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Table of Contents

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Parks Featured in this Issue

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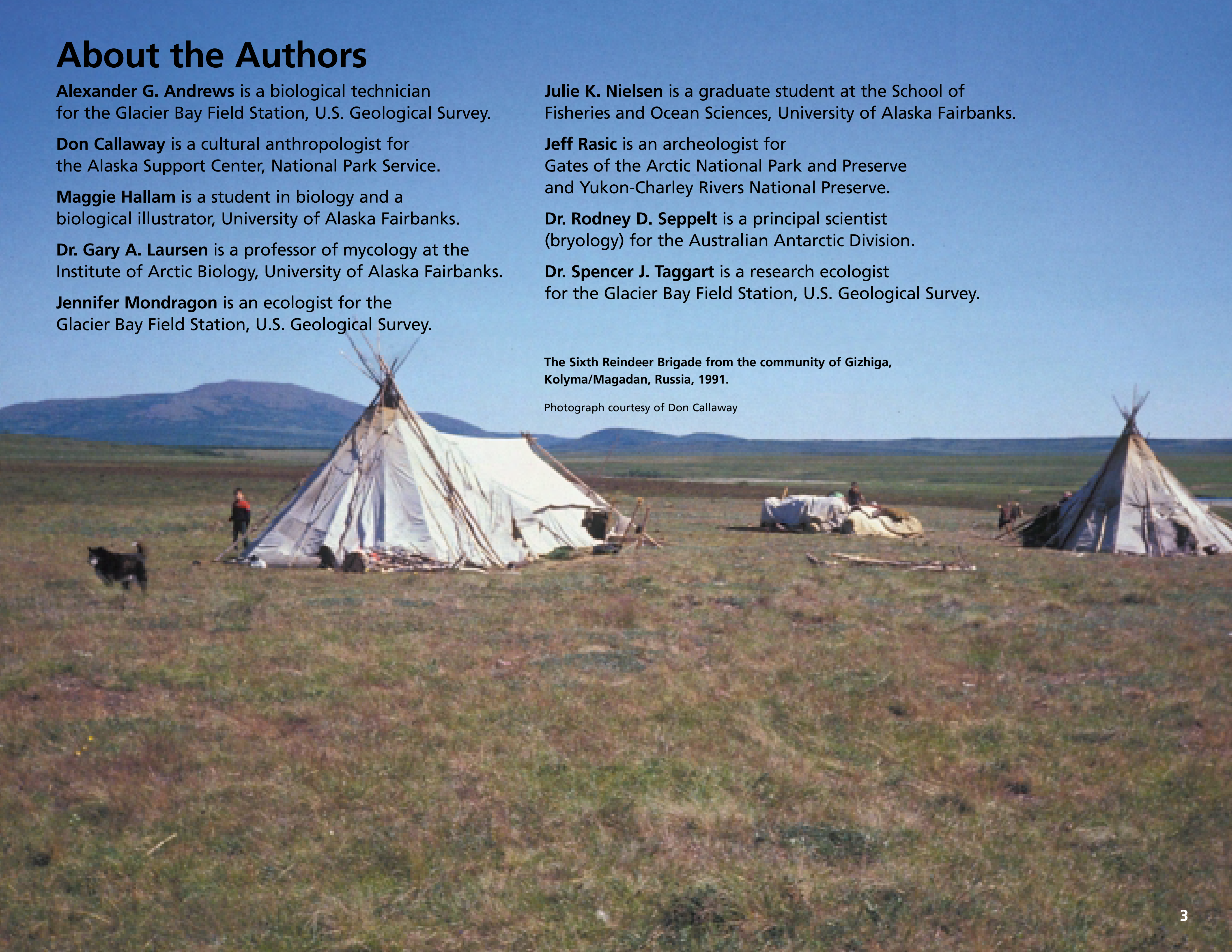

The Sixth Reindeer Brigade from the community of Gizhiga, Kolyma/Magadan, Russia, 1991.

Photograph courtesy of Don Callaway

Beringia: Visions of an International Park in Difficult Times

by Donald Callaway

Introduction

In 1990 Presidents Gorbachev and Bush signed an agreement to initiate the establishment of an international park in the Bering Sea region to recognize the common cultural and natural heritage of Beringia. This international park would combine units of the U.S. national park system in Alaska, specifically Bering Land Bridge National Preserve, Cape Krusenstern National Monument, Noatak National Preserve, and Kobuk Valley National Park with Russian units that have yet to be designated.

The U.S. National Park Service's Shared Beringian Heritage Program was established shortly after the agreement was signed. The program encourages the participation of local residents in the preservation and understanding of natural resources and protected lands, as "well as working to sustain the cultural vitality of Native peoples in the Central Beringia region" *(NPS n.d.)*.

Since its inception, the Shared Beringian Heritage Program has funded projects that: *…help link protected lands and the peoples of both sides of the Bering Strait in cultural exchanges, and in exchanges of scientific capabilities and findings, conservation ethics and philosophies, and natural and cultural resource management technologies* (NPS n.d.).

One such project was the "Beringia: Chukotka Subsistence Harvest Assessment Project" (BCSHAP), which was a cooperative effort funded by the National Park Service, the North Slope Borough (NSB), and the office of the Governor of Chukotka, Roman Abramovitch. This project documented the current social, economic, and traditional subsistence activities of three Chukotkan communities, Lavrentiya, Lorino, and Sireniki, and used this data to prepare a needs assessment report that was submitted to the International Whaling Commission (IWC).

This project was not simply an academic exercise. The IWC regulates all whale harvests, and its approval of a quota is essential for indigenous whaling communities in Alaska and critical to the stability of indigenous communities in Chukotka. Economic conditions had deteriorated so badly in Chukotka that the survival of many families depended on the harvest of wildlife resources, especially gray whales and other marine mammals. The technical needs assessment paper produced by this Beringian research was presented to the IWC in Shimonoseki, Japan in 2001. Based on the results of this assessment, the IWC granted the communities of Chukotka a quota of 120 gray whales per year to continue their indigenous subsistence activities.

Historic Background

For several hundred years the indigenous communities on both sides of the Bering Strait have been linked through a number of economic and social institutions. Trade, social contacts, and warfare have been documented by numerous sources including the records of the Jesup expedition, Chukchi and Eskimo oral histories, and the materials and artifacts collected on both sides of the strait *(Gurvich 1988)*. Tobacco, beads, and iron were traded from Siberia to Alaska where they were exchanged for furs, jade, and ivory.

During more recent periods, the interchange and contact has been more intimate, such as between the contemporary Siberian Yupik communities of Gambell (Alaska) and New Chaplino (Chukotka). Separated by only 64 kilometers of water, these two communities had been linked for centuries through intermarriage (sharing the same clan system), trade, and ceremo-

Photograph courtesy of John Tichotsky

In Chukotka, survival of many families depends on the harvest of wildlife resources, especially gray whales.

Left: The Soviet policy of abandoning "settlements without prospects," has led to the abandonment of many traditional communities. Migration by families from these settlements to larger communities has resulted in increased rates of social problems and has had serious detrimental consequences for the organization of traditional subsistence activities.

Photograph courtesy of Don Callaway

Photograph courtesy of Don Callaway

While traditional forms of harvest and distribution faced severe dislocations under the management of state farms, certain skills such as skin boat building were maintained. *(Sireniki 1992)*

nial exchanges. In the last 70 years, these two communities are representative of the dramatic and traumatic social and political changes that have swept through the Bering Straits region *(Callaway and Pilyasov 1993)*. The Chukotka side has seen substantial changes as indigenous systems of reindeer herding and marine mammal hunting have been collectivized, turned into state farms, and finally all but fiscally abandoned after the collapse of the Soviet system.

Since the 1930s these two small Native communities have encountered enormous changes, changes often engendered by the social and economic policies of the nation states in which they are embedded. The abandonment of small Native communities in Chukotka under the Soviet policy of "settlements without prospects," the forced resettlement of Chaplino to New Chaplino, and the reorganization of cooperatives into state farms have all had serious detrimental consequences for the organization of traditional subsistence activities in the small communities within this region.

Across the strait, Gambell, like many indigenous communities in the Alaska arctic, has very little economic infrastructure, high unemployment, increased social problems, and decreasing financial support from the state and federal sector. In contrast to Chukotka and despite some constraints caused by state and federal management of natural resources, much of rural Alaska has managed to maintain high levels of subsistence use. On St. Lawrence Island and in the Yukon-Kuskokwim delta, indigenous languages are spoken by young people (although this is less true in Inupiaq-speaking communities). On St. Lawrence Island important cultural features such as sharing, bride service, patri-clans, and ivory carving have been maintained while these same institutions were severely threatened in most Chukotkan communities, at least until the late 1990s.

For Chukotka the most dramatic short terms impacts came during the period of the Soviet state farms (circa 1975 - to about 1995). Central Russians and others, drawn by the prospect of high wages (regular salaries augmented by cost of living adjustments) and available housing, became the administrators of the state farms and reorganized existing marine mammal hunting practices. A factory boat that delivered whales to the communities replaced traditional whaling crews. Walrus crews formerly organized along kinship lines were now replaced by "brigades" headed by European Russians. Access to the means of production, such as boats and guns, was severely restricted by the concerns and policies of the Border Guard.

Traditional forms of harvest and distribution faced severe dislocations as the

Photograph courtesy of John Tichotsky

Traditional ivory carving was sustained in only a few Chukotka communities, such as Uelen, but is now experiencing a resurgence.

Photograph courtesy of John Tichotsky

One major consequence of the collapse of the Chukotka economy in last 10-15 years has been the emigration of European Russians and the remarkable increase in subsistence activities.

economic basis of communities were reorganized — reindeer herding became a commodity enterprise; marine mammal products were not only used for nutrition, but also as the major food supply to the fox farms; and "cost free" sharing of wildlife resources, resources now "owned" by the state farm, was prohibited although this prohibition was often ignored.

During the last ten years, the indigenous communities of the Chukotka Peninsula have experienced another round of tremendous social and economic changes as a result of the collapse of the Soviet Union. Prior to this collapse, the central government provided substantial support to the Chukotka communities through subsidies and the centralized purchase and delivery of equipment, supplies, food, and fuel. This government support was provided primarily through the state farm system. Between 1989 and 1995, government support diminished to a fraction of its previous level, and the state farm system collapsed.

Few regions in the world have experienced such complete economic collapse. Most enterprises and jobs created under the Soviet system disappeared. People who were fortunate enough to keep a job were often unpaid for months, or even years. Two major local industries, fox farming and reindeer herding, were decimated. Local production of milk and chickens, once a significant activity in the larger Chukotka settlements, disappeared. In addition, most government services, including essential services like power generation, health, and education are now being run on a survival basis.

One major consequence of the collapse of the Chukotka economy in last 10-15 years has been the emigration of European Russians and the remarkable increase in subsistence activities. At the end of the 1980s, subsistence activities provided about a quarter of the food products for rural villages. Today, subsistence activities provide over one-half of all food consumed and the bulk of protein in an individual's diet. In 1999, flour, tea, tobacco, alcohol, and sugar were the only western products received by the smaller villages in the Chukotka region.

Recently indigenous communities have begun the difficult process of reestablishing more traditional forms of subsistence harvesting. Small whaling boats, prohibited between 1972 and 1990, now harvest gray and bowhead whales. And while twentieth century technology in the form of boats, motors, and guns has been adopted, many of the repressed cultural traditions such as sharing, status of hunters, traditional carving, and respect for elders are reemerging and showing increased prominence.

Beringia: Chukotka Subsistence Harvest Assessment Project

The three Chukotka communities selected, Lavrentiya, Lorino, and Sireniki, were thought to be representative of the diversity extant within the region as a whole. Although there are significant differences among them, these three communities are characterized by dependence on wildlife resources, the reemergence of traditional practices and values, involvement in the wage and service sector, and diverse ethnic makeup. In addition they had all been differentially impacted by the demise of the state farms.

These three study communities have very different profiles with respect to population size, ethnic composition, and economic organization. Lavrentiya has a population of slightly fewer than 1,300 people, Lorino is slightly larger near 1,500 and Sireniki is the smallest with about 550 people.

All three communities have been characterized by selective emigration in the last five years. As the economic circumstances and living conditions have deteriorated, many Central Russian émigrés, initially drawn to the area by housing and wage incentives, have repatriated to their Republics of origin. Lavrentiya with a substantial airport has acted as a regional transportation and service hub. It is the only community to sustain a substantial Russian ethnic presence (nearly a third of the population) although only about two-thirds of these respondents consider themselves to be permanent residents. In contrast, nearly all the Russian residents of Lorino and Sireniki consider themselves to be permanent members of the community

Survey Research

The Chukotka Subsistence Harvest Assessment Project conducted 400 survey research interviews in the study communities using a formal questionnaire. The questionnaire gathered detailed information about household composition, participation in subsistence activities, harvest assessments of every major species, the use of western foods, food costs, individual and household

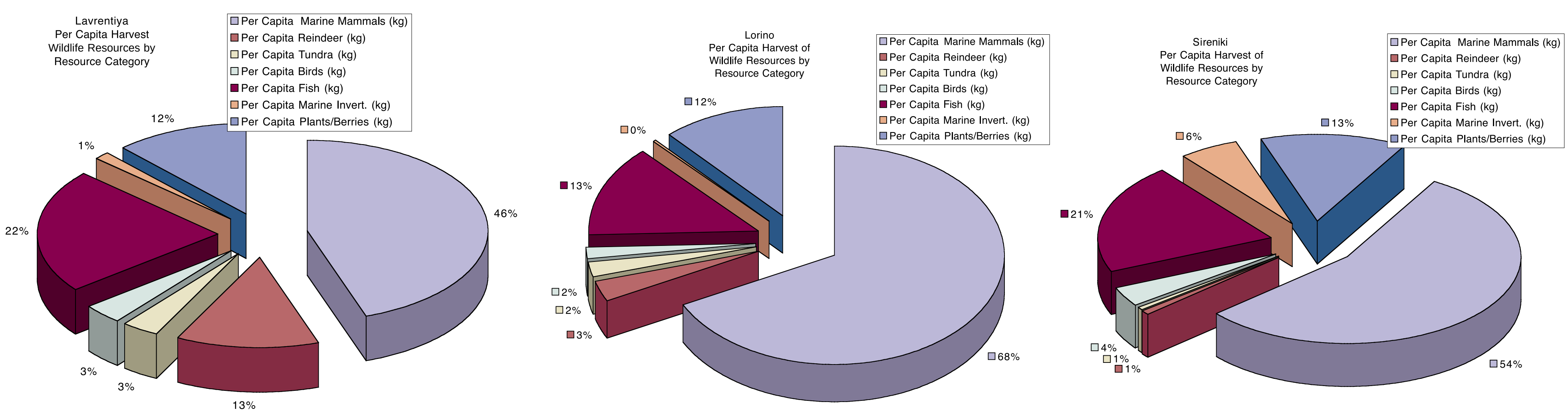

Chart 1. Comparison of three Chukotka communtites: per capita harvest by resource type.

