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ARCTIC RESEARCH

OF THE UNITED STATES



INTERAGENCY ARCTIC RESEARCH POLICY COMMITTEE

About the Journal

The journal *Arctic Research of the United States* is for people and organizations interested in learning about U.S. Government-financed Arctic research activities. It is published semi-annually (spring and fall) by the National Science Foundation on behalf of the Interagency Arctic Research Policy Committee and the Arctic Research Commission. Both the Interagency Committee and the Commission were authorized under the Arctic Research and Policy Act of 1984 (PL 98-373) and established by Executive Order 12501 (January 28, 1985). Publication of the journal has been approved by the Office of Management and Budget.

Arctic Research contains

- Reports on current and planned U.S. Government-sponsored research in the Arctic;
- Reports of ARC and IARPC meetings;
- Summaries of other current and planned Arctic research, including that of the State of Alaska, local governments, the private sector and other nations; and
- A calendar of forthcoming local, national and international meetings.

Arctic Research is aimed at national and international audiences of government officials, scientists, engineers, educators, private and public groups, and residents of the Arctic. The emphasis is on summary and survey articles covering U.S. Government-sponsored or -funded research rather than on technical reports, and the articles are intended to be comprehensible to a nontechnical

audience. Although the articles go through the normal editorial process, manuscripts are not refereed for scientific content or merit since the journal is not intended as a means of reporting scientific research. Articles are generally invited and are reviewed by agency staffs and others as appropriate.

As indicated in the U.S. Arctic Research Plan, research is defined differently by different agencies. It may include basic and applied research, monitoring efforts, and other information-gathering activities. The definition of Arctic according to the ARPA is "all United States and foreign territory north of the Arctic Circle and all United States territory north and west of the boundary formed by the Porcupine, Yukon, and Kuskokwim Rivers; all contiguous seas, including the Arctic Ocean and the Beaufort, Bering, and Chukchi Seas; and the Aleutian chain." Areas outside of the boundary are discussed in the journal when considered relevant to the broader scope of Arctic research.

Issues of the journal will report on Arctic topics and activities. Included will be reports of conferences and workshops, university-based research and activities of state and local governments and public, private and resident organizations. Unsolicited nontechnical reports on research and related activities are welcome.

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Front Cover

Occupational injury and death are an important aspect of health trends referred to as the "new morbidity and mortality" in the Arctic. Commercial fishing is one of the highest-risk occupations in the United States. This photo captures the dramatic struggle to capture fish from the sea. This longlining trip in the Gulf of Alaska is fighting 35- to 40-foot waves and winds of up to 40 knots. (Photo by Deborah Mercy, University of Alaska Sea Grant Marine Advisory Program.)

ARCTIC RESEARCH

OF THE UNITED STATES

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Arctic Social Science and Health Research

In many ways the future of the Arctic depends on the people who live there. This special issue of Arctic Research of the United States presents a sampling of Federally funded research focusing on the people of the Arctic—their history, their culture, their health, their economy and the effects of social change on their way of life.

The Arctic and Human Settlement

The Arctic Circumpolar Zone consists of an almost continuous expanse of land from Scandinavia through Eurasia to Greenland. The Arctic Ocean is thus largely landlocked, with its only major outlets between Greenland, Spitsbergen and Norway. Natural terrestrial conditions are very similar throughout this zone, which comprises both Subarctic (boreal forest) and Arctic (tundra) ecosystems. While geographically these zones are limited to the high latitudes above 60°N, during the last ice age they extended half a continent to the south.

Humans have occupied circumpolar lands for thousands of years and have developed sophisticated cultures and technologies enabling survival in extremes of cold, darkness and isolation. Polar conditions offer, in fact, the closest Earth analog to Space and as such constitute a valuable resource for scientists interested in human physiology, psychology and small-group social interactions.

tions equal to those of Europe and Asia at the time of European contact in the late 15th century.

Throughout the Circumpolar Zone numerous cultures developed independently, as well as through the influences of migrations and contacts with outside cultures. In the North American Arctic, two distinct populations and cultures developed. The Indians (the Athapaskan, Eyak–Tlingit–Haida, Tsimshian and Algonquian speakers) are the descendants of the earliest Siberian settlers, and the Eskimo (the Inuit), who live in the the high Arctic from easternmost Siberia to Greenland, are the descendants of Asiatic people whose more-recent culture evolved in the Beringian (Alaska) region over the past 5000 years.

The Arctic of Today

Despite the fact that the Arctic and Antarctic contain one fifth of the world's land area and are rich in mineral resources and fishing waters, they are still among the least-known regions on Earth.

Antarctica is governed by an international treaty and is not under the sovereignty of any one nation. The continent has no indigenous population. The Arctic, by contrast, lies within the political boundaries of eight of the world's richest nations (the United States, Russia, Canada, Denmark/Greenland, Iceland, Norway, Sweden and Finland) and is home to numerous Native cultures.

Because of their traditional dependence on hunting and fishing, northern communities still largely coincide with optimal locations for fish and game: near oxygen- and nutrient-rich lakes, rivers and estuaries and along ice-free coasts. Even with the development of modern oil, mining and commercial fishing activities, subsistence hunting and fishing remain an important component of daily life and cultural identity.

European mining and whaling ventures started in the Arctic as early as the 1500s, followed by commercial fishing, the fur trade, gold rushes, colonization and oil and gas development. In addition to

Because the Arctic Ocean is rimmed by so many nations, national security and scientific interests are uniquely international in character.

