongass National Forests. More information about the MSLC and its programs can be found on their website (www.murieslc.org).

By David Tomeo

Alaska Geographic photograph

The Murie Science and Learning Center is part of a nationwide effort to enhance science in national parks and to share research more effectively with the public. Ultimately, it is hoped that this effort supports science-informed decision making and most importantly, preservation of areas set aside for their significance to the Nation. The Murie Science and Learning Center consists of employees and partners from several organizations, with the National Park Service and Alaska Geographic serving as core partners, that extend across a total of eight national park service sites.

Podcasts in Denali National Park and Preserve

Science features prominently in three of the first video offerings posted to the Denali National Park and Preserve website (www.nps.gov/dena):

"Discovery" allows Anthony R. Fiorillo, a paleontologist and curator of Earth Sciences at the Museum of Nature and Science in Dallas, Texas, to answer some of the most common questions about the presence of dinosaurs in the region more than 65 million years ago.

"Access" describes how park officials are relying upon science to help develop a new management strategy for transporting people in the park.

"Stewardship" chronicles efforts by scientists to monitor the effects of climate change and determine how park management may need to change in the future based on current trends.

To date, the park has used online videos to reach viewers before, after, or instead of an on-site visit. In the future, front-country visitors may be able to access offerings through their cell phones or at wireless download kiosks located at visitor contact stations.

By Jay Elhard

Photograph courtesy of Peter Nelson

Globally endangered rare lichen discovered in Denali National Park and Preserve

Erioderma pedicellatum (Hue) P.M. Jørg is a globally rare, foliose cyanolichen that grows on the trunks and limbs of boreal trees. This species was previously known only from very limited areas in Scandinavia and southeastern Canada. Due to rapid population declines across its range, *E. pedicellatum* is currently classified as Critically Endangered by the International Union for Conservation of Nature (IUCN), and is listed by the Canadian government as Endangered for coastal populations or as a species of Special Concern for boreal populations.

During fieldwork for a nonvascular plant inventory project in August 2007, a few populations of *E. pedicellatum* were observed in Denali National Park and Preserve on the south side of the Alaska Range. Subsequently, several additional individuals were also observed in nearby Denali State Park. This represents an important and intriguing discovery because these populations represent the first detections of *E. pedicellatum* within the United States and western North America and mark a major range extension for one of the most rare and endangered lichens in the world. In addition to this extremely rare arboreal lichen, we have discovered scores of species new to the park as well as several likely new to Alaska during the course of this project – stay tuned for more exciting news as the large numbers of specimens are identified and cataloged.

More detailed information on this important and exciting find can be found in the journal *Evansia* (Volume 26, No. 1).

By James Walton, Peter Nelson, and Carl Roland

Ice Worms Possibly Locally Extinct as Glaciers Melt in Alaska Range

In the late spring of 2008, a party of researcher-adventurers trekked more than 120 miles across 15 glaciers in Denali National Park and Preserve in search of ice worms. No ice worms were found, but that in itself is valuable information.

Says Dr. Daniel Shain of the Biology Department at Rutgers University, "We made a strong effort to collect reliable information [about where ice worms were likely to be found] before we departed. Our best sources were Roger Robinson from the NPS, and a few of his climbing friends. All independently reported observing ice worms in regions proximal to `Little Switzerland`, and thus our expedition was deployed to that region."

The expedition, which included Roman Dial of Alaska Pacific University, collectively climbed and descended about 15,000 ft (5,000 m) without observing any ice worms. They focused their efforts on specific glaciers mentioned by Robinson and others, but these glaciers had retreated dramatically since the time when the ice worms had been previously observed there (about 20 years ago).

From his experience monitoring ice worms in relation to other retreating glaciers in Alaska, Shain postulates that the ice worms are unable to sustain viable populations with rapid melting. If they are not washed out during the melting, they likely freeze during the winter because they are forced to higher ground. He explains, "Ice worms are paradoxically very sensitive to cold climate regimes, requiring the thermal stability of relatively low elevation, temperate glaciers."

It seems that the few glaciers in the Alaska Range capable of supporting glacier ice worms have melted in recent years, as a consequence of global climate change. Any ice worms that once occupied these glaciers have experienced local extinctions, and probably ice worms are no longer present in Denali.