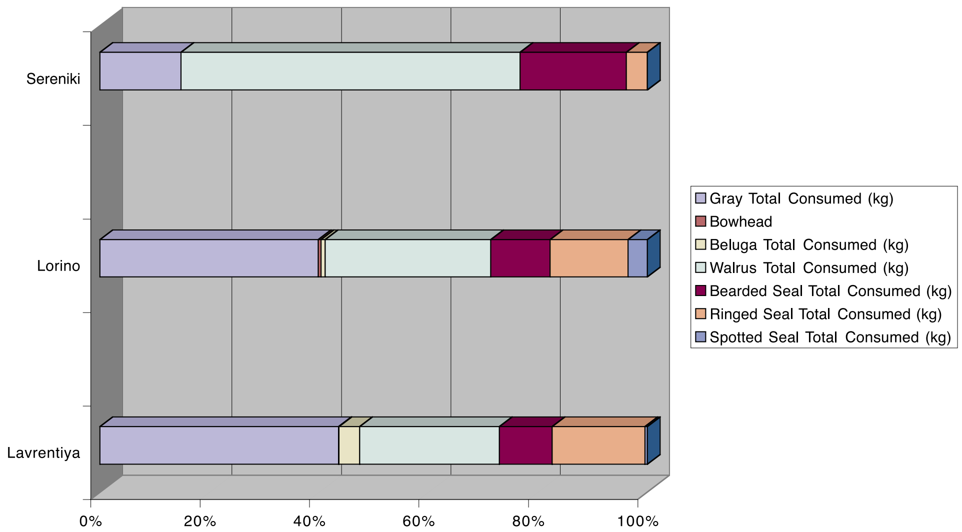

Chart 2. Chukotka: proportion of marine mammals harvested by species.

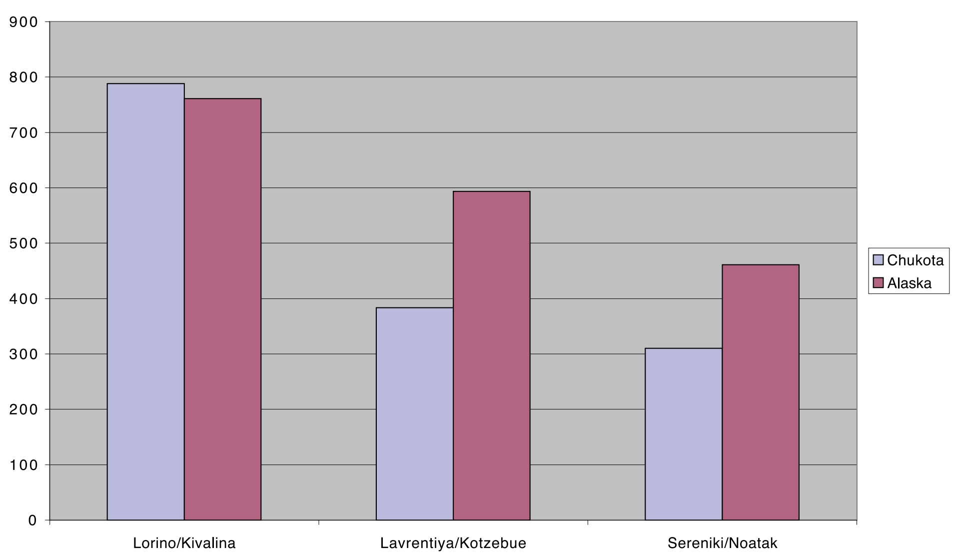

Chart 3. Comparison: Chukotka/NANA Region
Per Capita Consumption of Wildlife Resources in pounds.

income from all sources, food preferences, training and learning about subsistence activities, and estimates of the household's dependence on wildlife resources.

Economic Importance of Wildlife Resources in Traditional Communities

There is certainly no doubt that the harvest of wildlife resources is critical to the diet of indigenous communities on both sides of the Bering Strait. Two simple measures can indicate the level of this importance: per capita consumption of wildlife products and the replacement cost at market value of such resources.

However, one should not be mislead that the economic and dietary impact of subsistence activities is necessarily the most important outcome of these endeavors. Subsistence resources and the activities associated with the harvest of these resources define and establish the sense of family and community. The distribution of these resources establishes and promotes the most basic ethical values in Native and rural culture—generosity, respect for the knowledge and guidance of elders, self-esteem for the successful harvest of a resource, and family and public appreciation in the distribution of the harvest. No other set of activities provides a similar moral foundation for continuity between generations.

Per Capita Consumption of Wildlife Resources

The results confirmed the dependence on marine mammals of the Chukotka study communities. About half to two-thirds of the wildlife resources in the diet of these communities comes from marine mammals. For Lavrentiya, 46% of the per capita harvest of wildlife resources was marine mammals, while Lorino was 68% and Sireniki was 54% *(Chart 1)*. *Chart 2* provides a breakdown by species of community dependence on marine mammals. With the exception of Sireniki, which has limited access to whales but is heavily dependent on walrus, about 40% of all marine mammal consumption comes from gray whales.

Chart 3 indicates the per capita harvest levels of wildlife products for each community. Lorino clearly consumes considerable amounts of wildlife resources, nearly 788 pounds per year (a typical urban American will consume about 220 pounds of meat). This consumption of subsistence resources parallels similar behaviors on the Alaska side of the Bering Strait. Kotzebue (Alaska) is twice the size of Lavrentiya yet both have significant non-Native populations and are regional transportation and service hubs. Lorino is nearly four times the size of the Alaska village of Kivalina, yet both are primarily indigenous communities with strong dependence on marine mammal products. Sireniki and Noatak (Alaska) are about the same size, and both are primarily Native; however, Noatak obtains its primary subsistence diet from land mammals and fish while Sireniki relies primarily on marine mammals.

Household Income

The three Russian study communities in the CSHAP research project demonstrate considerable variance in their circumstances. Lavrentiya has about 60% more income than the other two communities and 80% of the community's income comes from wage sources. Lorino, with considerably less income, receives about two-thirds of its household income from wage sources. At most risk is Sireniki where nearly 60% of income is derived from welfare, pensions, or similar forms of transfer payments.

Many households and communities in the Alaska Bering Strait region depend heavily on unearned income and seasonal wage work. In general these households have lower incomes and their fortunes have been declining in an era of legislative program cuts. In addition these communities can rarely sustain their low purchasing power under circumstances of even modest inflation.

There is some risk in comparing the economic circumstances of Chukotka communities with those of their counterparts in Alaska. A key difference is that the organization for the harvest and distribution of wildlife resources in Alaska resides with the household or extended family *(Magdanz et al. 2002)*. Although the products of subsistence activities are often widely shared throughout the community, the capital for engaging in subsistence activities is normally borne by the family. Thus, boats, motors, rifles, gasoline, bullets, and all the other expenses are purchased by a household and are used by that household or by close extended family members. In Chukotka few individual households or even extended families have the financial means to support such activities.

With respect to income sources, Bering Strait Alaska communities mirror that of Lavrentiya and Lorino, with about 70% of their income derived from wage sources.

It should be noted that on neither side of the Bering Strait do communities enjoy robust and diversified economies. Most sources of wage income are due to employment in the government or service sector, while most of the construction is linked to federal, state, or regional programs. Neither side, because of a variety of factors including transportation costs, has a viable manufacturing sector. Similar analysis of other economic sectors indicate that all these rural communities on each side of the strait are extremely dependent on transfer payments and programs from federal or "state" (oblast) entities.

Ten years ago most rural indigenous households in Alaska had 15 to 20 times more income than their Chukotka neighbors. However, rural indigenous Alaskans have five to six times less income than non-Native urban dwellers in Alaska whose per capita income at this time is about $26,000. Thus, even if one were to take into account such issues as purchasing power, differences in the provision of health services (now sporadic in Chukotka), and subsidized housing, most observers would agree that the economic conditions of indigenous Chukotka households are considerably more precarious than their counterparts in rural Alaska.

Per Capita Income - 1990 Census*	Kotzebue	Kivalina	Noatak
	$13,906	$4968	$7089
Per Capita Income - 2000 CSHAP	**Lavrentiya**	**Lorino**	**Sireniki**
	$892	$345	$357

Table 1: Three Northwest Alaska Communities and Three Chukotka Communities.
* The latest census for which per capita income is available.

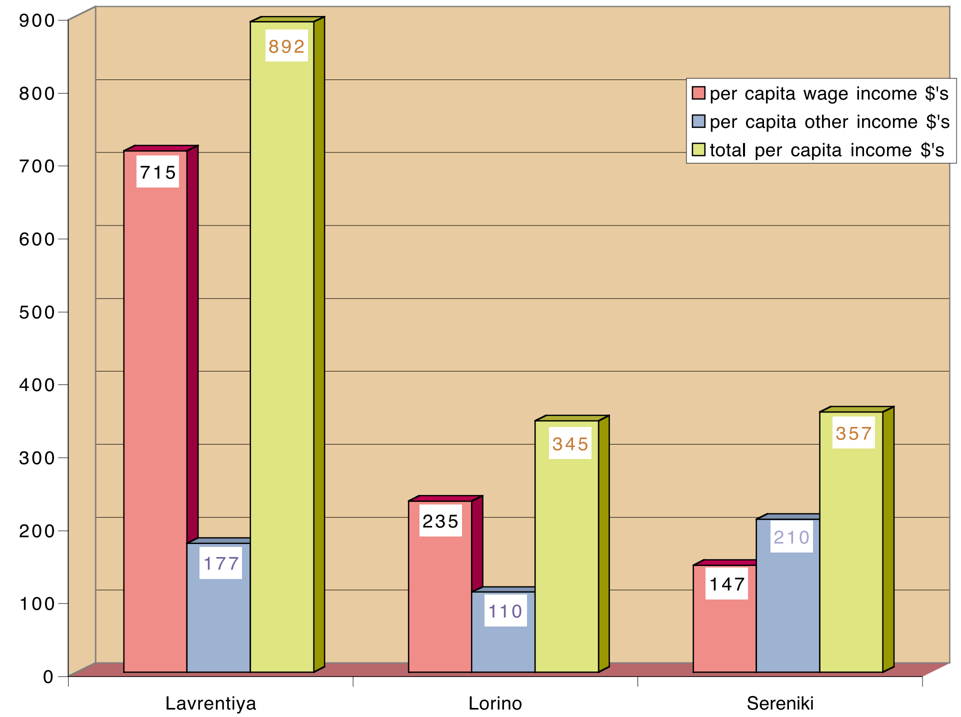

Chart 4. Per capita income in dollars, three Chukotkan communities.

Food and Replacement Costs

Chukotka

The critical nature of modest per capita income is underscored in an examination of household expenditures for food. Of most concern is Sireniki where nearly every available ruble is spent on food. Lorino, despite considerable consumption of wildlife resources, still spends over 60% of its disposable income on food. Finally, Lavrentiya with the highest per capita income spends over half of its total income on food, much of it western foods. Western foods, such as canned goods, bulk grains, potatoes, or a variety of other processed items are usually imported from central Russia.

Alaska

Northwest Alaska communities are substantially dependent on wildlife resources. Statistical data indicate that rural

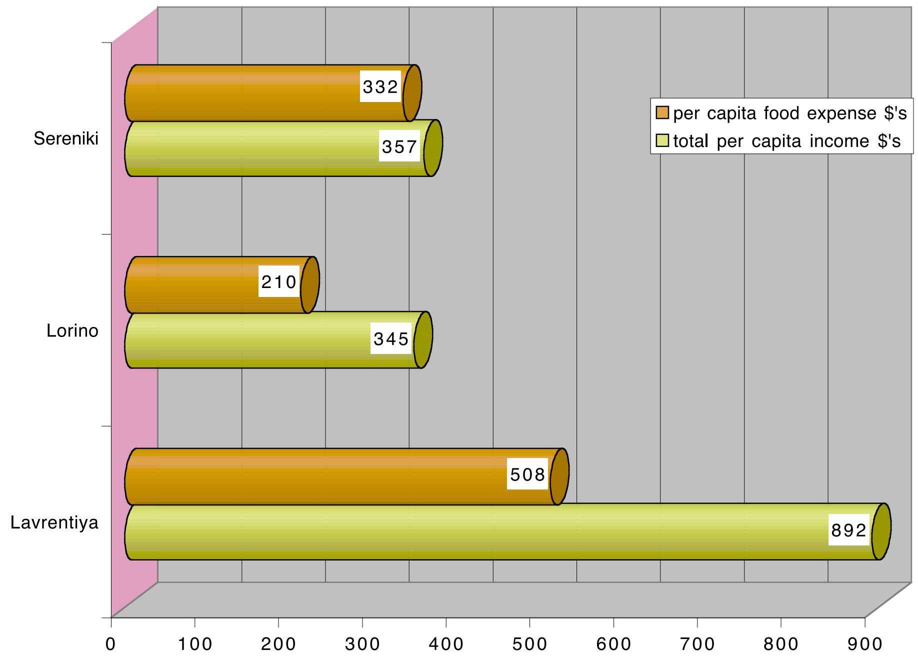

Chart 5. Per capita income and food costs in dollars.

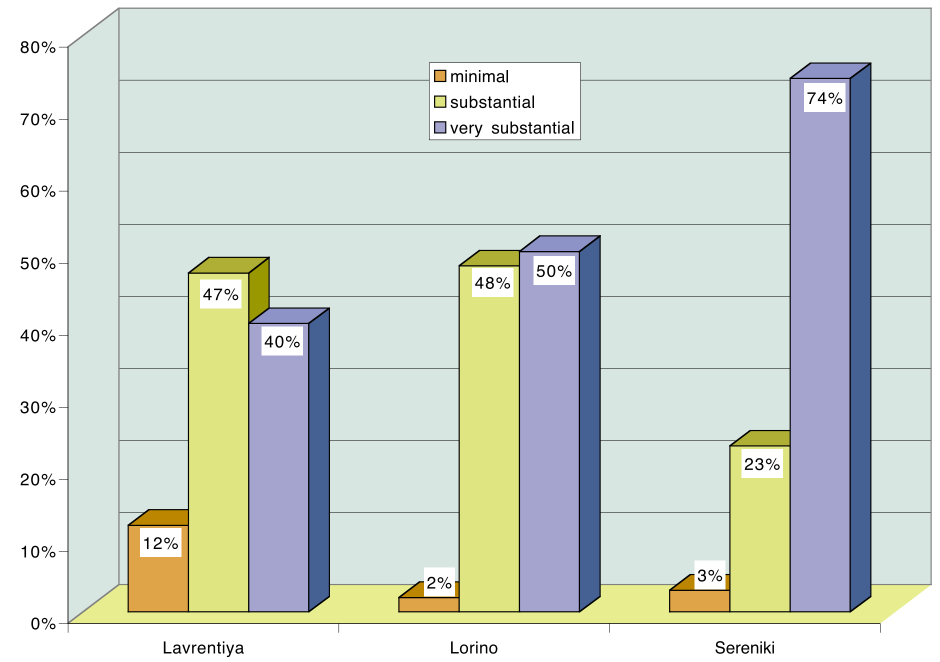

Chart 6. What role has humanitarian aid played in household diets?

indigenous people, when compared to other Alaskans, have very low incomes and a high dependence on unearned income. What would life be like for rural Alaska residents without subsistence resources? From a strictly economic standpoint the harvest of wildlife resources is crucial for the survival of rural Alaska households.