From this point of view the Arctic is a hostile environment, but to those who live there permanently, this is a land of great beauty and ample resources that has given rise to a rich cultural heritage. Humans have thrived in Arctic regions for at least 15,000 years, since Siberian peoples moved across the Bering land bridge into Alaska and then southward. Radiocarbon dating suggests that human populations reached Tierra del Fuego, the southern tip of South America, within 1000 years of crossing the land bridge. All American indigenous cultures thus have their origins in the North, and from this beginning they forged new civiliza-

the cultural and economic changes these activities brought, the spread of European infectious diseases devastated indigenous populations. Modern medicine has helped eliminate many of these diseases, but they have been replaced by new morbidities, and northern peoples are still suffering from serious health problems.

Arctic Social Sciences Research and the Federal Government

Because the Arctic Ocean is rimmed by so many nations, national security and scientific interests are uniquely international in character. These interests encompass strategic, political, economic, environmental and cultural (particularly indigenous) concerns.

Although previously recognized as important to national security, Arctic social science and health

ple are claiming greater political control, not only of land and resources, but also of education, science and health care. Scientific research in the Arctic can no longer be carried out without the permission of northern peoples; it will have to be built on partnerships with them. For these reasons, a "Statement of Principles for the Conduct of Research in the Arctic" was formulated by the Arctic Social Sciences Task Force (see p. 78 of this issue).

The need for social science research is recognized by both Alaska Natives and the Federal government. The Arctic Research and Policy Act of 1984 specifically referred to social, behavioral and health research, directing particular attention to the interests of Arctic residents and the adverse consequences of development for northern peoples. This legislation also designated the National Science Foundation as the lead Federal agency for coordinating U.S. Arctic research. The Director of NSF chairs the Interagency Arctic Research Policy Committee (IARPC), which was created by this Act. An interagency Arctic Social Sciences Task Force was created under the aegis of IARPC to help coordinate Federally sponsored social sciences and health research.

The 1984 Act further mandated an Arctic Research Plan. The Plan has been updated every two years since 1987. The most recent revision appeared in *Arctic Research of the United States*, Spring 1991.

The need for increased social science support was reiterated in the National Science Board report *The Role of the National Science Foundation in the Polar Regions*. A more detailed plan for the social sciences was subsequently developed in the National Research Council's Polar Research Board report *Arctic Social Science: An Agenda for Action* (National Academy Press, 1989).

In January 1990 the National Science Foundation, following these recommendations, initiated an Arctic Social Sciences Program within the Division of Polar Programs. The program funds multidisciplinary research in archaeology, anthropology, sociology, linguistics, psychology, geography, history, political science, law and economics.

Why a Special Issue on Social Science and Health?

Given the urgency of contemporary political, socioeconomic, environmental and health issues in the Arctic, a special issue of *Arctic Research of the United States* devoted to social sciences and health research is particularly timely.

With growing political autonomy, Native peoples are claiming greater political control, not only of land and resources, but also education, science and health care.

research has taken on heightened significance for the United States because of recent political and environmental developments. Among the issues are the political developments in the former Soviet Union, anthropogenic contamination of the atmosphere, nuclear and other sources of contamination in northern rivers and seas, and the development of Native autonomy.

Throughout the Arctic, Native peoples are working toward ownership and political control of the lands where they live. The recent Nunavut land claim settlement in Canada, comprising 493 million acres, makes the Inuit the single largest landowner in North America. Greenland has Home Rule, and there is a growing demand for increased self-determination among the indigenous peoples of Alaska and the Russian North and Far East. In Alaska, the largest state in the U.S., with an area of 367.7 million acres, 9.8% is Native-owned land and 66.4% is Federal land. The Alaska Native Claims Settlement Act of 1971 affirmed Alaska Native title to 44 million acres. Today there are increasing demands for recognition of Alaska tribal sovereignty, which would acknowledge a direct government-to-government relationship with the Federal government.

With growing political autonomy, Native peo-

This issue was created to showcase research by Federally funded scientists and educators working in Arctic regions. An important goal of the issue was to demonstrate that the research, while fascinating and valuable by itself, makes useful contributions towards improving health, education, economic development, resource management, criminal justice and cultural life.

The special issue is organized around three research themes identified by the Polar Research Board in *Arctic Social Science, An Agenda for Action*. The three priority areas identified for research are human–environment interactions, community viability and rapid social change.

Human–Environment Interactions

These interactions refer to the complex interrelationships of humans and the ecosystems of which they are a part. There are few regions of the world where the interactions of environment, culture and health are so intertwined as in the Arctic. The Arctic is a rich repository of human experience, reflecting both a successful adaptation to changing environmental conditions and the devastating effects of modern development on small, natural-resource-dependent societies. This section includes articles on the prehistory of the earliest Alaskans, the use of tree rings from archaeological sites for studying climate change, and the genetic connections between ancient Siberians and American Indian populations.

Another aspect of human–environment interactions is the effect of the Arctic environment on the human body. Arctic regions provide ideal conditions examining the limits of human physiology in the cold and for testing cross-cultural hypotheses about human health and nutrition. An article on health trends describes a remarkable record in conquering infectious diseases. But at the same time it

opment. The commercial harvesting of fish in the dangerous seas off Alaska has pushed occupational safety to its limits.

Community Viability

This issue is critical for all northern residents. Outside of the regional centers like Anchorage and Fairbanks, communities in rural Alaska tend to be small and isolated, often accessible only by air or sea, and sometimes only during ice-free months. Most families in rural communities rely on a mixed strategy of subsistence harvesting, wage labor and commodity production to make ends meet. In these small, mixed-economy communities, there is little by way of a conventional economic base for taxable revenue. Yet most communities need the range of services such as education, law enforcement, health care and other services taken for granted in the more populous “lower 48.”