"We have nonetheless tried to communicate our interest in ice worms to the outdoor/climbing community," and Shain hopes, "perhaps someone will stumble across a surviving population at some future date and inform us of their discovery".

More information about Dr. Shain's iceworm research is available in Volume 3, Issue 1 of *Alaska Park Science* at: http://www.nps.gov/akso/AKParkScience/KenaiFjordsIssue/ICE%20WORMS.pdf

Photograph courtesy of Brad Perry

Research in Northern Parks

What does an archeological survey in the Brooks Range (Gates of the Arctic), a study of Dall Sheep genetics and parasites (Wrangell-St. Elias), a reconstruction of the paleoenvironments near Sable Mountain at the time of dinosaurs (Denali), and investigations of the changes in vegetation at tree line (Noatak, Denali) have in common? These scientific investigations and more (a total of 11 projects) were all partly funded in 2008 via research fellowships awarded through the Murie Science and Learning Center (MSLC). In 2008, five Discover Denali Research Fellowships were made possible by the Denali Education Center, for research in or near Denali National Park and Preserve. And six Murie Science and Learning Research Center Fellowships were made possible by Alaska Geographic, and provided to scientists working in Denali or any of the other seven northern Alaskan parks.

The MSLC has facilitated funding for 21 projects since the inception of its research fellowships in 2006. The Discover Denali Research Fellowship Program is in its fourth year, and the Murie Science and Learning Center Fellowship Program is in its second year of offering awards to scientists working in any of the eight northern parks.

Fellowship awards are typically $3,000 to $5,000. Research fellows provide to the MSLC and the respective parks photos of the project in progress and a final report, including a brief synopsis. An important component of the research fellowship is the requirement for the scientist to deliver an educational outreach product (e.g., a presentation, poster, fact sheet, or article for Alaska Park Science) that helps share the research process and research findings with others.

By the time this is printed, the research fellows for 2009 will have been selected. However, it is anticipated that these fellowship programs will continue. Information about the funding opportunities can be found at: http://www.nps.gov/dena/naturescience/discodena.htm.

By Lucy Tyrrell

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

During May 2008, a collaborative team of seven scientists (two from the University of New Hampshire, three from the University of Maine, one from Dartmouth College, and one from Data North Consulting) conducted a field program in Denali consisting of reconnaissance flights over most of the Alaska Range and the northern reaches of the Talkeetna Range, installation of an automatic weather station at Kahiltna Base Camp (7,800 ft), the collection of snowpit samples and firn cores for glaciochemical analysis, and ground profiling radar surveys at two sites: Kahiltna Pass (9,500 ft) (*Figure 1*) and Mount Russell Plateau/Upper Yenta Glacier (8,400 ft).

Annual layers in the snowpack at both sites have been identified based on the location of ice layers and seasonal fluctuations in stable isotope ratios. Our analysis indicates that the 23.12 m long record from Kahiltna Pass extends back to the summer of 2003, while the Mount Russell Plateau 18.33 m record extends back

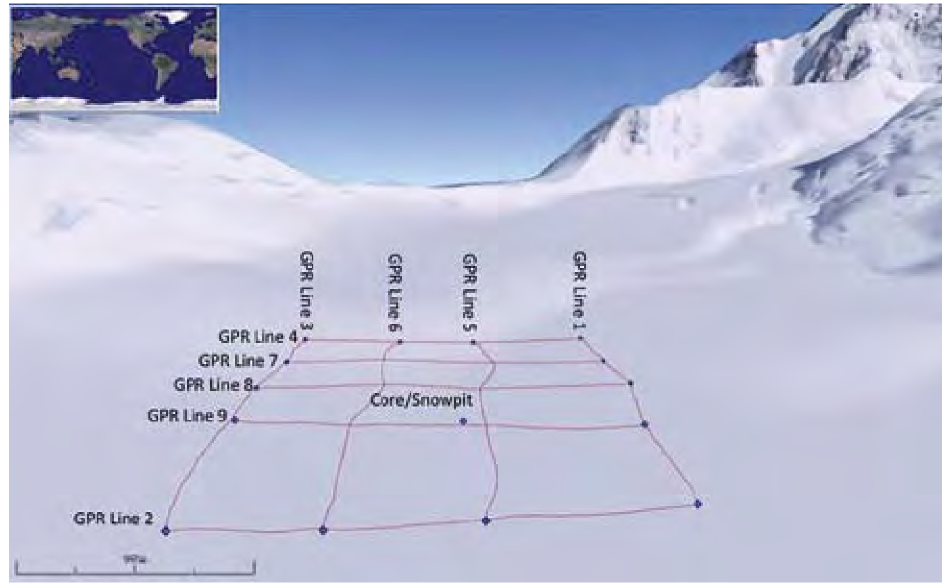


Figure 1. Study site at 9,500' south of Kahiltna Pass with location of GPR survey lines and snowpit core.