Most rural northwest Alaska communities are accessible only by air, although some commodities such as fuel oil and construction materials are brought in by barge. Bulk items such as food are extremely expensive to transport. For example, if a family of four (with elementary age school children) spends $93.22 for a market basket of food in Anchorage, then this same market basket will cost $217.96 for a similar family in Stebbens. Thus, while Anchorage food costs are about 25% greater than most cities in the western U.S., the rural communities of northwest Alaska have food costs more than twice that of Anchorage.

For the Arctic region (which includes the Bering Strait region), the Alaska Department of Fish and Game (ADF&G) estimates an annual harvest of 10.5 million pounds of wildlife products per year. ADF&G also points out that attaching a dollar value to subsistence uses is difficult, as subsistence products generally do not circulate in markets. However, if families did not have subsistence foods, substitutes would have to be imported and purchased.

If one assumes a replacement expense of $3-5 per pound, the simple replacement costs of the wild food harvests in the Arctic region would be $31.5 million to $52 million.

	Kotzebue	Kivalina	Noatak
Per Capita Income - 1990 Census	$13,906	$4,968	$7,089
Replacement Cost $3/lb.	$1,779	$2,283	$1,383
Replacement Cost $5/lb.	$2,965	$3,805	$2,305

Table 2. Replacement Cost of Subsistence Products at $3 and $5 per pound.

Table 2 puts this into context. With per capita incomes ranging from $5,000 to $14,000, the total replacement cost of wildlife resources in the three communities presented in this comparison range from 13% to 77% of the total income for that community.

It is important to realize that none of the Chukotka communities has the income to replace subsistence resources and that many of the northwest Alaska communities simply could not function if they were required to import all their food. As the analysis indicates, even the relatively affluent (within the region) community of Lavrentiya lacks the financial resources to purchase food to substitute for wildlife resources. And for a community like

Sireniki, which currently spends almost all of its available income on food, the situation would be disastrous. In fact, Sireniki is on the edge of survival and copes by using a substantial amount of humanitarian aid.

Discussion

One might be concerned that under these trying economic circumstances some resource populations, especially marine mammals, may be exploited beyond the habitat's carrying capacity. A number of factors mitigate this concern.

First, the former state farm system did treat natural resources as commodities, resources to be exploited for their economic return. Marine mammals were hunted factory style by "killer" ships to provide feed for fox farms. Meat and other products designated for human consumption were regulated by market values established by the state. However, the whole structure of this economic system had been dictated by the central government in Moscow and had no real support within the region. In the absence of the centralized "command" economy, the state farm system that supported fox farms and factory ships has disappeared.

Secondly, the commodity view of natural resources is gradually being replaced with a more traditional indigenous orientation. This traditional view emphasizes the reciprocal relationship between hunters and hunted. Traditional values also stress the importance of sharing resources, a non-commercial distribution system *(Callaway n.d.)*. Commercial markets, if there is a profit still to be made, know no constraints. In contrast, traditional values cap the harvest level when a community's needs have been met.* Thus marine mammal hunting with modern technology continues, but the values that these technologies serve have changed.

In addition, the Chukotka Marine Mammal Hunters Association has worked closely with the International Whaling Commission and its technical committees, the North Slope Borough, and the Alaska Eskimo Whaling Commission to identify local nutritional needs and to set sustainable harvest quotas for gray and bowhead whales for the small human populations in the Chukotka region.

Photograph courtesy of John Tichotsky

North Pacific walrus may be at near peak levels, but are rarely harvested for commodity purposes.

In conclusion, it is important to realize that the absence of formal protected areas is not an absence of resource management. Indigenous management regimes are often complex, but one ethic underlies them all — one can not take more animals than one can use, even if an abundance presents itself. The injunction against waste supersedes any other mandate. In the interim, as the Beringia vision unfolds, the resources will be respected.

**Note that marine mammal products such as walrus ivory are still carved in some communities (e.g., Uelen). Traditionally these products were traded but they are now for sale. Demand for these products is limited, however, because the U.S. Marine Mammal Protection Act makes the sale of these Russian products illegal in the U.S. In contrast, indigenous Alaska artists are permitted to sell their carved walrus ivory.*

Acknowledgments

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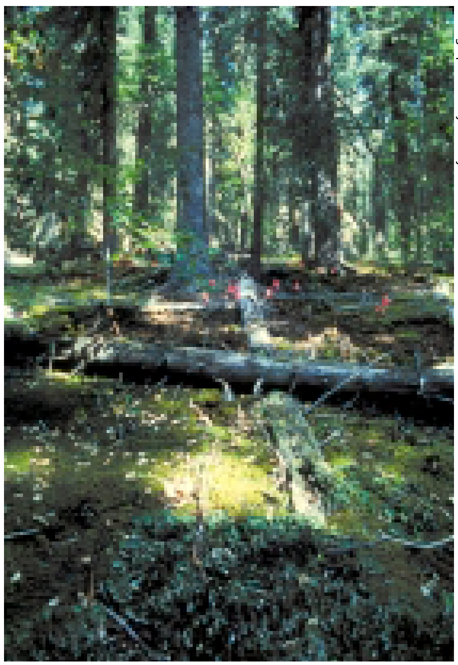
Cycles in the Forest: Mammals, Mushrooms, Mycophagy, Mycoses and Mycorrhizae

by Gary A. Laursen, Dr. Rodney D. Seppelt, and Maggie Hallam



Photograph courtesy of Gary A. Laursen

Figure 1. Interior mixed deciduous/conifer boreal forest stand and small mammal habitat.

Figure 2. Left: Boreal forest landscape mosaic with underlain permafrost.

Photograph courtesy of Gary A. Laursen

Cycles in the Forest

Cyclic interactions are omnipresent in natural ecosystems. In the northern boreal forests like those found in Denali National Park, such interactions involving the smaller microtine and sciurid rodents are vital to the health and survival of the forest ecosystem. These small mycophagous (mushroom eating) mammals consume selected above and below ground mushrooms (gilled agarics, false and true truffles) and distribute the fungal spores through their droppings along prescribed runways. Squirrels utilize spruce trees to dry and preserve these fungi aerially and then make storage caches in old nest sites hollowed out of "witch's brooms," the tangle of small branches and twigs that result from rust fungus infections (mycoses) of tree crowns. Extensive spruce stands could not exist in Alaska's northern boreal forests if it were not for symbiotic mycorrhizal associations with above and below ground fungi that are eaten and dispersed year round by the rodents. Ironically, similar fungi are responsible for the forests' demise and decomposition, which return vital nutrients to the relatively poor soils. (Glossary at end of article with select terms included)

Introduction

Alaska's far northern interior boreal and taiga deciduous broadleaf and conifer forests *(Figure 1)* present a mosaic landscape with discontinuous permafrost *(Figure 2)*. These forested landscapes, such as those seen in Denali National Park and Preserve, support a host of animal, plant, and fungal inhabitants and their associated biological interactions *(Laursen et al. 2001, 2002)*. Forest growth, propagation, regeneration, disease, death, and decomposition are continual processes, and each is important to different components of the total forest cycle.

Both biotic and abiotic factors play a significant role in determining the interaction between components of the ecosystem. Such interactions may have positive or negative influences on the landscape. These complex interactions, or "cycles in the forest," result in the development of complex ecological communities *(Figure 3)*.

Abiotic influences on the forest ecosystem include drying or desiccation, frost, freeze-thaw action, lightning strike, fire, and flood.

Extensive spruce stands could not exist in Alaska's northern boreal forests if it were not for symbiotic mycorrhizal associations with above and below ground fungi that are eaten and dispersed year round by the rodents.

Biotic influences include the building of squirrel and bird dwellings; bark stripping by woodchuck, bear, and porcupine; and browsing by hare and moose. Less obvious biotic influences include the interactions between heart and root rot fungi, broom rusts *(Figure 4)*, and other fungi that cause blights, cankers, casts, crooks, galls, and the "diamond-formations" that are found in some diamond willows. A multitude of insects also invade forest canopies, laying eggs, causing galls and minor lesions, drilling into the damaged stems, and ejecting a form of fecal "sawdust" (frass). Insects forage on young plant parts and carve extensive galleries under the bark where they lay eggs and deposit yeasts and other fungi. These fungi may also subsequently invade host plants, altering

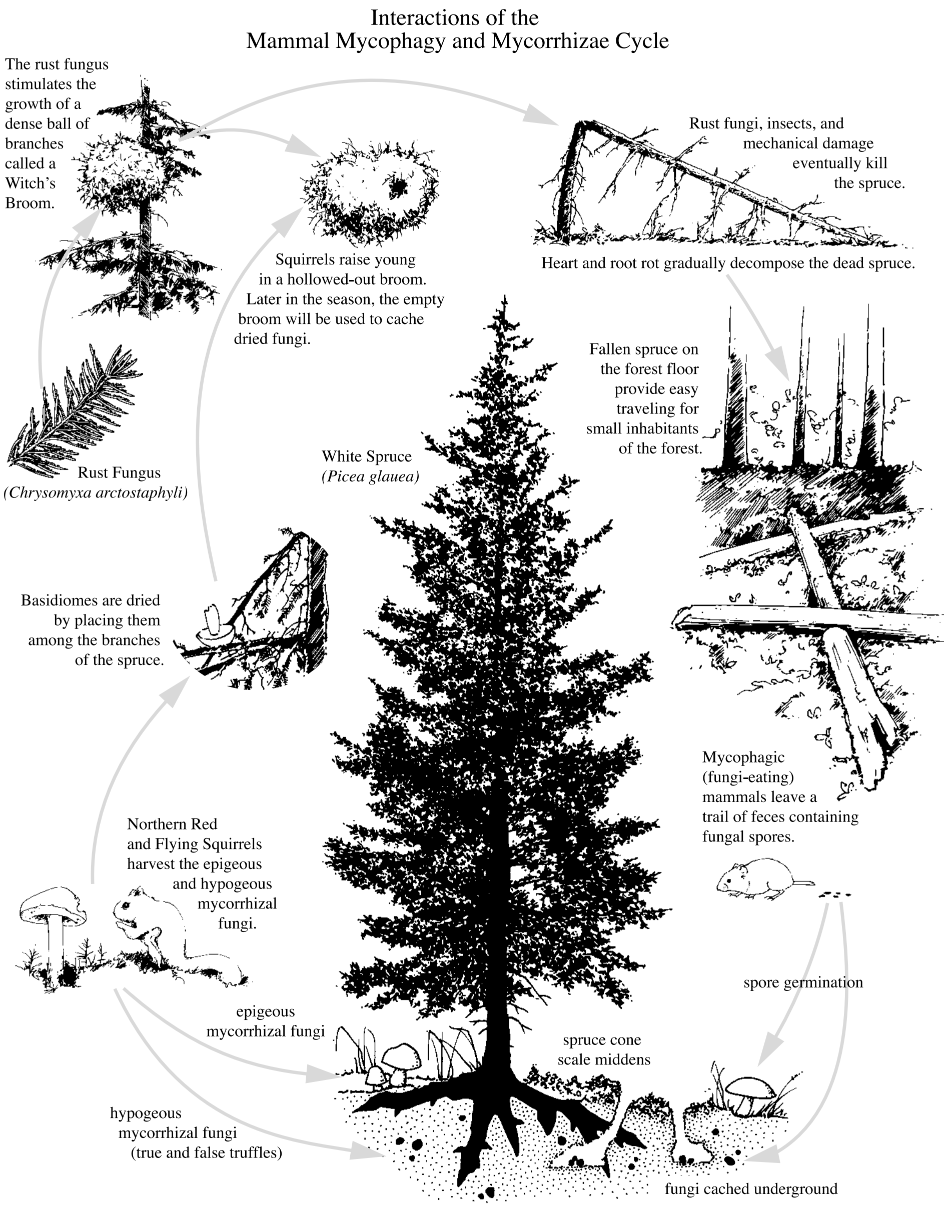


Figure 3. Mammals, mushrooms, mycophagy, mycoses and mycorrhizae boreal forest cycle.

Photograph courtesy of Gary A. Laursen

Squirrels utilize spruce trees to dry and preserve these fungi aerially and then make storage caches in old nest sites hollowed out of "witch's brooms", the tangle of small branches and twigs that result from rust fungus infections (mycoses) of tree crowns.

Figure 4. ***Chrysomyxa arctostaphyli*** **broom rust.**

their morphology, inducing disease, and eventually contributing to their slow demise and decomposition. Plant parasites, such as mistletoes, also play a part in influencing these cyclic interactions in the high latitude forests.

Role of Small Mammals in the Forests

At least three mycophagous small mammals—the northern flying squirrel *(Glaucomys sabrinus, Figure 5)*, the red squirrel *(Tamiasciurus hudsonicus, Figure 6)*, and the redback vole *(Clethrionomys rutilus, Figure 7)* play important roles in the dynamic reshaping of arctic woodlands and forests. By their foraging, voles and squirrels, as well as moose and caribou, play vital roles in transporting and transferring microscopic spores of important ectomycorrhizal fungi, without which forests would die.

Importance of Fungi in Forests

In northern high latitude forests, white spruce *(Picea glauca var. albertiana)* and black spruce *(Picea mariana)* are important symbiotic hosts to numerous ascomycete (sac) and basidiomycete (club) fungi, both as above ground (epigeous) and below ground (hypogeous) ectomycorrhizal forms *(Treu et al. 1996)*. The fungal filaments or hyphae *(Figure 8)* have an intimate association with the outside of small roots of trees and greatly assist nutrient uptake into the roots of these host plants. The hyphae coalesce on the outside of the root to form a "mantle" of fungal tissue *(Figure 9)*. This is also true for boreal forest elements of the expansive temperate coastal rain forests of southeast Alaska *(Bruner et al. 2001)*.