Social scientists identify and analyze the diverse market and subsistence economic bases of communities. For example, the commercial fishing and processing sector provides about 16% of the employment base in the state of Alaska, surpassed only by the military and local and state government. The seafood industry is critical to the viability of small communities such as Dillingham, Togiak, Cordova, Dutch Harbor–Unalaska and Kotzebue. One article describes how economists helped producers see the global forces that affect their salmon markets. Another shows the importance of modeling “bycatch” (incidental take) for the increasingly complex groundfish fishery. Many jobs and families in Alaska depend on these analyses.

The subsistence harvest is critical to many communities in Alaska. Subsistence as a way of life is perhaps more extensive in Alaska than in any other U.S. state. Social scientists have helped to define these activities as not merely economic in nature but as a vital component of Native social and cultural life.

Whaling, as practiced by Eskimo villages, is a form of subsistence harvest, as long recognized by the International Whaling Commission. The hunting of whales is an intergenerational bond between father and sons, it is a way to gain or lose status in the village, it is a way to bring extended families together through sharing, it is a way to meet ritual obligations in the community, and it is a community celebration of the new spring season. An article on whaling highlights the close relationship between community survival and cultural survival.

Another article focuses on the role subsistence

There are few regions of the world where the interactions of environment, culture and health are so intertwined as in the Arctic.

highlights new challenges to human health and well-being. The “new morbidity and mortality,” including cancer, diabetes, heart disease and alcohol-related problems, are related to the introduction of new lifestyles and dietary habits, and even to prolonged lifespans due to improved medical care.

Arctic conditions also test our ability to transport and transfer technologies for economic devel-

harvesting in the Bristol Bay region of southwest Alaska, and a presentation of an in-progress ethnographic study of subsistence in the northwest Alaska is included.

Education is a national priority, and it is doubly so in the Arctic. With the decentralization of rural education over the last decade, schools are actively seeking new models of educational administration, resources and teacher training, among other things. This issue includes two articles related to education: an essay by a Native author, which discusses the Yup'ik philosophy of knowledge and Western education, and an article on a clearinghouse for educational resources and experiences among the far-flung, isolated schools and districts of the circumpolar North.

Rapid Social Change

Change has become a way of life in the North. It is often initiated from outside through institutions having organizational structures and methods of decision-making that conflict with those of Arctic cultures. The U.S. legal and justice system, for example, is based on assumptions and procedures very different from the traditional Native ways for dealing with conflict. This section includes an article investigating the causes and results of the disproportionately high confession and incarceration rates in western Alaska.

Rapid social change also means that people's hopes and aspirations change over time, turning away from known ways and towards the outside world. Included in this issue is an article describing in-progress research on the impacts of resource development on the attitudes of Arctic youth towards

education, out-migration and labor force participation—important keys to understanding the future demographic and economic profiles of rural Alaska.

Economic development in the Arctic has brought new occupations, and an article on occupational fatalities documents the increasing numbers of injuries and fatalities that have accompanied development. These jobs are usually related to resource extraction, such as lumbering, mining, fishing or transportation.

Federal agencies also have roles as historical archivists. The two final articles describe the documentation of historic structures and other information threatened by development and change.

Bringing together the articles in this special issue has not been easy. We obviously could not include the work being done by all Federal agencies. Agencies were encouraged to submit articles on research that addressed Arctic and national needs. What we hope to accomplish is to introduce at least a portion of the research being done in a variety of fields. Naturally these contributions represent the views of individual researchers, not necessarily those of the sponsoring agencies.

Arctic regions, while offering unique physical conditions for research in the natural, social and health sciences, also provide a platform for studying the most urgent scientific questions facing all humankind. There are few better opportunities for monitoring and analyzing the effects of global change on natural ecosystems and natural-resource-dependent societies. It is hoped that the wealth of knowledge resulting from the efforts of these, and numerous other, scholars will contribute to an improved understanding of Arctic issues and will open new pathways to solutions that will benefit society within and outside of the Arctic.

The Term "Eskimo"

The term "Esquimawes" first appeared in 1584, and the spelling "Eskimo" was in common usage by the mid-nineteenth century. The origin of the term can be traced to contacts between Natives and Europeans in the eastern Arctic, which was frequented by Basque whalers, the English and the French. The word derives from the Algonquian Indian language, and in Ojibwa it means "eaters of raw meat." In Montagnais, another Algonquian language, the name has been interpreted as deriving from "snowshoe netter."

Eskimo self-designations, translated as "people" or "real people," are "Inuit" (West Greenland and Canada), "Inuvialuit" (Mackenzie Delta), "Inupiat" (north Alaska), "Alutiiq" and "Yup'ik" (southwest Alaska and Siberia). In 1977 the Inuit Circumpolar Confer-

ence adopted "Inuit" as the designation for all Eskimos, regardless of local usages. The Aleuts speak a separate branch of the Eskimo language family.

"Alaska Eskimo" is still commonly used in Alaska (also "Yup'ik Eskimo" etc.). The term is also used with regard to prehistoric cultures (for example, Paleoeskimo) or in linguistics, physical anthropology and medicine. In Canada, "Inuit" has nevertheless replaced "Eskimo" in governmental and most scientific contexts.

Because these terms are used in varying contexts in this issue of *Arctic Research of the United States*, the editors have chosen to retain author usages. For more information about the use of these names, refer to *Handbook of North American Indians*, Vol. 5, *Arctic*, Smithsonian Institution, Washington, D.C., 1984, p. 5-7.