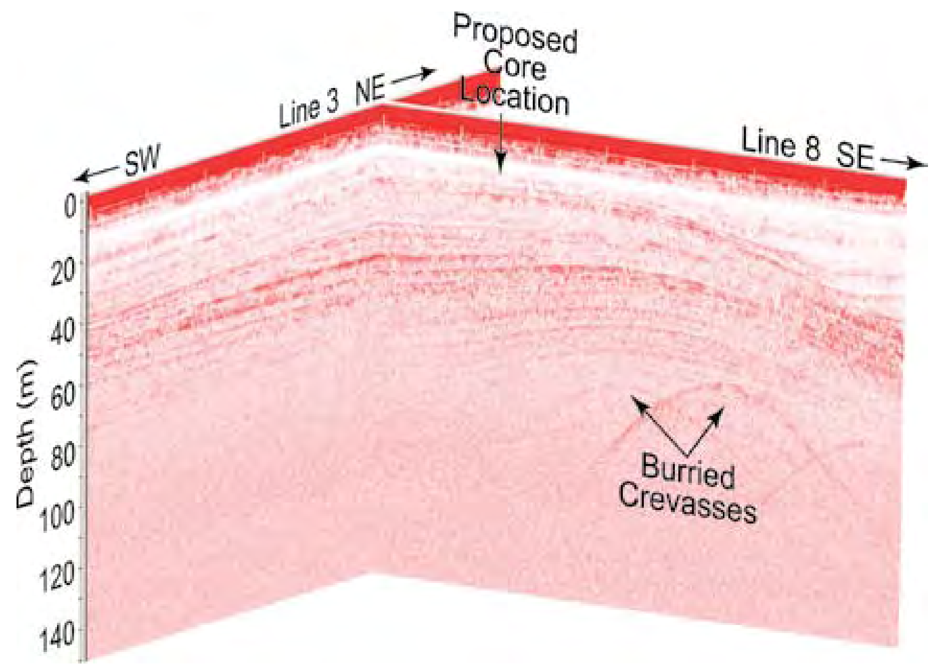


Figure 2. Three-dimensional GPR profile from Kahiltna Pass showing complex flow to the SE, but horizontal layering near the Line 3/8 intersection where a drill site is preliminarily proposed.

to the summer of 2006. From this preliminary analysis, we have identified annual snow accumulation and annual percent melt for both records. The Kahiltna Pass melt percent record is strongly correlated (r > 0.9) with the number of warm summer days at Talkeetna, Cantwell, and Fairbanks. This suggests that we will be able to develop a robust record of summer warmth back in time from stratigraphic analysis of a series of cores from this site.

Ground penetrating radar (GPR) profiles were collected at Kahiltna Pass and Russell Plateau to assess the subsurface flow regime and determine glacier thickness for optimal drill site selection. These high-resolution profiles reveal convergent ice flow in the south-east region of Kahiltna Pass, but conformable horizontal layering suitable for ice core drilling in the north-west region near the intersection of lines 3 and 8 (*Figure 2*). Dipping bedrock was observed at a depth of 250 m on the edge of one GPR profile #4 (not shown). Extrapolating the bedrock slope beneath the suitable drill site indicates that ~350 m of ice is present.

Trace element analyses of snow pit samples from Kahiltna Pass and Russell Plateau reveal elevated concentrations of Cd, Pb, Bi, As, Cu and Zn relative to crustal reference element concentrations (*e.g. Al, Fe*). These toxic metal(oid)s have crustal enrichment factors ranging from 30-612, indicating that greater than 90% of each represents anthropogenic pollution. We do not see any evidence for local contamination of the Kahiltna Pass site by mountaineers, as trace metal concentrations and enrichment factors from the two sites are nearly identical over the last year (snowpit data). This is significant because Kahiltna Pass is close to the main route for climbers on Denali, whereas Russell Plateau is rarely visited. Thus, we are confident that trace metal records from Kahiltna Pass will represent regional atmospheric concentrations rather than local contamination.