Mycorrhizal fungi (myco = fungus; rhiza = root. Literally, root fungi) are essential to the survival of Alaska ecosystems. No tree species would exist in Alaska without this symbiotic or mutually beneficial relationship.

Healthy white spruce live in a mutually beneficial symbiosis with their mycorrhizal fungal partners. The hair-like fungal hyphae or mycelium surround the spruce root tips *(Figure 9)* and invade between cells inside roots *(Figure 10)*. The mycelial filaments are much finer than the roots and root hairs, and greatly increase the surface area available for absorption of nutrients and water

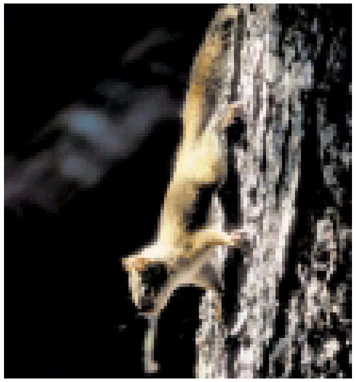


Figure 5. Inset-top: *Glaucomys sabrinus,* the northern flying squirrel eating a truffle fungus.

Figure 6. Inset-middle: *Tamiasciurus hudsonicus,* the northern red squirrel.

Figure 7. Inset-bottom: *Clethrionomys rutilus,* the red-backed vole.

Figure 8. Right: Extended mantel hyphae of an ectomycorrhiza x100

Photographs courtesy of Gary A. Laursen

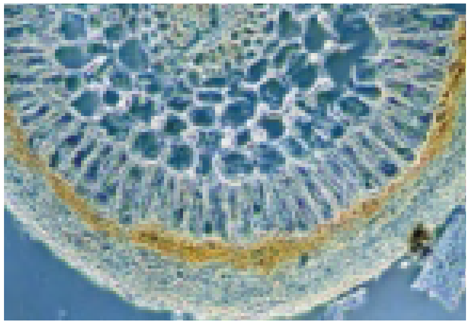


Figure 9. Ectomycorrhizal mantel hyphae, x400.

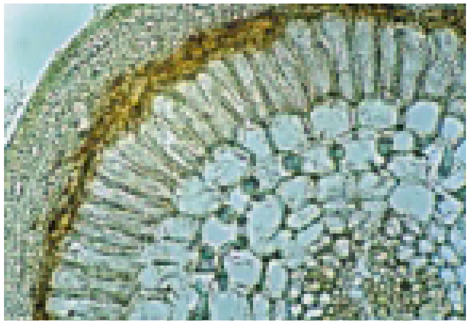


Figure 10. Mantel mycorrhiza and interior Hartig net between cortical cells, x1000.

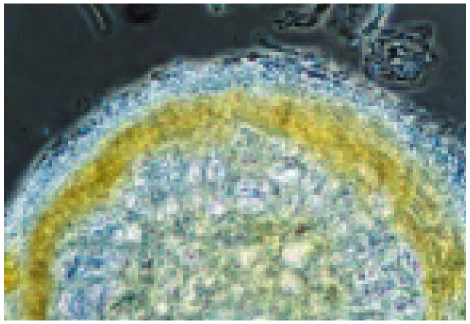


Figure 11. Ectomycorrhizal root xsect., x250.

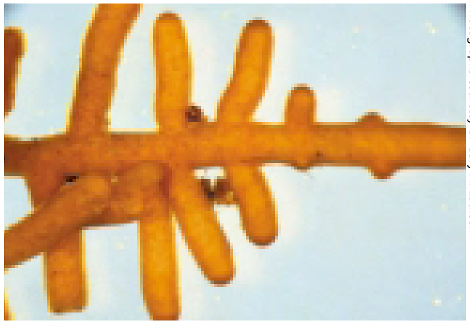


Figure 12. Birch root ectomycorrhizal with pinnate branching habit.

Photographs courtesy of Gary A. Laursen

from the nutrient poor soils. In addition, the glove-like covering of mycelium provides physical protection for the delicate root tips and also a barrier to the entry of soil microorganisms *(Figure 11)*. The mycelium produces antimicrobial compounds that deter competition from other fungi and microbes. In return, the spruce roots provide a supply of essential sugars and amino acids that are necessary for growth of the fungal mycelium and production of fungal fruiting bodies, the mushrooms.

It is possible that the present northern limit of spruce is at higher latitudes than would otherwise be possible because of the presence of mycorrhizal symbioses and, conversely, these fungi would not be present without their host trees. Even broad-leaved birches are not immune from this dependency *(Figure 12)*.

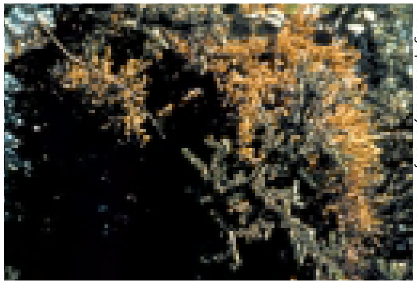
The diversity of these fungal-root associations provides a multitude of plants with a range of strategies for functioning efficiently under seemingly adverse conditions. It has been estimated that around 95% of all plant species characteristically form one of several types of mycorrhizal associations. Significant amounts of organic carbon may also be transferred between different plants through interconnecting fungal mycelia, thereby reducing competition for available resources and maintaining community diversity.

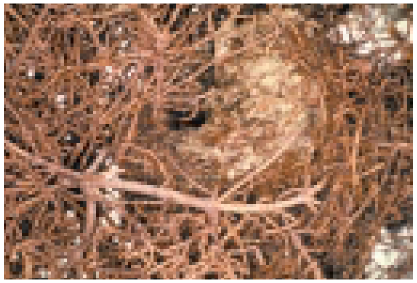
Parasitic Fungi— Where the Broom Rust Fits In

Parasitic fungi, and especially the spruce broom rust *(Chrysomyxa arctostaphyli, Figure 13)*, occur abundantly in the boreal forests of Interior Alaska, where the geographic ranges of spruce and kinnikinnick or mealberry *(Arctostaphylos uva-ursi var. uva-ursi)*, acting as an intermediate host in one stage of the life of the broom rust, coincide. Germinating rust spores on the spruce result in a perennial systemic infection on the host tree. The rust fungus produces auxins (plant growth hormones) that stimulate prolific branching on the spruce at the site of infection, causing the familiar "witch's broom" *(Figure 14)*. Other parts of the host tree continue to grow normally. Fruiting of the rust fungus occurs on the needles of the witch's broom, causing the telltale rusty-orange coloration. In the fall, needles of infected branches are shed and the broom then appears as a mass of dead twigs *(Figure 15)*.

Northern flying squirrels and red squirrels take advantage of these dense and often massive branch clumps. Squirrels hollow out brooms, construct nest sites *(Fig. 16 a & b.)*, raise their young, and then cache dried epigeous and hypogeous fungal fruit bodies *(Figs. 17a & b.)* in these old nest sites that serve as winter food larders *(Phillips 1998)*.

Left behind by these sciurid and microtine rodents and insects are feces and frass that contain viable but dormant fungal spores. During the following spring,





Photographs courtesy of Gary A. Laursen

Figure 13. Left: *Chrysomyxa arctostaphyli* broom at treetop.

Figure 14. Top-right: *Chrysomyxa arctostaphyli* broom with fruiting rust.

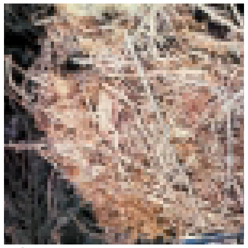
Figure 15. Bottom-right: Broom and potential nest/cache site with copious branching.

spores germinate and produce new hyphal growth that becomes associated with the rootlets of young plants, once again creating the beneficial mycorrhizal associations. Each summer and fall a new crop of fungal fruiting bodies appear, ready to be harvested by the mycophagous mammals and insects that are attracted to the nutrient rich spores.

Closing the Cycle

So it is that the forest cycle begins anew. Seedling establishment requires the development of a mycorrhizal association for the efficient extraction of moisture and soil nutrients. The fungal root mantle provides a protective physical barrier and microbial defense mechanism for the young and tender roots in a soil that will become, if not already, nutrient poor, yet able to sustain tree growth for 150 to 250 years or more. Soil and litter buildup ensures sufficient organic detritus to harbor the many non-mycorrhizal fungi that break down organic matter and release the otherwise bound nutrients to the soil. The litter also provides shelter for small mammals and insects and a suitable bed for future fruitings of mycorrhizal species of fungi.

Fungi that are harvested, dried, and


16a


16b


17a


17b

Photographs courtesy of Gary A. Laursen


18a

Figure 16a. Flying squirrel nest and cache site.

Figure 16b. Flying squirrel nest opening.

Figure 17a. Drying agarics (gilled mushroom) next to a flying squirrel.

Figure 17b. Drying *Lactarius* sp.

Figure 18a. Cone scale middens with surrounding *Hylocomium spendens* mosses.


18b


19a


19b


20a


20b

Photographs courtesy of Gary A. Laursen

Figure 18b. Cone scale middens with diggings for hypogeous truffle fungi.

Figure 19a. Fecal *Glomus* spores.

Figure 19b. Fecal *Elaphomyces muricatus, Gauteria* sp. and *Hysterangium separabile* spores.

Figure 20a. *Alpova diplophloeus* basidiome (fruitbody).

Figure 20b. *Gauteria otthii* basidiome (fruitbody-field).

stored in the tangled masses of branches of the witch's brooms are consumed throughout the winter months. The spores, after passing through the animals and being deposited in dung, will, in their turn, germinate and grow. Witch's brooms and cone scale middens *(Figure 18)* provide both nesting sites and caches for copious reserves of dried fungal fruiting bodies eaten during the long winter months. Fungal spores pass through the animals and are shed in the dung pellets where they are effectively wrapped in protective nutrient rich packets. As with some flowering plant seeds, passage through an animal not only disperses the seed (or fungal spores in this case), but the digestive chemicals of the animal also prepare the seed (or spore) for germination after defecation *(Figure 19)*. Squirrels also search in middens for hypogeous false truffle fungi *(Figure 20)* and true truffle fungi *(Figure 21)*.

With age, healthy trees gradually become stressed and, over a period of time, prone to increased attack from insect and fungal infections. With death, the trunks and branches are returned to the debris-choked forest floor to join a host of invertebrate animals and decomposer fungi, which slowly break down the plant cellulose and lignin by mechanical and chemical means, thus releasing nutrients to again be recycled into the ecosystem.

Fallen trees play a significant role on the debris-strewn forest floor by providing convenient raised walkways or highways for travel by smaller animals *(Figure 1)*. These animals, in their turn, deposit spore-laden feces on the logs and upon the forest floor debris. Flying squirrels are particularly important because they disperse mycorrhizal and other fungal spores in their dung pellets in the form of "nutrient pills"—rich in yeasts, nitrogen-fixing bacteria, and the vital nutrients necessary for germination, early growth, and establishment.

Waves of decomposer fungi, in a multitude of different shapes, sizes, and forms, soon become residents in the forest. Examples are the agarics (gilled), polypores (bracket and shelf fungi), tooth fungi, chanterelles, coral fungi, puffballs, and cup fungi. The above ground forms, such as the agarics *Amanita, Cortinarius, Lactarius, Pholiota,* and *Russula,* the boletes such as *Boletus, Fuscobolitinus, Leccinum,* and *Suillus,* and tooth fungi, such as *Hydnum* and *Sarcodon* species, are particularly abundant and striking on the forest floor. These above ground forms are accompanied by their below ground cousins such as the false truffles *Alpova (Figure 20a), Gauteria (Figures 20b),* and *Hysterangium (Figures 20c and 20d),* and the true truffle, *Elaphomyces (Figure 21)* and *Geopora* species. Their fruit bodies are harvested, dried, cached, and used for winter food by small mammals.

Conclusion

This complex cyclical biological system is dynamically balanced. Any change in the physical environment will be reflected in the biotic components of the ecosystem. Under the influence of global climate warming, hypothesized increases in microbial activity can only increase concerns for altering the arctic and subarctic carbon pool and contribute to an increase in the emission of greenhouse gases. Climate warming trends are having adverse effects by increasing plant stress through desiccation. Of concern is the possible decline or demise of the northern boreal spruce forest in the next 50 to 100 years, and what might replace these forests. Any changes in the forest structure will impact the ecosystem at all levels — the large megafauna, small mammals, invertebrates, microbes, trees, shrubs, herbs, bryophytes, lichens, and even microscopic soil algae.

Continued integrated research will assist in comprehending the effects of altering one aspect of these biotic cycles in the ecosystem.

Figure 20d. ***Hysterangium separabile* fruitbodies.**

Photographs courtesy of Gary A. Laursen

Figure 20c. ***Glaucomys sabrinus*** **with** ***Hysterangium separabile*** **fruitbody.**

Figure 21. ***Elaphomyces muricatus*** **cleistothecium (fruitbody), a true truffle with roots.**

Glossary

abiotic — pertaining to non-living conditions.

biotic — pertaining to life or specific life conditions.

boreal — northern.

ectomycorrhizal—describes when fungi associated with plant roots are external, not within the cell structure of the plant root.

hyphae — vegetative threadlike filaments, which form the mycelium and fruitbody of a fungus.

microtine — small rodents consisting of the lemmings, voles, and mice.

mushrooms — fruiting bodies of fungi that support sexual reproduction.

mycelium — the vegetative part of a fungus, consisting of a mass of branching filaments called hyphae.

mycophagous — mushroom eating.

mycorrhizal — the symbiotic association between fungal mycelium and plant roots.

mycoses — fungus infections.

sciurid — mid-sized rodents consisting of the squirrels.

taiga — intermediate zone between the boreal forest and tundra.

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National Park Service photograph

Test excavations underway at the Caribou Crossing site. A grid is projected onto the site to provide reference points for measuring artifact locations in three dimensional space. Sergei Slobodin, an archeologist from Magadan, Russia, and Sabra Gilbert-Young, a graduate student at Washington State University, take notes.

Left: Screening sediment to retrieve small artifacts at the Tuluaq Hill site. Wrench Creek and the De Long Mountains in the background.

National Park Service photograph

Ancient Hunters of the Western Brooks Range: Integrating Research and Cultural Resource Management

By Jeff Rasic

"Look at this one!" "Hey, here's another over here!" "This one is huge...and almost complete!" In the first ten minutes at the Caribou Crossing site—a barren, remote hilltop in northwestern Alaska surrounded by rocky peaks and hundreds of miles from the nearest road or village—the crew of eight archeologists found almost 30 large, masterfully made stone spear points. We suspected they were 10,000-11,000 years old. Even the old sourdoughs on the crew had given in to the excitement and were scurrying around like kids hunting for Easter eggs. And for good reason; rarely does an entire field season encompassing dozens of sites yield so many stone tools, particularly tools this old. The vast majority of known sites in the region consist of a surface scatter, with perhaps five or ten pieces of stone flaking debris. The sites are often impossible to date, a guess of 200-12,000 years old is the most precise archeologists can be. Particularly rare are sites dated to the early end of this time range, and few sites anywhere in the Americas have yielded such a dense accumulation of spear points.