Investigating the Earliest Alaskans

The Broken Mammoth Archaeological Project

CHARLES E. HOLMES AND DAVID R. YESNER

The Broken Mammoth and Mead sites in central Alaska may provide the first conclusive evidence that humans and mammoths coexisted in Alaska, the gateway to the New World. More significantly, these archaeological excavations provide data about subsistence and the environment during one of the earliest phases of human settlement in North America.

Charles Holmes is with the Office of History and Archaeology, Alaska Department of Natural Resources, and is Affiliate Assistant Professor in the Anthropology Department, University of Alaska–Anchorage; David Yesner is an Associate Professor in the Anthropology Department, University of Alaska–Anchorage.

Archaeologists are uncovering evidence that allows the first comprehensive view of subsistence lifeways of ancient peoples who hunted and camped in central Alaska between 10,000 and 12,000 years ago. Investigations at rare archaeological sites in the Tanana Valley 100 km south-east of Fairbanks have yielded data that show that a broad-based hunting and foraging economy was practiced in Eastern Beringia (interior Alaska and Yukon) at the end of the last ice age. Late Pleistocene and Early Holocene aeolian silt (loess) deposits rich with calcium carbonate have preserved butchered remains of birds and mammals in unequivocal stratigraphic context with human-made stone tools and hearth charcoal. These sites are the oldest in Alaska to contain evidence of artifacts associated with extinct mammals such as camel, elk, bison and mammoth. The co-occurrence of human tools and animal bones in the three sites described below provide a unique opportunity to refine our knowledge about human adaptation to environmental change.

The Broken Mammoth Site, discovered by Holmes in August 1989, was given its name because of the recovery of mammoth tusk fragments associated with other faunal remains and lithic tools from the eroding bluff face. The 1990 testing program was a joint project between the Alaska

concentrations and study the stratigraphy. Approximately 10,000 items were recovered in 1990.

Testing during 1990 showed that the nearby Mead Site has multiple archaeological components in a stratigraphic context similar to the Broken Mammoth Site. Faunal remains were also recovered, including elk, bison, birds and mammoth ivory tusk fragments. Among the artifacts recovered is a carved piece of ivory.

Work in 1991 (supported by a National Science Foundation grant) focused on better defining the various archaeological components at the Broken Mammoth and Mead sites. Archaeological collections from both sites were doubled, and a series of radiocarbon dates were obtained. In addition, a regional survey to locate previously unrecorded sites was begun, resulting in the discovery of two more stratified sites with preserved faunal remains associated with archaeological components. One of these sites (called Swan Point) produced mammoth ivory. The Broken Mammoth, Mead and Swan Point sites are the only three Alaskan archaeological sites containing mammoth and other extinct fauna in good association with artifacts.

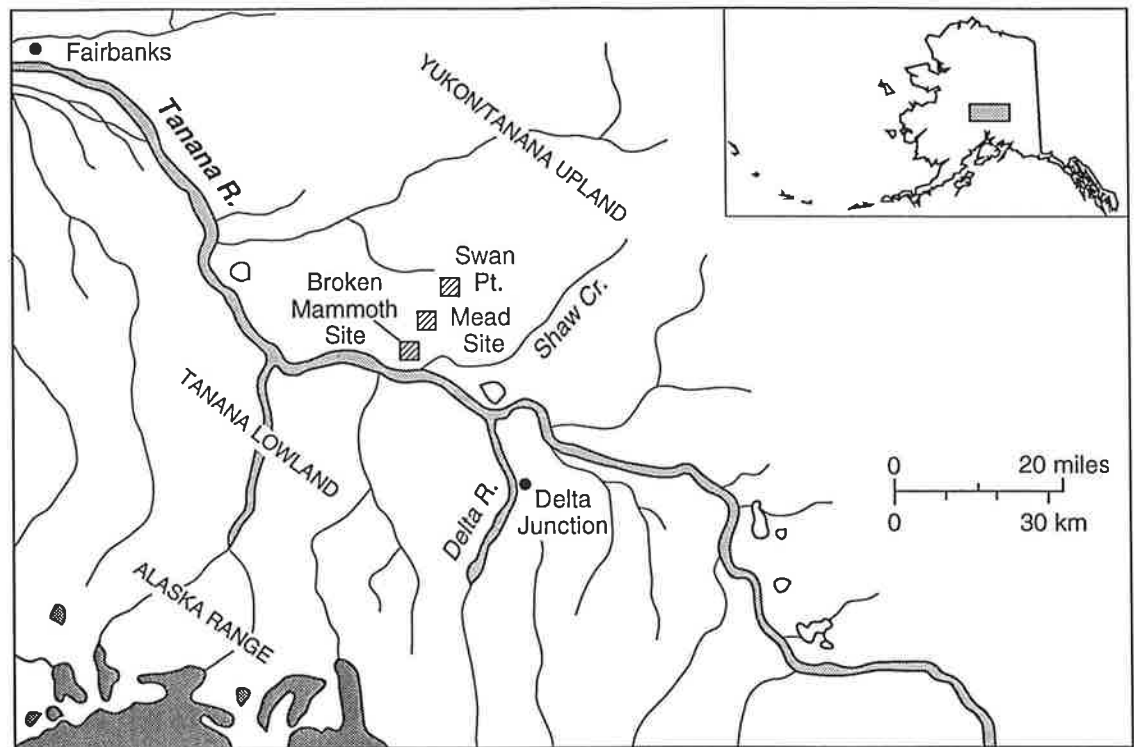
The stratigraphy at the Broken Mammoth, Mead and other sites in the Shaw Creek region consists of a series of sand and loess sediments overlying frost-shattered and weathered bedrock. The sediments and soils at the sites contain a record of past environmental changes in east-central Alaska. For example, the Broken Mammoth stratigraphy documents the change from a glacial environment at the close of the Pleistocene to one of alternating episodes of aeolian deposition and soil formation during the Holocene.