Our eventual goal is to develop a high resolution, multi-parameter record of climatic and environmental change for central Alaska via the recovery and detailed analysis of two parallel ice cores recovered from the central region of the Alaska Range. This new record would enhance our understanding of climate variability and environmental change in central Alaska and the North Pacific, provide an important geographic addition to multiproxy reconstructions of climate, and place the recent warming in the region in a broader context of climate variability and change over the past 500 years.

By Cameron Wake, Karl Kreutz, and Erich Osterberg

NPS photograph

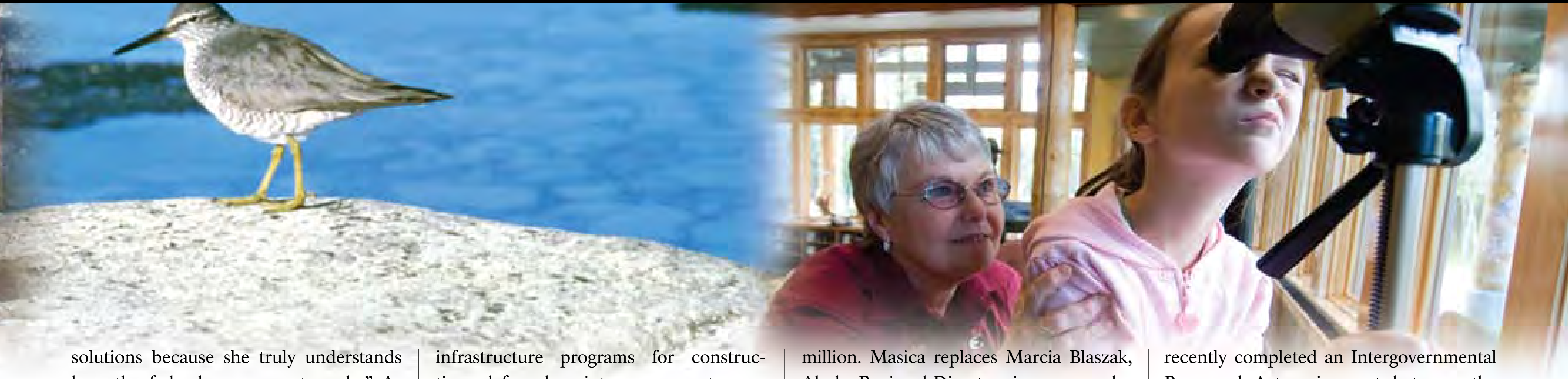
4,000 year-old Hearth near Historic Cabin

Archeologists from Lake Clark National Park and Preserve were surprised to find a small 4,000 year-old hearth adjacent to the historic Woodward cabin in Hardenburg Bay. The cabin is slated for restoration including foundation replacement, and the archeological investigations occurred prior to allowing any ground disturbance. No artifacts were found associated with the hearth, which sits on old beach deposits, but plentiful wood charcoal provided a radiocarbon date. Another prehistoric camp is located in the sediments above the hearth and is marked by a small flake scatter and associated wood charcoal that has been radiocarbon dated to 2,600 years ago. Archeologists plan to continue investigations here to better understand the cultural and natural history of the area. Note the prominent white tephra (volcanic ash) below the buried vegetation mat in the stratigraphic profile, upper right corner of photograph.

By Jeanne Schaaf

Sue Masica is the New Regional Director for National Park Service in Alaska.

"My loss is Alaska's gain," said Director Mary Bomar. "In addition to being passionate about national parks, Sue is a rare individual who can handle numerous issues at once, advocate for visitors, work with partners, and find



solutions because she truly understands how the federal government works." As the NPS chief of staff since 2006, Masica served as senior advisor to Director Bomar and other park service executives. She coordinated key strategic and operational issues, participated in all significant policy, budget, and personnel decisions, and oversaw the day-to-day operations of the Director's office.

Previously, Masica served as the NPS Associate Director for Park Planning, Facilities, and Lands. In this capacity, she was responsible for the formulation, justification, and execution of NPS infrastructure programs for construction, deferred maintenance, asset management, land acquisition, roadways, and planning. In recognition of her leadership in these areas, Masica received the Presidential Rank of Meritorious Executive in 2004. Masica also served as the Associate Director for Administration, in charge of the NPS budget, training, personnel, contracting, and other support functions.