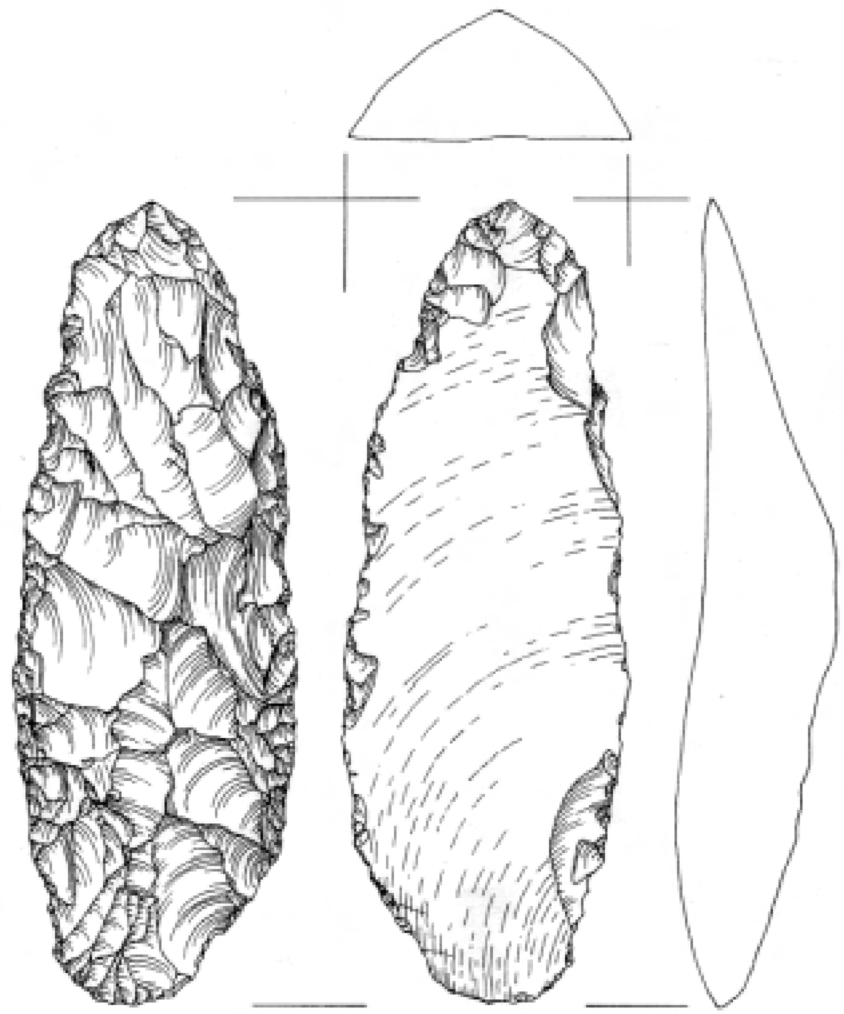
In addition, we had been in a holding pattern for the first three days of the season, huddled in our tents waiting for the snow to melt from a July storm. The crew had just found a focus for their pent up enthusiasm. The systematic, painstaking, and sometimes tedious work of mapping and documenting the site could wait a few minutes while we enjoyed this amazing place. Despite the apparent chaos of archeologists running in all directions, the knoll quickly sprouted a forest of small pin flags, which marked the precise locations of artifacts and ensured each was returned to its original location. We would map these later and examine spatial patterns to reconstruct site activities and to establish the age of artifacts by associating them with any radiocarbon samples we might recover.

Holding these well-crafted tools in the hand, one could not help ponder some interesting questions. What animals were hunted using these massive points? Why were these painstakingly-made weapons thrown away with apparent carelessness and in such large numbers? Was the hilltop crowded with people all at once, or was the accumulation the result of occasional stops by a few hunters over centuries? Were there similar sites on the numerous hilltops visible from this knoll?

But our purpose here was not to tally a high artifact count. Nor did we have a special interest in projectile points. Points, however, and lots of them, were what this site presented, and they were obviously vital to the story the site had to tell. Information from Caribou Crossing was also part of a larger, multi-year program aimed at understanding how the earliest hunter-gatherers in the region made a living. The research sought information on how people structured their seasonal movements across the landscape, how they procured food and other resources, and how they organized family or social groups.

One of the most fascinating problems in archeology is how humans initially settled the Americas at the end of the last ice age, sometime before 12,000 years ago. It is truly an impressive story as nearly all corners of the New World were settled in an archeological instant, perhaps in less than a thousand years. In the process, people encountered unfamiliar plants and animals, a countryside largely devoid of other people, and all occurring in the face of drastic environmental changes as the climate shifted to one more like that of today's.

The adaptations of early Alaskans is of special interest in this story since most archeologists agree that the first Americans originated in Asia and passed through Alaska. At some point, these people must have adapted to high latitude living, with its extreme seasonality, rapid fluctuations in food availability, and harsh temperatures.



Thick, steep-edged tools like this one are often found in late ice age sites in the Noatak River basin and co-occur with damaged spear points. They show wear marks and damage that indicate use as woodworking tools, and they appear to be part of the tool kit used to manufacture and repair hunting weapons. This specimen is just over 4 inches (11 cm) long.

To understand this process, it is critical to have good information from Alaska—the gateway to the New World as it has been called—as a comparison with the early archeology of mid-latitudes.

The Caribou Crossing project in 2002, conducted by the cultural resources branch of the Western Arctic National Parklands, aimed to investigate both site-specific questions and contribute to some of these broader issues. As a federal agency, however, federal environmental policy and historic preservation laws, particularly the National Historic Preservation Act, were driving forces behind the work. Section 110 of this act directs federal agencies to identify and evaluate historic properties on their lands, and manage and maintain them so as to preserve their values. Furthermore, the National Park Service is unique among federal agencies in that a central part of its mission is to ensure important historic places and the information they hold are cared for and made available for public understanding and enjoyment. These laws and policies recognize that not only are sites valued by living people as links to their heritage and traditions, but are also important for their ability to provide information about history and past human behavior.

A logical first step toward managing the resources is to inventory and evaluate them, a tall order in the vast, remote, and rugged parks of Alaska. Many sites are already known. In the Brooks Range alone, 16.5 million acres of contiguous parklands (Kobuk Valley National Preserve, Noatak National Preserve, and Gates of the Arctic National Park and Preserve) contain more than 1,500 documented sites. To put this in perspective, a recent study estimates only about one percent of the land area has been viewed by archeologists, perhaps another 85,000 sites remain undiscovered.

Threats to the resource are real, especially considering much of the archeological record in northern Alaska is largely a surface phenomenon. Due to slow sediment deposition in the region, tools discarded thousands of years ago are still visible on the ground and are thus vulnerable to erosion, breakage from animal trampling (easy to imagine for anyone who has seen the herds of several thousand caribou that migrate yearly through the Brooks Range), and dispersal due to frost heaving. Other impacts result from current human use. People may unknowingly (but nonetheless illegally) pick up an artifact as a souvenir, or may disassemble an ancient tent ring in order to weigh down a tarp. This is a difficult problem to quantify unless detailed base line information exists, since the absence of artifacts is impossible to detect. It is likely a serious one, given that modern park visitors are drawn to the same places that attracted past inhabitants of these lands—flat, well-drained ground, good viewpoints, and shelter from the wind.

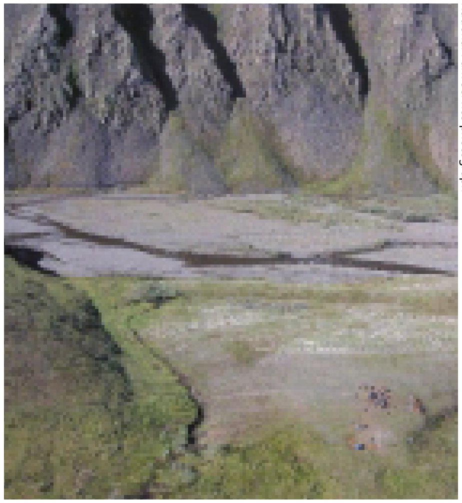
For cultural resource managers, tackling this issue is a huge problem—how can we protect or even find all of the thousands of sites that exist? One way of prioritizing is to focus survey efforts in areas with the highest potential for impacts, such as popular access points or shorelines subject to intense erosion. Another key factor in setting work priorities is the information value of particular sites. Those most likely to have high quality information can be targeted for more detailed documentation and protection. While seemingly self-evident, this is a challenge in northwestern Alaska where knowledge about the range of variation in sites and artifact types, and more importantly the causes of the variation, is still in a formative stage. While a site's ability to inform us about an interesting theme in human history or prehistory determines the significance of a site, themes are continually being redefined as we learn more about the archeology of the region. Thus we are presented with a moving target, and one we ourselves are responsible for clarifying.

Another of our goals at Caribou Crossing in 2002 was to flesh out an emerging construct that NPS archeologists were examining as both a research and resource management tool: the Sluiceway Complex. This was a provisional term we had begun to use in reference to a handful of sites from the western Brooks Range, which contained the distinctive projectile points seen at Caribou Crossing. The term "complex" refers to a patterned set of artifact types or manufacturing techniques. It is an imprecise term that simply notes a set of traits that occur together and seem different from other phenomena archeologists have observed. It skirts the tough questions of whether the manufacturers of the tools shared common ideas or values (culture), spoke the same language, or even whether the artifacts date to the same period.

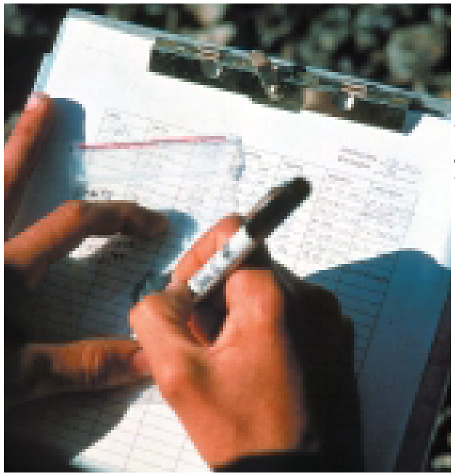
Until recently few sites in northwestern Alaska were dated to older than 9,000 years old, and before five years ago, there was no concept of a Sluiceway Complex or recognition of the artifact styles we were now discovering. Similar spear points had been found as early as the 1960s, but their age and significance were ambiguous. No independent dating (from associated radiocarbon dates or stratigraphy) was available, and guesses based on the artifact shapes and styles varied from 2,000 years to 8,000 years old. Sometimes they were not even recognized as projectile points, but instead simply "bifaces", a general term without any functional or temporal implication.

Identification of these tools began to change in 1993 when Western Arctic National Parklands archeologist Robert Gal and U.S. Geological Survey geologist Tom Hamilton discovered a site, later named the Irwin Sluiceway, in the Anisak River drainage, about 70 miles east of Caribou Crossing. Gal recognized the tools as projectile points since they had impact fractures—scalloped scars running down the face or edge of the point, which is a clear indication of a high velocity shock. He also knew these tools were not quite like anything previously noted in the region. The general outline of the points was not unique and could not be differentiated from tools 1,000 or 11,000 years old; however, manufacturing details were very distinctive. The flaking was quite regular, made in a serial fashion down each margin of the point. The edges along the base were ground or polished smooth—probably to help avoid damage to the wood or antler shafts to which the stone points were mounted. These features were reminiscent of early technologies known from the central Brooks Range and North Slope, as well as Paleoindian materials from the western U.S.

It was not until 1998 that an age for the


National Park Service photograph

Test excavations underway at the Caribou Crossing site in 2002.


National Park Service photograph

Archeologists catalog artifacts as they are collected and record precise location information for each item.


National Park Service photograph

A few of the 117 chert projectile points recovered during work at the Caribou Crossing site in 2002. Every single specimen was broken, and not one was a tip fragment. Instead, all are damaged basal portions that would have remained hafted in spear shafts. These were discarded at the site in the process of re-arming spears with serviceable points.

Site	Sample	Radiocarbon Age (years before present)	Context
MIS-495	Beta-165298	9910±40	Hearth feature
	Beta-165299	10,010±40	Hearth feature
NR-5	Beta-146117	9550±60	Wildfire? Sealed stratum
	Beta-146116	9640±300	Wildfire? Sealed stratum
Irwin Sluiceway	Beta-120696	9550±50	Hearth feature
	Beta-134677	10,050±70	Hearth feature
	Beta-131336	10,060±80	Hearth feature
Tuluaq Hill	Beta-133394	7950±40	Hearth feature?
	Beta-122323	11,110±80	Isolated charcoal fragment
	Beta-159913	11,120±40	Hearth feature
	Beta-159915	11,160±40	Hearth feature
	Beta-122322	11,180±80	Hearth feature
	Beta-159914	11,200±40	Above hearth D
	Beta-133393	11,200±40	Hearth feature

Table 1. Radiocarbon dates for charcoal samples from early Noatak river basin sites.

Irwin Sluiceway site — and perhaps the distinctive projectile points it contained — was established. In the summer of 1998, Dennis Stanford, a Paleoindian expert from the Smithsonian, collaborated with Gal on testing the site, and the work uncovered a well-preserved fire hearth. Charcoal samples from the ancient campfire were radiocarbon dated to 10,000 years old. Altogether the site yielded about ten projectile points and a small amount of flaking debris; it appeared to be the remains of a single, briefly occupied hunting camp and lookout site.

During the same season, an NPS inventory project was conducted on Wrench Creek, another Noatak River tributary located in the western portion of the preserve. More spear points of the same style were found at a site named Tuluaq Hill. The site yielded charcoal samples radiocarbon dated to between 11,100-11,200 years. Later work at the site in 1999 and 2001 yielded more dates in this time range and confirmed that the charcoal was from a human-made hearth. We also found hundreds of pounds of flaking debris and more than 300 bifaces that were broken in the process of manufacture. These artifacts indicated that Tuluaq Hill was an intensively used workshop site where people shaped chunks of chert into large bifaces, which were later made into tools such as projectile points or knives. We also recovered 64 worn out or broken projectile points that were discarded at the site in the process of re-arming spears.

The information from Tuluaq Hill helped support an early age range for the Sluiceway technology, but a complex history of site use and relatively shallow stratigraphy at Tuluaq Hill still left many questions unanswered. While the radiocarbon samples were spatially associated with Sluiceway-style artifacts, a concern at this site is whether people at other times in the past had also been drawn there for the same stone raw materials, thus resulting in a mixture of artifacts from different time periods. Dated occurrences of these artifacts at less complicated sites would help refine their age range.