Thirteen radiocarbon dates on charcoal are available for the four cultural zones at the Broken Mammoth Site. Cultural Zone 1, the youngest, is associated with dates between 2,000 and 4,700 years ago. Charcoal from a large hearth feature defining Cultural Zone 2 yielded dates between

Studying these sites is like focusing a microscope on small slices of time taken from a tiny piece of the globe.

Office of History and Archaeology and the University of Alaska–Anchorage. It was designed to answer basic questions critical for evaluating the significance and research potential of the site. About 6% (54 m²) of the site area was excavated in 1990 to define the site limits, locate artifact

Location of the
Broken Mammoth,
Mead and Swan Point
archeological sites.



7,200 and 7,600 years ago. Cultural Zone 3, which is associated with the middle paleosol complex, has provided dates between 9,300 and 10,300 years ago. The oldest cultural material, Cultural Zone 4, is associated with the lower paleosol complex. Radiocarbon dates for Cultural Zone 4 are between 11,000 and 11,800 years ago.

One of the distinctive characteristics of the Broken Mammoth Site is the well-preserved faunal remains associated with Cultural Zones 2, 3 and 4 (Cultural Zone 1 has yielded relatively few bone fragments). Cultural Zone 2 produced a substantial amount of faunal remains associated with a large hearth. Cultural Zones 3 and 4 appear to be similar in faunal composition. Both mammal and bird remains are well represented, particularly in the lower paleosol complexes.

The abundant evidence of waterfowl (swans, geese and ducks) suggests that modern avian flyways through the Alaska Range had become established by the time the Broken Mammoth Site was occupied around 12,000 years ago. The prevalence of waterfowl further suggests that this nearby food resource may have been a key factor in attracting human populations to the site during the spring or fall. The presence of eggshell fragments indicates a spring occupation.

Identifiable large ungulate bones, many with spiral fractures, suggest that bison and elk were of considerable economic importance. These herd animals would have represented a concentrated, storable biomass essential to the well-being of Late Pleistocene hunters. These species indicate

climatic conditions and habitat comparable to the modern northwestern Plains, particularly semi-forested regions in higher-altitude environments. The presence of a small camelid appears to corroborate the idea of open parkland conditions capable of supporting entire herds.

The paleosol complexes associated with Cultural Zones 3 and 4, indicative of stable occupation surfaces, correlate with the latter part of the Birch Period (an open shrubland that included dwarf birch and willow) and the *Populus-Salix* Zone (open poplar woodland and birch-shrub tundra). After about 9000 years ago, this shrubland changed to a woodland that included spruce and alder species. Red squirrel and porcupine remains from Cultural Zone 3 suggest that this process may have begun by 9500 years ago. Shortly thereafter, windier conditions may have become reestablished, as loess accumulation appears to have accelerated until after 7500 years ago. Following that period, more modern conditions appear to have prevailed, with the modern forest soil established sometime after 5000 years ago.

Tusk fragments found at three sites indicate that mammoth ivory was available to human populations in the region in the Late Pleistocene and Early Holocene. Thus far, no postcranial remains of mammoth have been found. It may be that ivory, along with hide and meat, was obtained at kill sites located away from the blufftop campsites and brought back to camp for use as raw material. This circumstantial evidence suggests that mammoth and humans coexisted.

Uncovering geese bones next to a hearth dated to 11,700 years ago in Cultural Zone 4.



Preliminary examination of flotation samples indicates the presence of plant macrofossils, insects and mammal hairs. Initial pollen scans indicate that, although pollen is present in the loess, the pollen may be too poorly preserved to be of analytic value.

A number of former hearths were uncovered during the 1990 and 1991 excavations. A shallow lenticular pit hearth was excavated in Cultural Zone 1 associated with a few flakes and obsidian microblades. The artifact distribution in Cultural Zone 1 suggests that the area of occupation was near the bluff edge. Cultural Zone 2 consists of a large hearth smear (with some evidence for hearth stones) suggestive of multiple fires built on the former ground surface in a radius of about 4 m. Cultural Zone 2 appears to be restricted to the northern area of the site away from the former bluff face. At least two large hearth smears with associated hearth stones, similar to Cultural Zone 2, were uncovered in Cultural Zone 3. Lithics and fauna were scattered around and in the hearths. Similarly two large hearth smears were also excavated for Cultural Zone 4. The artifact, fauna and hearth distributions for both Cultural Zones 3 and 4 indicate occupation near the bluff edge, more so than for Cultural Zone 1.

Several lithologies (rhyolite, chalcedony, chert, basalt, obsidian) are represented in the Cultural Zone 1 assemblage. Artifacts include retouched flakes, endscrapers, sidescrapers, point fragments, flake burins, burin spalls, microblades and small wedge-shaped microblade cores. Thus far, only a few flakes (some are retouched), fire-broken rocks and hearth stones have been recovered in Cultural Zone 2. There are several tool correspondences

with both the Denali Complex and also with the Northern Archaic Tradition.

Artifacts found in Cultural Zone 3 include numerous tiny flakes, a few retouched flakes, large biface fragments, small point fragments, hammers and anvils. Two chert points, reminiscent of paleoindian types, are thin lenticular in cross section and have concave bases with basal edge grinding. Cultural Zone 4 has produced chipping detritus of rhyolite, basalt, obsidian, chert and quartzite. Only a few retouched flakes and one sidescraper can be called tools. The presence of biface thinning flakes indicates that bifacial tools were part of the tool kit. It is perhaps noteworthy that there is no evidence of a microblade industry in either Cultural Zone 3 or 4 artifact assemblages. However, because the tool inventories for these earliest assemblages are quite meager (thus far), very little can be said about cultural affiliations.