Prior to joining the NPS, Masica worked 10 years on the staff of the U.S. Senate Committee on Appropriations, as staff director of the Subcommittee on the Department of the Interior and Related Agencies. Masica began her federal career as a Presidential Management Intern with the Department of the Interior.

Masica earned a master of public affairs degree from the University of Texas (Lyndon B. Johnson School of Public Affairs) and a bachelor of arts in political science from Austin College.

One of seven regions in the national park system, the Alaska Region encompasses 16 park units, 54.7 million acres, 1,000 employees during the summer, and an annual budget of nearly $100 million. Masica replaces Marcia Blaszak, Alaska Regional Director since 2003, who recently retired.

Debora Cooper is the NPS-Alaska Regional Office's new Associate Regional Director for Resources and Subsistence

Cooper comes to the NPS from a 21-year career with the U.S. Forest Service, most recently as the USFS Alaska Region group leader for fire and fuels. She recently completed an Intergovernmental Personnel Act assignment between the State of Alaska Division of Forestry, the U.S. Forest Service and the Department of the Interior. She has served as the Forest Service's director for state and private programs in Alaska. She served as the district ranger on the Kenai Peninsula portion of the Chugach National Forest for 2 1/2 years, the area superintendent for the Sawtooth National Recreation Area in Idaho for 4 1/2 years, and as the ecologist for the Bridger-Teton National Forest in Wyoming for 5 years.

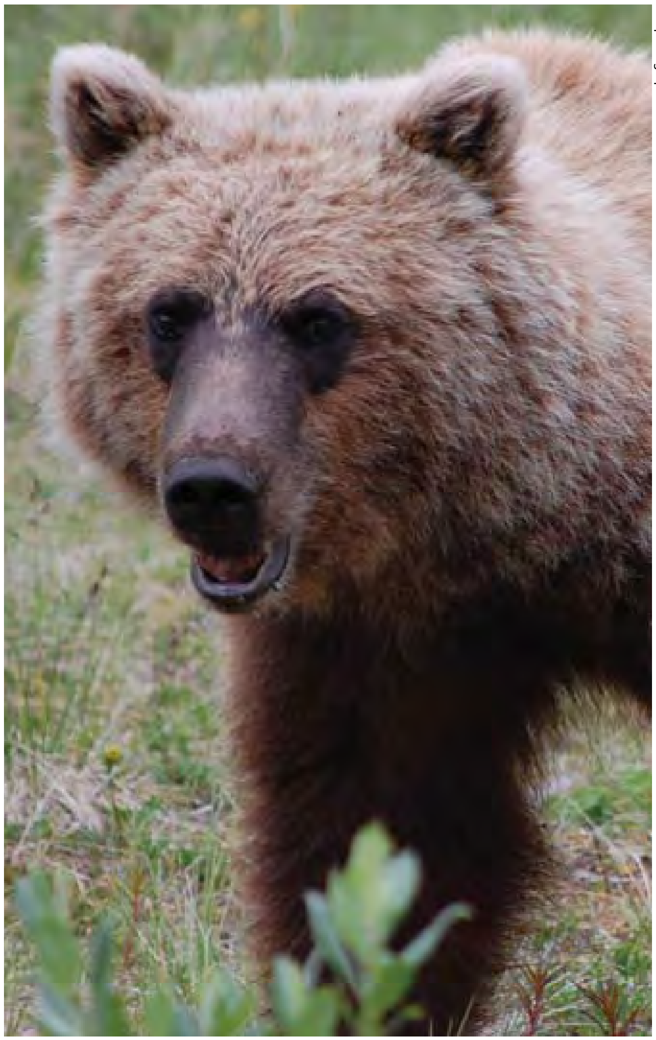
"Deb brings very strong management skills, a passion for resource protection, and Alaska experience to our team," said deputy regional director Vic Knox. She began her NPS work in late October 2008.

She began her career after completing an M.S. from the University of Idaho in wildlife and range management and a B.S. from the University of California at Davis in wildland science.

Alaska Park Science

National Park Service
Alaska Regional Office
240 West 5th Avenue
Anchorage, Alaska 99501

http://www.nps.gov/akso/AKParkScience/index.htm



NPS photograph