In addition to the new field discoveries, in 1999 more Sluiceway-like artifacts were "rediscovered" in old museum collections. One such discovery was a collection at the Haffenreffer Museum at Brown University from the NR-5 site. Located on the Noatak River in what is now Noatak Preserve, the site was identified and tested by Brown University archeologist Douglas Anderson in the early 1960s. It was briefly described in a 1972 article, but never given much attention in subsequent academic discussions since its age and relationship to recognized complexes was unclear. The collection contains about a dozen spear points, identical to those from the Irwin Sluiceway and Tuluaq Hill sites, and a number of scraping and cutting tools, some of which replicated types seen at Tuluaq Hill. We were now beginning to piece together components of the Sluiceway tool kit other than spear points. The collection also contained microblades — long, thin stone flakes that were mounted in slotted handles for use as cutting tools or projectile armaments. Microblades occur in some, but not all, of the earliest sites in Alaska and are interpreted to indicate cultural contacts with Siberia since this technology is seen much earlier there than it is in Alaska. It would be interesting to know if microblades were also part of the Sluiceway Complex tool kit, and we continue to pursue this question. They have since been found at Caribou Crossing and another Sluiceway Complex site on the Kelly River.

National Park Service photograph

Dozens of microblades — small, regularly shaped slivers of stone — could be detached from a single core and set in pieces of slotted bone, antler, or wood for use as cutting tools or projectile armaments.

Other small collections housed at the University of Alaska Museum have also been found to contain Sluiceway-like artifacts, and additional new sites in Noatak National Preserve were discovered during surveys conducted between 1998 and 2002. Small scale testing at some of these sites has yielded radiocarbon dates. A revisit to NR-5 showed that the artifacts at the site where Anderson excavated occur in a discrete, sealed sediment layer, which has been dated to at least 9,550 years before present. A site near Natinakunit Pass (MIS-495) produced radiocarbon dates from a hearth feature of 9,910 and 10,010 years ago. In all, 19 sites with probable Sluiceway artifacts have been identified in northwestern interior Alaska, centered on the Noatak River Basin and the adjacent North Slope foothills. This is a substantial data set for looking at how some of the earliest known inhabitants of the region lived.

Test excavations at Caribou Crossing in 2002 unfortunately did not produce hearth remains nor samples suitable for radiocarbon dating, but an age estimate of about 10,000 years seems reasonable based on the

National Park Service photograph

Game trails crisscross the Caribou Crossing site. Despite its name, it is not clear which animals were hunted 10,000 years ago when this site was likely occupied.

radiocarbon dates accumulating at similar sites *(Table 1)*. The fieldwork did yield surprising information about prehistoric technology, and hunting and storage tactics. The sheer number of projectiles points, 145 from two nearby localities, is unmatched in any Alaska site of any age. This dense accumulation, along with other lines of evidence, suggests it is unlikely to have resulted from a single occupation. People were instead visiting this location repeatedly. They knew animal behavior well enough to predict their migrations through this narrow valley, probably using the natural topography to limit animal movement and kill large numbers of animals. Which prey species was hunted is still a mystery since no faunal remains (bones) are preserved at the site. It was almost surely a herd animal. Therefore bison, which still roamed northern Alaska at this time, as well as caribou, are good bets. The huge store of meat produced by group hunts like this probably meant that fairly substantial settlements were located nearby, in order to make use of these stores without having to transport them long distances.

The traces of past human activity—along with wildlife sightings, animal tracks, flora, etc.—are another of the rich layers of experience that make being in the wild places of an Alaska national park a memorable and enriching adventure. It is encouraging to think that these are still wild and beautiful places, and 11 millennia of human habitation have only added to their allure. Our understanding of human history in this region is very much a work in progress. Because sites must be evaluated in terms of what they can teach us about the past, it is important to have good baseline knowledge about the sites we encounter and to understand how they relate to interesting research problems. In this sense, research and resource management must proceed simultaneously. Ten years ago, before the age of Sluiceway Complex artifacts were known, a site like MIS-495 would probably have received little attention. Seen from the perspective of a regional research question about hunters and with enough background knowledge to spur interest, the site was given a second look and as a result became one the few sites in the region radiocarbon dated to the early Holocene.

NOTE: Ages cited in this article are expressed in radiocarbon years before present (BP), which differ from actual calendar years. By convention "present" is established as 1950.

Radiocarbon dating is based on the principle that all living organisms—and thus the wood charcoal or bone deposited in archeological sites—contains a small proportion of radioactive carbon-14. Upon an organism's death, carbon-14 is no longer ingested, and it begins to decay at a known rate (a half life of 5,730 years). The amount of carbon-14 remaining in an organic sample can then be used to calculate its age; however, the amount of carbon-14 in the atmosphere has fluctuated slightly over time.

The small errors compound with increasing age and can result in radiocarbon ages that are too young. For example, a radiocarbon date of 10,000 years BP is equivalent to about 11,400 calendar years, and a radiocarbon age of 11,200 years is equivalent to approximately 13,300 calendar years. To control for these discrepancies, scientists have documented the variation in atmospheric carbon-14 and developed calibration curves that can be used to convert radiocarbon ages into calendar years, known as calibrated radiocarbon years.

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High Latitude Marine Reserve Research in Glacier Bay National Park

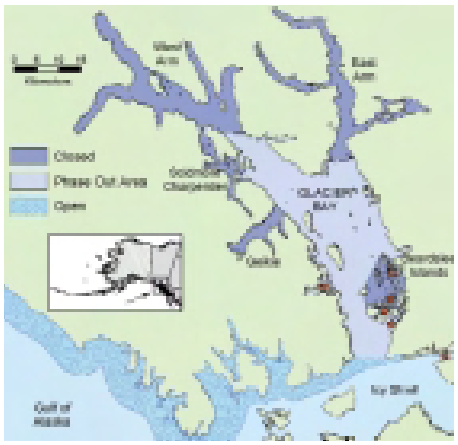

Figure 1: The open, closed, and phase-out areas for commercial fishing in Glacier Bay National Park and Preserve. The red stars represent study locations for the long-term study monitoring changes in the Dungeness crab population before and after commercial fishing.

Left: There has been a dramatic shift in the size of male Dungeness crabs following the closure of commercial fishing in Glacier Bay National Park.

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By S. J. Taggart, J. Mondragon, A. G. Andrews, J. K. Nielsen

Glacier Bay National Park and Preserve is dominated by the marine waters that make up nearly one-fifth of the park's area. Since the late 1800s, the nutrient rich waters of Glacier Bay have supported highly productive commercial fisheries. Congress closed fishing in parts of Glacier Bay National Park in 1999, creating one of North America's largest marine reserves. Throughout the world, marine reserves are being promoted as effective tools for managing fisheries while simultaneously meeting marine conservation goals and maintaining marine biodiversity. Increases in individual size, density, biomass, and diversity have been demonstrated in studies of fish and invertebrates from both temperate and tropical marine reserves *(Halpern 2003)*. Studies on the effectiveness of marine reserves at high latitudes, however, are rare. The formation of marine reserves in Glacier Bay National Park provides a unique opportunity for marine reserve research in a high latitude ecosystem.

The legislation that closed commercial fishing in the park specifies the species and the areas that will be protected. All commercial fishing was left open in a three-mile band of water adjacent to the park's shore along Icy Strait and the Gulf of Alaska, while it was closed in Glacier Bay proper *(Figure 1)*. Commercial fishing for Tanner crab *(Chionoecetes bairdi)* and Pacific halibut *(Hippoglossus stenolepis)* was immediately closed in five areas that vary in shape and range in size from 40 to 280 km^2. In the central part of the bay, fishing is being phased out through a grandfather clause, which allows fishermen to continue fishing in the central part of the bay for Tanner crab, salmon, and Pacific halibut. Over the next several decades, as fishermen retire, Glacier Bay proper will become a single large reserve for all species. For red king crabs *(Paralithodes camtschaticus)* and Dungeness crabs *(Cancer magister)* the legislation immediately closed commercial fishing in all of Glacier Bay proper.

Thus, for the immediate future, there is a reserve network of five closed areas for Tanner crabs and halibut, while the entire bay is a reserve for red king crabs and Dungeness crabs. The network of closed areas adjacent to the open portion of the bay provides a large-scale laboratory to study marine reserve effectiveness. The marine reserves in Glacier Bay are changing the protected populations beneath the waters in ways that we are just beginning to see.

To manage the marine resources and understand marine reserve processes in Glacier Bay, the U.S. Geological Survey (USGS), with support from the National Park Service (NPS), is conducting research in order to answer some fundamental questions. First, since the reserves only protect the animals that reside within the boundaries of the protected area, we need to know the distribution and abundance of resources in each reserve. Secondly, it is important to understand how animals are moving in relation to the reserve boundaries and how much time they are spending in the protected areas. If animals are spending a significant portion of time inside the reserves, then we may start to observe some of the population changes,

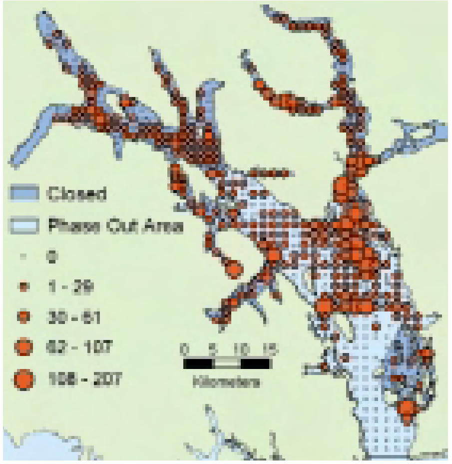

Figure 2: The catch per pot (or Catch-Per-Unit-Effort) of Tanner crabs throughout Glacier Bay.

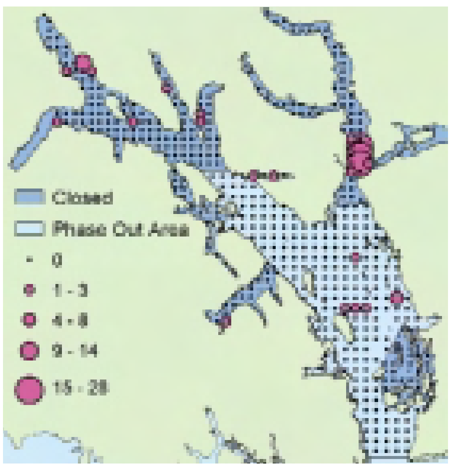

Figure 3: The catch per pot (or Catch-Per-Unit-Effort) of red king crabs throughout Glacier Bay.

such as higher abundance, that have been demonstrated in protected areas in other parts of the world.

Distribution and Abundance of Fisheries Resources in Reserves

In 1999 researchers conducted a pot survey to determine the distribution and relative abundance of Dungeness crabs throughout Glacier Bay. Although Dungeness crabs occurred throughout the park, they were very rare in the northern portion of the bay *(Taggart et al. 2003)*. In the summer of 2002, researchers systematically sampled for Tanner and red king crabs throughout Glacier Bay. Sampling occurred on a one mile (1.6 km) grid blanketing the entire bay. From this sampling, estimates of the relative abundance and size frequency of the crabs inside and outside of the newly created reserves were made. Tanner crabs were widely distributed and their density was approximately equal in the closed and open areas *(Figure 2)*. On the other hand, their distribution varied widely between protected areas; the majority of the Tanner crabs in the protected areas were in two reserves. In addition, two of the reserves had areas where juvenile Tanner crabs were abundant and thus might be potential nursery areas. In contrast to Tanner crabs, red king crabs were highly aggregated, and 73% were in a small part of a single reserve *(Figure 3)*.

These studies illustrate that basic systematic sampling could provide vital information on where future marine reserves should be located and that reserves in close proximity to each other may have very different relative abundances of animals. Knowing there are areas with high relative abundance inside the reserve boundaries is the first step. The next step is to determine the movements of the population in relation to the reserve boundary.

Tanner and King Crab Movement in Marine Reserves

We have initiated a research program to measure how often breeding adults enter and leave the protected areas. Our long-term vision is to simultaneously measure the transfer rate among multiple reserves and the adjacent area remaining open to commercial fishing. Red king crabs, Tanner crabs, and Pacific halibut will be sonic-tagged within each of the reserve areas and the area open to fishing, and their movements will be detected by strings of submersible data loggers that create acoustic gates along the reserve boundaries.

In September 2002, we initiated the research by tagging 21 Tanner crabs and 16 king crabs in the East Arm reserve and installing a string of data loggers along the boundary. The data loggers are recording tagged animals that move across the reserve border. We have relocated tagged crabs every two to three months since being released by visiting a series of grid stations and systematically searching with underwa-

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A USGS researcher releases a tagged king crab into the East Arm marine reserve in Glacier Bay National Park.

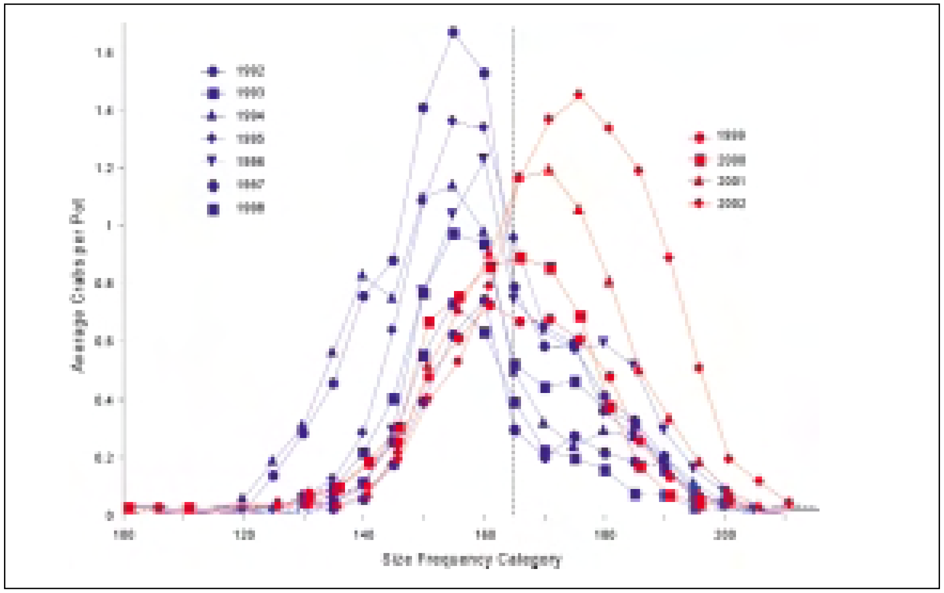

Figure 4: Average size abundance distribution for male Dungeness crab at all sites closed to commercial fishing. Each line represents a year from 1992 to 2002; blue lines are years before commercial fishing closed, and the red lines are the years after fishing closed. the dashed line shows the legal size limit (165mm) for male Dungeness crab.

ter hydrophones. Tanner crabs have shown large variation in the distance that they move. A few individuals have been relocated in the same area, but one male has traveled at least 32.5 km since it was released. The king crabs were highly aggregated when they were tagged, and they have tended to move as a group. To date, three of the male Tanner crabs have moved across the reserve boundary, and one male and one female king crab have been located on the boundary.