Several ivory tusk fragments (associated with either Cultural Zone 3 or 4) have scratches that could have been produced by stone tools. There are two sizes of scratches, a narrow set approximately 1 mm across and a wider set about 3 mm across. One tusk piece has a stone microchip embedded in one of the wide scratch channels. Experimentation with a flake burin suggests that a tiny chip broken away during the ivory grooving process became embedded in the channel.

The analysis of these data will provide a sharper focus on some of the subtle climatic and environmental changes that can be seen only grossly by looking at, for instance, pollen data or mammalian remains. Typically an archaeological site does not have all the pieces of information necessary for environmental reconstruction and consequently

Economically important fauna from the Broken Mammoth Site.				
Species	Cultural Zone			
Bison	1	2	3	4
Elk (wapiti)	—	—	3	—
Mammoth	—	—	3/4	—
Caribou	—	2	—	—
Dall sheep	—	—	3	—
Camelid	—	—	3	—
Beaver	—	2	—	—
Arctic fox	—	—	—	4
River otter	—	—	3/4	—
Porcupine	—	—	3	—
Hare	—	—	—	4
Marmot	—	—	3	4
Ground squirrel	—	—	3	4
Red squirrel	—	—	3	—
Swans	—	—	3	4
Geese	—	—	3	4
Ducks	—	—	3	4
Ptarmigan	—	—	3	4
Fish	—	—	3/4	—

the interpretation must rely on regional data pooled from areas away from the site. The resulting bigger picture misses any subtle localized changes. Fossil assemblages (for example, mammal and pollen) often are not precisely dated and can only provide a

general picture, but dating of sites with human occupations containing campfire charcoal can be more precise. Environmentally sensitive archaeological sites such as these, which have documented human activities, preserved fauna and stratified sediments, help to refine the local picture. Therefore, all the indices (pollen, faunal, etc.) are being brought together to better understand a small piece of the regional picture. Studying these sites is like focusing a microscope on small slices of time taken from a tiny piece of the globe. It will help refine interpretations of human interactions and adaptations during worldwide climatic fluctuations.

The data provide a picture of small, highly mobile groups whose strategy for survival was to move around seasonally to exploit various resources such as caribou in the fall and migratory waterfowl in the spring. These people were highly knowledgeable about the environment and the animals they hunted. The evidence suggests that mammoths were a part of their resource base. The resources being exploited were changing during that period, and the human populations were adapting with new technologies, such as changes to projectile point forms.

Data collection continued during the 1992 field season at the Broken Mammoth, Mead and the Swan Point sites.

Student excavating a metacarpal (identified as elk) from the occupation layer in Cultural Zone 3, which dates between 9,300 and 10,300 years ago.



Reconstructing Temperature History from Tree Rings in Northwestern Alaska

LISA J. GRAUMLICH AND S. CRAIG GERLACH

Tree rings contain information on past climates, providing clues to global and regional climate change. Understanding tree ring data from northwestern Alaska will help provide a basis for interpreting changes in aboriginal land and resource uses over the last 1000 years.

Lisa J. Graumlich is Assistant Professor of Dendrochronology at the Laboratory of Tree-Ring Research, University of Arizona; and S. Craig Gerlach is Assistant Professor of Anthropology and Quaternary Science at the University of Alaska-Fairbanks.

Since the annual growth rings of trees reflect the year-to-year variations in growing conditions, the rings form distinctive patterns. Studies of these patterns, called dendrochronology, can be used to date pieces of wood and the structures and artifacts associated with them.

In the 1940s and 1950s J. Louis Giddings, a pioneering Alaskan archaeologist and dendrochronologist, used tree-ring dating to establish a 1000-year chronology for the Arctic Woodland Culture in northwestern Alaska. By cross-dating samples from house timbers, Giddings documented the timing of village establishment and abandonment for numerous late-prehistoric archaeological sites along roughly a 200-mile stretch of the Kobuk River. The artifact sequences found in association with these house sites provided a rich opportunity for Giddings and those who followed him to examine the causes and consequences of cultural stability and change in this part of northwestern Alaska. Although Giddings was interested primarily in using tree-ring data to establish a chronology and

to resolve the dating problems that plagued Arctic archaeology, his data are equally rich and relatively unexplored for reconstructing past climates. Even though these data were collected roughly fifty years ago, recent reanalysis of the Giddings material shows how archaeological data may be used to independently generate and corroborate climatic data.

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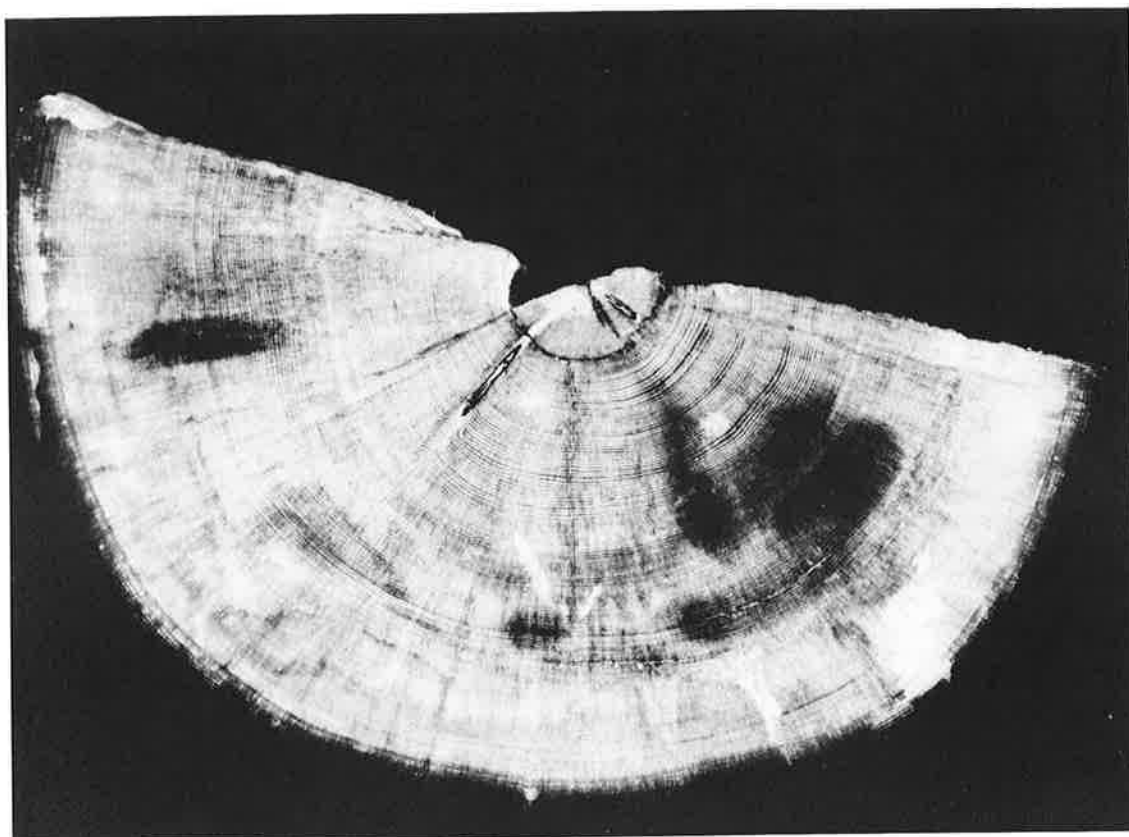
Treeline sampling site near Kobuk, Alaska. Cores from living trees were obtained from sites ranging from elevational treeline to the river valley.



In 1991, with funding from the National Science Foundation, a project involving the University of Arizona and the University of Alaska began to establish a chronologic and climatic basis for modeling human responses to late Holocene climatic change in the western Arctic. The first phase of the project has been to develop quantitative reconstructions of temperature variation based in large part on analyses of Giddings' tree-ring samples. Deriving a quantitative estimate of past climate from the archaeological samples requires a model of climatic effects on tree-growth based on modern data, as well as an adequate sample of prehistoric wood to ensure that the estimates, based on the average growth of a number of samples, are not biased by what may be the anomalous behavior of a small number of specimens.

During the summer of 1991 the researchers sampled spruce trees growing along the Kobuk River at seven sites located at or near Giddings' archaeological sites. A comparison of the annual growth indices with meteorological data recorded

Cross section of a house timber from Ekseavik, Alaska. The ring sequence extends from AD 1126 to 1375. Each ring is dated to the exact calendar year and measured to the nearest 0.01 mm.



at Fairbanks for 1908–1991 showed significant positive correlations between average June and July temperatures and annual growth. This relationship was true not only for trees within a site but also among sites. These results imply that the archaeological materials should reveal a similarly strong correlation to regional temperature.

A large number of the archaeological wood specimens collected by Giddings are now archived at the University of Arizona and have been reanalyzed for this project. Contemporary tree cores

the record still requires caution in interpretation. Cultural and economic changes from Ahteut (about AD 1250) through Ekseavik (about AD 1400) to Ambler Island (about AD 1750) reveal subtle differences in how land and subsistence resources were used by Native populations in the Kobuk River Valley.

The archaeological record of the Kobuk River Valley documents human response to variability in the environment through the seasonal use of available resources. The Arctic Woodland Culture contains a core of basic artifactual and technological traits that appeared stable for roughly 700 years. However, the relative emphasis on subsistence resources, specifically caribou, salmon, other river fish and small seals, changes through time and across space from the lower to the upper river. Human harvest strategies have adjusted to fluctuations in both long- and short-term cycles of abundance over the past thousand years or so. The flexible use of a variety of animals and plants by the Kobuk River people provides a buffer against scarcity in any one population of subsistence resources. What is not so obvious at present is how caribou and salmon, the primary subsistence resources in the region, respond to minor changes in the weather, particularly warming trends. Recent studies in Alaska show that a series of warm and dry summers, for example, result in changes in the chemistry of Arctic vegetation in ways that may

The climate–growth model is being applied to the prehistoric part of the record to estimate the variation in summer temperatures over long periods of time; when complete, this reconstruction will be one of the longest annually resolved temperature records for the western Arctic.