Knowing there are areas with high relative abundance inside the reserve boundaries is the first step. The next step is to determine the movements of the population in relation to the reserve boundary.

We will continue to track these crabs over the next two years to estimate how much time the population spends in the reserve and determine the transfer rate across the boundary. This study will enable us to evaluate the effectiveness of the East Arm marine reserve and develop predictions about long-term changes in the Tanner and king crab population demographics inside the reserve. If the transfer rate is low, then we would expect to see increases in body size and or population abundance in the reserve.

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Researchers attach a sonic tag to a Tanner crab in order to study the movement of animals inside a marine reserve in Glacier Bay National Park.

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The number and size of male Dungeness crabs increased dramatically after the 1999 closure of Glacier Bay to commerial fishing.

Changes in size of Dungeness crab after fishing closure

In anticipation of commercial fishery closures, scientists from the U.S. Geological Survey, the University of Alaska Fairbanks, and the National Marine Fisheries Service initiated a study in 1992 to document changes in the population structure of Dungeness crabs. Study sites were selected both inside and outside the proposed closure areas and sampled with commercial pots and scuba transects *(Figure 1)*. Since 1992, we have collected seven years of pre-closure and four years of post-closure data.

After the 1999 closure of Glacier Bay to commercial fishing, the number and size of male Dungeness crabs increased dramatically *(Taggart et al. In Press) (Figure 4)*. Harvest regulations allow only large male Dungeness crabs to be removed by the fishery. Therefore, one would expect changes to occur more quickly among the male crab population. During the pre-closure phase of the study, the number of male crabs over 165 mm (legal size) was relatively small compared to the number of sub-legal sized males. After the fishery closure, the number of male crabs over 165 mm began increasing, and by 2000, the number of crabs larger than 170 mm exceeded the highest abundance we had recorded during any of the 7 pre-closure years. This trend continued, and in each subsequent year since the closure, the number and size of male crabs increased. In contrast, at a control site outside of the park that is still open to commercial fishing, there was not a large shift in the size of male crabs. At all sites, female and sub-legal sized male crabs, the portions of the population not directly targeted by commercial fishing, did not increase in size or abundance following the closure.

Our data demonstrate that a marine reserve can markedly increase the size of male Dungeness crabs. Fisheries that remove most of the large individuals from a population can select against genotypes that promote fast growth *(Reznick et al. 1990)*, and slower growth can reduce productivity of fisheries *(Conover and Munch 2002)*. If reserves protect adult animals so they have the opportunity to grow to a larger size, and there is gene exchange between the reserve and the adjacent area, the genetic consequences of commercial fishing could potentially be mitigated by strategically located marine reserves *(National Research Council 2001; Trexler and Travis 2000)*. The results of our research in Glacier Bay support the concept that marine reserves could help maintain genetic diversity in Dungeness crabs and other crab species subjected to size limit fisheries.

Implications

Controlled experiments testing the impact of human exploitation on the population structure of marine species are rare and even more unusual for crustaceans. Closures of fisheries are usually prompted by major declines in the abundance of the harvested species resulting in the collapses of the fishery *(Jackson et al. 2001)*. In Alaska, such closures for crustaceans normally remain in effect only until there is evidence that the stocks are rebounding *(Orensanz et al. 1998)*; so there are limited opportunities to compare changes in the populations of a closed area with nearby populations still being exploited. The ongoing marine reserve research in Glacier Bay will provide valuable information to managers, scientists, and the public to evaluate the utility of reserves as a management tool for solving local, national, and global marine conservation issues.

Acknowledgments

Special thanks to J. de La Bruere for his expert ability to operate the R/V 'Alaskan Gyre' and his effort toward this work. We thank T. Lee and E. Knudsen for their continued support of long-term studies at Glacier Bay National Park and Preserve. The U.S. Geological Survey and the National Park Service funded this work.

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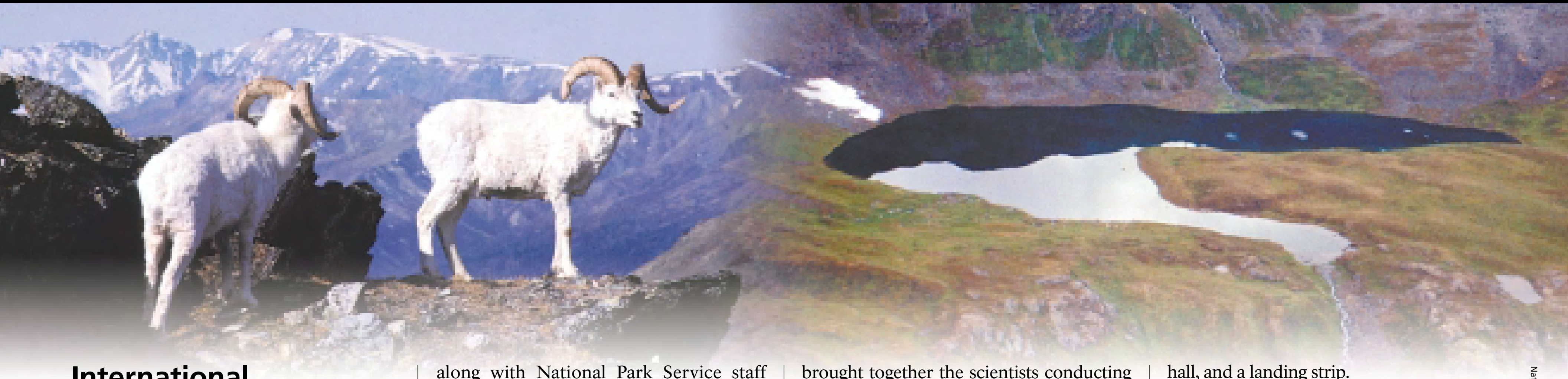
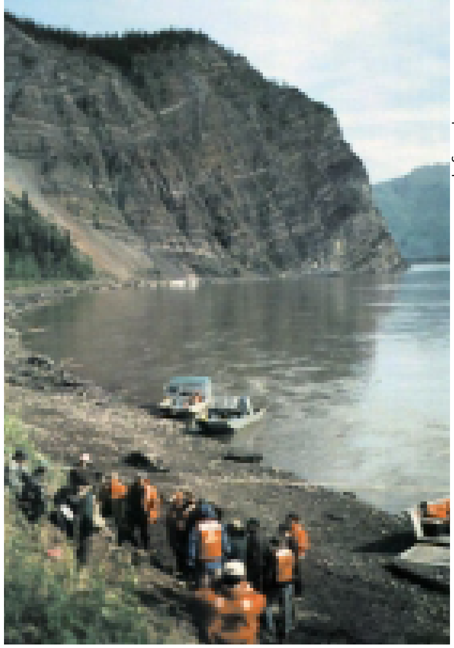


National Park Service photographs

International Mammoth Conference Visits Yukon-Charley Research Sites

This May the 3rd International Mammoth Conference drew quaternary scientists—paleontologists, biologists, geologists and archeologists-from around the world to Dawson City, Yukon Territory. The conference focused on mammoth evolution and ecology as a springboard for addressing broader issues of Pleistocene and Holocene ecology and environmental change. This year, because of its Beringian venue, it focused heavily on Beringian themes—the evolution of mammoth faunas and ecosystems, permafrost preservation, and the effects of past climate change on vegetation and animal communities. Participants attended workshops, poster and paper presentations, and field trips to key Beringian geological and paleontological sites.

One field trip brought a group of Russian, Canadian, and American scientists along with National Park Service staff to the town of Eagle and Yukon-Charley Rivers National Preserve. In Eagle, a community picnic and public lecture brought together the scientists conducting research in and around the preserve with local residents. There was a great showing of local interest among Eagle residents. Researchers talked informally about their projects, and an enthusiastic question and answer session resulted. Topics included volcanic ash stratigraphy and dating, Holocene flood history of the upper Yukon, and the archeology of the Calico Bluff site. Field trip stops included the Calico Bluff archeological site, where recent excavations have documented one of the best middle Holocene human occupations in Interior Alaska; Chester Bluff, where sediments document a series of catastrophic floods that temporarily reversed the flow of the Yukon River; and historic sites at Coal Creek and Slaven's Roadhouse.



National Park Service photograph

Field trip participants discuss archaeological surveys near Calico Bluff on the Yukon River. More than 250 species of fossils have been identified from the Upper Mississippian age Calico Bluff Formation.

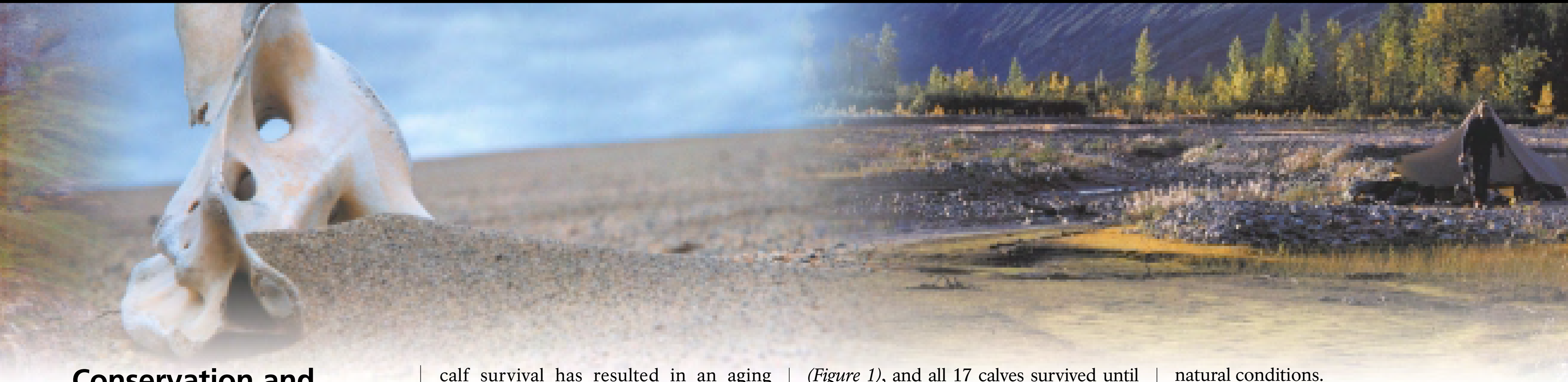
Superintendent Dave Mills also led a side trip to the preserve's Coal Creek field camp. This restored gold mining camp now serves as a year-round operations center for science and fire operations, emphasizing adaptive reuse of the historic district and landscape. Restored facilities include multiple historic cabins and offices, a mess hall, and a landing strip.

The conference field trip received wide support from a variety of funding sources and participants: the International Mammoth Conference, the Alaska Quaternary Center, Cultural Services Branch of the Yukon Tourism and Culture Department, the International Arctic Research Center, the Shared Beringian Heritage Program, Yukon-Charley Rivers National Preserve, and Tanana Chiefs Conference.

Abstracts of papers presented at the 3rd International Mammoth Conference are available at:
http://www.yukonmuseum.ca/mammoth/progabst.htm

Information about research opportunities in Yukon-Charley Rivers National Preserve can be found at:
http://science.nature.nps.gov/permits/servlet/ParkResPrefAppViewServlet?parkCode=YUCH

—by Jeff Rasic, Archeologist,
Gates of the Arctic National Park and Preserve,
Yukon-Charley Rivers National Preserve



Conservation and Complexity: The Chisana Caribou Herd

The Chisana caribou herd, inhabiting eastern Wrangell-St. Elias National Park and Preserve (WRST) and neighboring Yukon Territory, may be the only herd of the woodland subspecies, *Rangifer tarandus caribou,* found in Alaska. Preliminary genetic analyses indicate that Chisana caribou may be distinct from caribou found throughout the rest of Alaska.

Yukon Department of Environment, Alaska Department of Fish and Game, and WRST began a cooperative research program on the herd in 1987. The Chisana herd has declined from about 1,900 animals in 1988, to only about 315 in 2002. Although all licensed hunting of the herd was stopped in 1994, the herd has continued to decline. High mortality of calves (sometimes 100%) was observed, and is believed to be due to predation *(Farnell and Gardner 2002)*. The vast majority of these losses occur on preserve lands that contain most of the calving grounds. Low calf survival has resulted in an aging population, with increased adult mortality and reduced reproductive rates, further hastening the decline.

Last year the Yukon government afforded the herd its highest level of protection under the Yukon Wildlife Act. In spring of 2003, the Yukon Department of Environment implemented a captive rearing program adjacent to WRST—20 females were captured and radio-collared, 17 of which were pregnant. The females were contained in "predator proof" pens *(Figure 1)*, and all 17 calves survived until released at about two to four weeks of age. Within a few days, the animals returned to their native summer range in WRST. The National Park Service, Alaska Department of Fish and Game, and United States Geological Survey-Biological Resources Division have developed a monitoring program to track the herd, as well as determine the effectiveness of the captive rearing program. As of late July, the released captives have shown less than 50% mortality rate among calves, an improvement over natural conditions.

The plight of the Chisana herd presents a complex policy issue for the Park Service. NPS management policies are specific in maintaining native populations, natural processes, and genetic diversity. ANILCA specifies maintaining "healthy" wildlife populations. The Chisana herd, a native species that is genetically distinct, is declining due to natural processes (weather impacts and predation by native predators), calling into question whether a "healthy" population and genetic diversity are being maintained.

Figure1.

National Park Service photographs

Preliminary discussions with the U.S. Fish and Wildlife Service suggest that the herd may warrant protection under the Endangered Species Act. If listed, the Chisana herd would constitute the only terrestrial mammal listed under the Endangered Species Act in Alaska, and would occur primarily on NPS lands. Furthermore, such a listing will instigate discussions of predator control on NPS lands since NPS management policies provide for predator control as part of an approved recovery plan for threatened and endangered species.

The Yukon Territory school system has a website on the captive rearing program at: **http://www.yesnet.yk.ca/schools/stelias/caribou/**

Farnell, R. and C. L. Gardner. 2002. *Status of the Chisana caribou herd: 2002.* Department of Environment, Government of Yukon, Whitehorse, Yukon, Canada. 22pp.

-by Mason Reid, Wildlife Biologist, Wrangell-St. Elias National Park and Preserve

Wolverines' Secrets Soon to Be Uncovered

In 1961, Frank and John Craighead built and placed the first radio-transmitting collar on Marian, a female grizzly bear in Yellowstone National Park, in order to learn the secrets of her daily wanderings. Over 40 years later, homemade radio transmitters have yielded to satellite transmitters — small, high-tech transmitters that send location (latitude and longitude coordinates) and activity information about an animal to satellites that process the data and then e-mail the information to biologists. Technological improvements of satellite transmitters have reduced the weight of the transmitters from nearly 25 pounds (11 kg) to less than 9 ounces (257 gm), for the current wolverine design.

Tranquilized wolverine being fitted with a satellite radiotransmitter.

Satellite-transmitting radiocollar placed on wolverines.

Wolverine habitat in the upper Noatak valley.

As part of a larger ecological study of wolverine distribution and survival, biologists tested prototype satellite transmitters to track the movements of ten wolverines (7 males, 3 females) in the Noatak National Preserve between 1999 and 2002. During the 113 days that the transmitters operated, 617 locations were recorded for these ten wolverines. For comparison, during the same three years, researchers were only able to obtain 150 locations of these same wolverines by observing them from aircraft. Inclement weather, distance from Kotzebue, and short, winter days all contributed to the limited information by traditional observation from aircraft.

Ultimately, using a small number of satellite-telemetered wolverines, biologists will be able to characterize the movements and home ranges of wolverines throughout the valley. Although technology will never substitute for traditional field observations, satellite transmitters may prove to be the best method to study the movements of these far-ranging, secretive carnivores.

-by Brad Shults, Wildlife Biologist and Pilot, Western Arctic National Parklands;

Kyran Kunkel, Turner Endangered Species Fund, Bozeman, Montana; and

Fredrik Dalerum, Stockholm University, Stockholm, Sweden

High Whale Numbers Found at Glacier Bay National Park and Preserve

A record number of humpback whales were in Glacier Bay National Park this summer, and biologists recorded a rare sighting of three generations of related whales.

Since 1985, park biologists have monitored humpback whale populations in Glacier Bay and nearby Icy Strait. This year's survey estimates at least 40 whales in Glacier Bay and another 20 in Icy Strait, with movement between the areas, according to NPS whale biologists Chris Gabriele and Janet Doherty. Humpback whales are distributed throughout Glacier Bay, with high concentrations seen recently in three areas: the Bartlett Cove/Point Carolus area has about two dozen whales; the Upper Sitakaday Narrows has about 10 whales; and the Beartrack Cove area has three to four whales.

Whales entered Glacier Bay early this year, arriving into the lower bay in mid-May. By June 12, 30 whales had been at the entrance to the bay. "All observations to date suggest that the marine mammal and bird activity this year is due to the high abundance of capelin smelt, a small schooling fish," Gabriele said.

Whales return to southeast Alaska each summer after a 1,500-mile migration from Hawaii. Among those back this year are four related whales, representing three generations. A whale designated as #581 was seen in June in Icy Strait with a calf; her 16-year-old daughter (#1042) was also seen nearby with her calf. Collaborative studies with other researchers revealed that the 16-year-old along with other whales spent time in Tenakee Inlet, southeast of Glacier Bay in October and November 2002, presumably eating herring that over-winter there.

A 13-knot speed limit has been in place in lower Glacier Bay since late May to reduce whale disturbance and decrease the risk of whale-vessel collisions. Given the number of whales in the bay and the fact that they are feeding in mid-channel, Park Superintendent Tomie Lee has requested vessels to use extra caution while navigating through any areas where whales are likely to be. The whale monitoring effort is a long-term project of park biologists, with significant assistance from volunteers and several vessel operators who contact the park with sightings.

—Chris Gabriele, Wildlife Biologist, Glacier Bay National Park and Preserve

Editor's note: An article by Chris Gabriele and others on underwater acoustic monitoring research of humpback whale songs at Glacier Bay appeared in the fall 2002 issue of Alaska Park Science, available at **http://www.nps.gov/akso/AKScience2002.pdf**

National Park Service photograph

National Park Service photographs

On-Line Volcano Information

The Alaska Volcano Observatory (AVO) has an on-line atlas and database of photos of selected Alaska volcanoes, including many in national parks. The Alaska Volcano Observatory is a joint program of the U.S. Geological Survey, the Geophysical Institute of the University of Alaska Fairbanks (UAFGI), and the State of Alaska Division of Geological and Geophysical Surveys. AVO was formed in 1988, and uses federal, state, and university resources to:

- conduct monitoring and other scientific investigations in order to assess the nature, timing, and likelihood of volcanic activity;

Photograph courtesy of R. McGimsey, 1990

- assess volcanic hazards associated with anticipated activity, including kinds of events, their effects, and areas at risk; and
- provide timely and accurate information on volcanic hazards, and warnings of impending dangerous activity to local, state, and federal officials and the public.

The following links will take you to a variety of useful databases:

Atlas
http://www.avo.alaska.edu/avo4/atlas/atlas.htm

Photos
http://geopubs.wr.usgs.gov/dds/dds-39/
http://geopubs.wr.usgs.gov/dds/dds-39/captions.txt

Catalogs of volcano-related earthquake events
2002: **http://geopubs.wr.usgs.gov/open-file/of03-267/**
2000 - 2001: **http://geopubs.wr.usgs.gov/open-file/of02-342/**
1994 - 1999: **http://geopubs.wr.usgs.gov/open-file/of01-189/**

Mysteries in the Rocks of Ancient Chukotka

In 1965, a geologist conducting work in northern Chukotka discovered a series of petroglyphs on rocky cliffs along the Pegtymel' River. The geologist had stumbled upon the northernmost petroglyphs known to prehistorians. On his return to Magadan, he reported his find to Nikolai N. Dikov, a director of archeological research in the Russian Far East. When Dikov visited the site in 1967 with a crew of archeologists and artists, they surveyed the area, conducted test excavations at the occupation sites, and recorded the petroglyphs.

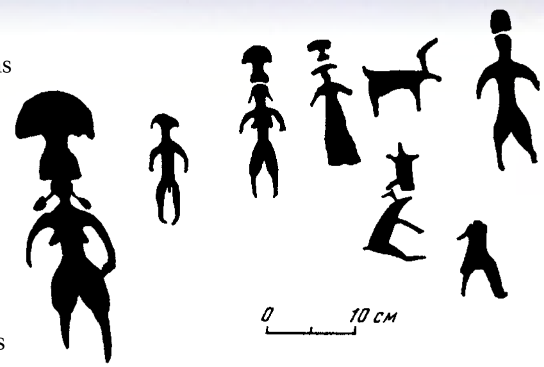
Dikov's research culminated in the publication *Naskal'nye Zagadki Drevnei Chukotki (Petroglify Pegtymelia)*, in which he explores the origins of these intriguing images—who made them, when, and why. The author divides the petroglyphs into five canons based on the style of art, then compares the canons with art from other regions of Eurasia. Dikov utilizes the archeological and ethnographic data to

attempt to date the petroglyphs.

A large number of the petroglyphs are of swimming deer pursued by spear-wielding men in boats. These undoubtedly portray the taking of migrating deer as they swam across the Pegtymel' River. Other scenes depict whaling, bear hunting with dogs, and strange mushroom figures, which appear to be human females with mushroom headdresses.

Dikov includes excellent illustrations of all 104 petroglyph groups and about three dozen photographs of selected groups. Anyone interested in rock art will be intrigued by this book, which has been published in translation by the Beringia Heritage International Park Program, National Park Service, 240 West Fifth Avenue, Anchorage, Alaska 99501, under the title *Mysteries in the Rocks of Ancient Chukotka (Petroglyphs of Pegtymel')*.

-by Richard L. Bland,
Museum of Natural History,
University of Oregon, Eugene, Oregon

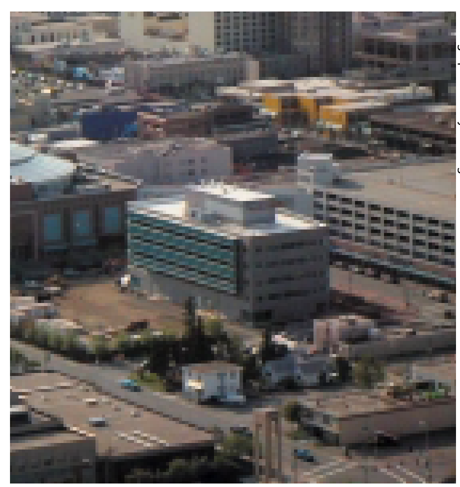


It's Easy To Be Green

The National Park Service's Alaska Regional Office has moved into its new location in downtown Anchorage. The new mailing address and contact information are: 240 West 5th Avenue, Room 114, Anchorage, AK 99501; Main Phone: 907-644-3510. A complete listing of direct phone numbers for individual employees is on our internet site at: **http://www.nps.gov/akso.**

The office building houses about 225 Park Service employees who provide technical and administrative support and oversight for the 16 national parks in Alaska. Information about visiting Alaska's national parks and other public lands is still available at the Alaska Public Lands Information Center on 4th Avenue. Questions about all your public lands in Alaska can be directed to them at 271-2737.

The new building is also green. Green in that many new features in the building utilized recycled materials. For example, fiberboard in the elevators is made from sunflower seed hulls, recycled newspapers, and bio-based resins. Fiberboard made from



Photograph courtesy of Greg Daniels

recycled newspapers and bio-safe resins are incorporated into the lobby.

Timber grass bamboo was used in the elevator cabs and in the directorial and conference rooms. Unlike hardwood trees, which require more than 120 years to grow to maturity, bamboo grows to maturity in less than six years and is a renewable resource. Bamboo can be harvested from the same plant multiple times. Timber grass bamboo is not a food source or habitat for pandas.

All the carpeting in the building is made from fibers with recycled content, and carpets were produced using 71% less water than traditional methods. The ceramic tile entry is made with 70-75% recycled solid waste—a combination of post-consumer recycled glass, post-industrial grinding paste from the computer industry, and post-industrial mining waste from the sand and gravel industry. In addition, office lighting contains occupancy sensors that turn lights on or off, saving on energy use and cost.

-Communications Office, Alaska Region

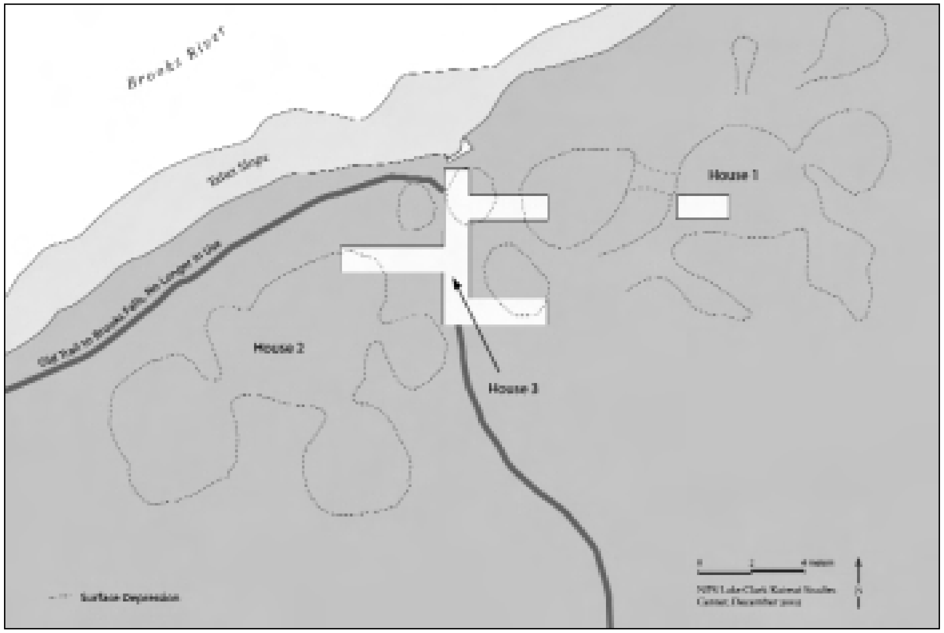


Figure 2. (above) Figure3. (below)

National Park Service photograph

Working on the Edge: the Brooks River Cutbank Archeological Data Recovery Project

The Brooks River is the heart of Katmai National Park and Preserve. Brooks Camp is the gateway to the geologically significant Valley of 10,000 Smokes and the home of many of Katmai's famous brown bears. The area is also a National Historic Landmark and an archeological district consisting of 19 different sites. People have made their homes along the Brooks River for at least 4,500 years, and many of the descendants of earlier Brooks River residents still live on the Alaska Peninsula. Descendant communities and park archeologists share an interest in protecting these important archeological sites.

The Brooks River Cutbank site has been steadily eroding as the river meanders *(Figure 1)*. The site is fairly recent, dating to the Bluffs Phase (A.D. 1450-1800). In 1999 NPS archeologists discovered human remains eroding from the river bank. In compliance with federal law and NPS policy, archeologists contacted culturally affiliated Alaska Native groups through the Council of Katmai Descendants. Archeologists and the council agreed on a plan for the disposition of the human remains and an excavation at the site that would address questions of mutual interest. Both were interested if the the burial could be linked stratigraphically to either of the two nearest houses, allowing researchers to learn more about the individual's life, and whether the houses were built in the same multi-room style as contemporaneous houses elsewhere on the Alaska Peninsula and Kodiak Island. In 2002, archeologists began excavations designed to answer these questions *(Figure 2)*.

The site held surprises. Between the two houses, visible on the surface, was a third older house. In addition, the burial appears to be more recent than all three of the houses, although further excavation in 2003 will provide more information. The newly discovered house had an ingenious deep cold-trap entrance tunnel. Within the third house, archeologists found incised pebbles *(Figure 3)* lightly etched with stylized human figures. The pebbles resemble those commonly found on Kodiak Island, suggesting a long-distance connection.

Further scientific investigations are in progress at the Cutbank site. Geologists are currently identifying the volcanic tephras found in the soils, and archeologists conducted a second excavation season. In the summer of 2003, archeologists studied the third house, its chronological relationship to the two nearby houses, and cultural connections across the region. Erosion cannot be stopped, but through archeological investigation and partnering with local communities, we can learn about prehistoric lifeways before the evidence vanishes.

—by Dale M. Vinson and
Barbara E. Bundy,
Lake Clark-Katmai Studies Center

National Park Service photograph

Figure 1.

Alaska Park Science

National Park Service
Alaska Support Office
240 W. 5th Avenue
Anchorage, Alaska 99501

National Park Service photograph

National Park Service photograph

Cindy Williams, an undergraduate anthropology student at University of Alaska Anchorage, searches for small artifacts.

Top-Right: Black chert at a prehistoric chert quarry on Wrench Creek.