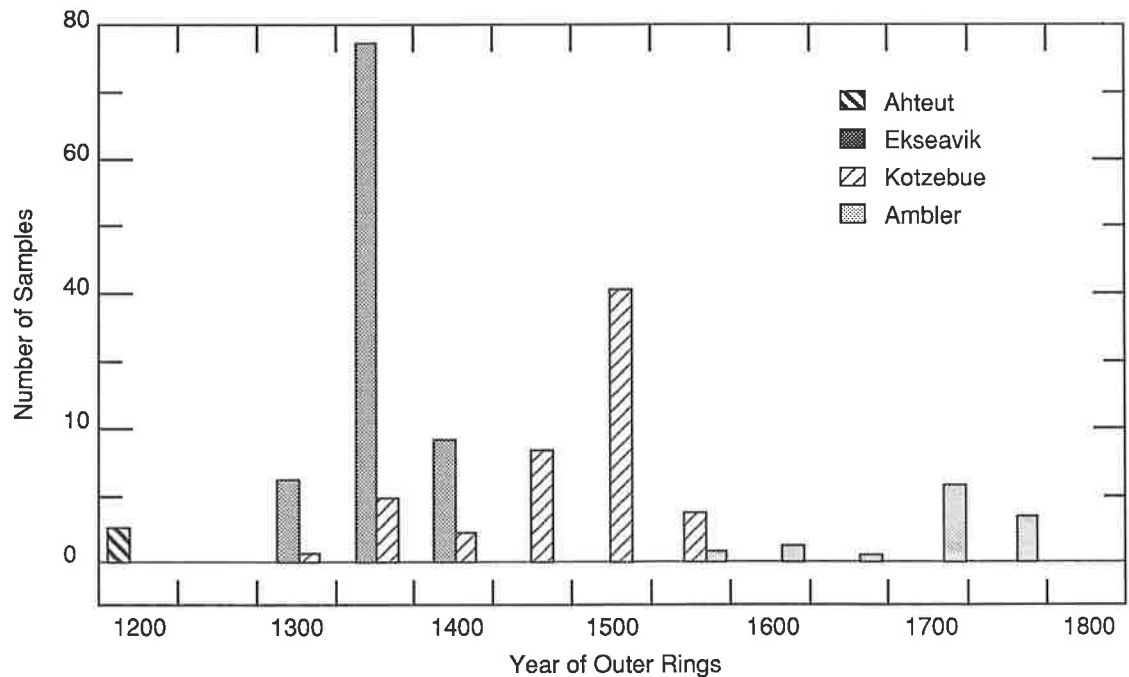
from spruce extend back into the 1700s, where they overlap with Giddings' Ambler Island specimens; the record now extends back into the 1600s. Similarly, successive overlapping chronologies with Kotzebue, Ekseavik and Ahteut samples provide a well-replicated chronology back to the early 1300s. The oldest samples date to AD 977, although the small sample size of this early part of

negatively affect the forage resources of wildlife and stream invertebrates. What is still important for the Kobuk River area is to understand how minor shifts in settlement and subsistence of the indigenous people were influenced by minor shifts in the distribution of animal resources as a result of changes in weather and climate.

The climate-growth model is now being applied to the prehistoric part of the record to estimate the variation in summer temperatures over relatively long periods of time. When complete, this reconstruction will be one of the longest annually resolved temperature records for the west-

ern Arctic. These data are potentially important for understanding the human ecology of the region, since severe winters, prolonged droughts, periods of increased storminess and temperature-related physiological stresses all have profound effects on plant-animal interactions and on the people who depend on those plants and animals. In combination with precipitation reconstructions, the temperature records provide a framework for evaluating the relationship between long-term temperature changes and aboriginal land and resource use, as well as the potential consequences of future warming for contemporary subsistence patterns.

Number of specimens for sites in the Kobuk River Valley. Each individual tree-ring sequence spans 150–350 years, so the samples within a site and among sites overlap. The large sample size adds to the reliability of the paleoclimatic reconstructions.



New Light on Nutrition and the Peopling of the New World

WILLIAM LEONARD, MICHAEL CRAWFORD, ANTHONY COMUZZIE AND REM SUKERNIK

This anthropological study of the Evenki reindeer herders of central Siberia provides new clues about the origins of the Indians and Eskimos of the New World, suggesting that the American Indians separated from the Siberians more than 30,000 years ago. The study has also provided evidence that exercise may be as important as diet for maintaining low cholesterol levels.

William Leonard is Assistant Professor at the School of Human Biology, University of Guelph, Ontario, Canada; Michael Crawford is Professor of Anthropology and Anthony Comuzzie is Graduate Research Assistant, both with the Laboratory of Biological Anthropology, University of Kansas, Lawrence; and Rem Sukernik is Director of the Molecular Genetics Laboratory, Siberian Branch of the Russian Academy of Science, Novosibirsk.

Although much research has been conducted on human populations from the Arctic and Subarctic regions of Europe and North America, less is known about the biology of indigenous Siberian groups. In 1991 a team of U.S., Canadian and Russian researchers, with funding from the National Science Foundation, the U.S. Man and the Biosphere Program and the Natural Sciences and Engineering Research Council of Canada, began the first detailed study of the biology of an indigenous Siberian population. This ongoing research project is examining the ecology, health and genetic diversity of the Evenki, a Tungusic-speaking group of reindeer herders whose settlements are distributed over the taiga of central Siberia.

The biological and cultural origins of the Evenki are unclear. It appears likely, however, that the Evenki were once reindeer hunters who, over time, adopted a breeding and herding subsistence. Until the 1930s the Evenki remained socially organized into named, extended family lineages that served as herding units. During Stalinist times they were forcibly reorganized into cooperative settlements and herder groups called brigades. In 1989 the total population of the Evenki was 29,975; this represented a 10% increase since

1979. About 80% of the Evenki resided in rural areas in 1989, about the same as in the previous decade.

During the 1991 field season the field team studied two Evenki settlements (Surinda and Poligus) and six of their associated brigades. Body measurements, blood and hair samples, and color-blindness assessments were taken on a sample of over 200 individuals, and interviews were used to collect demographic and dietary data. These data will shed light on how recent changes in Siberia are influencing the genetic diversity, demographic structure, health and nutrition of the Evenki.

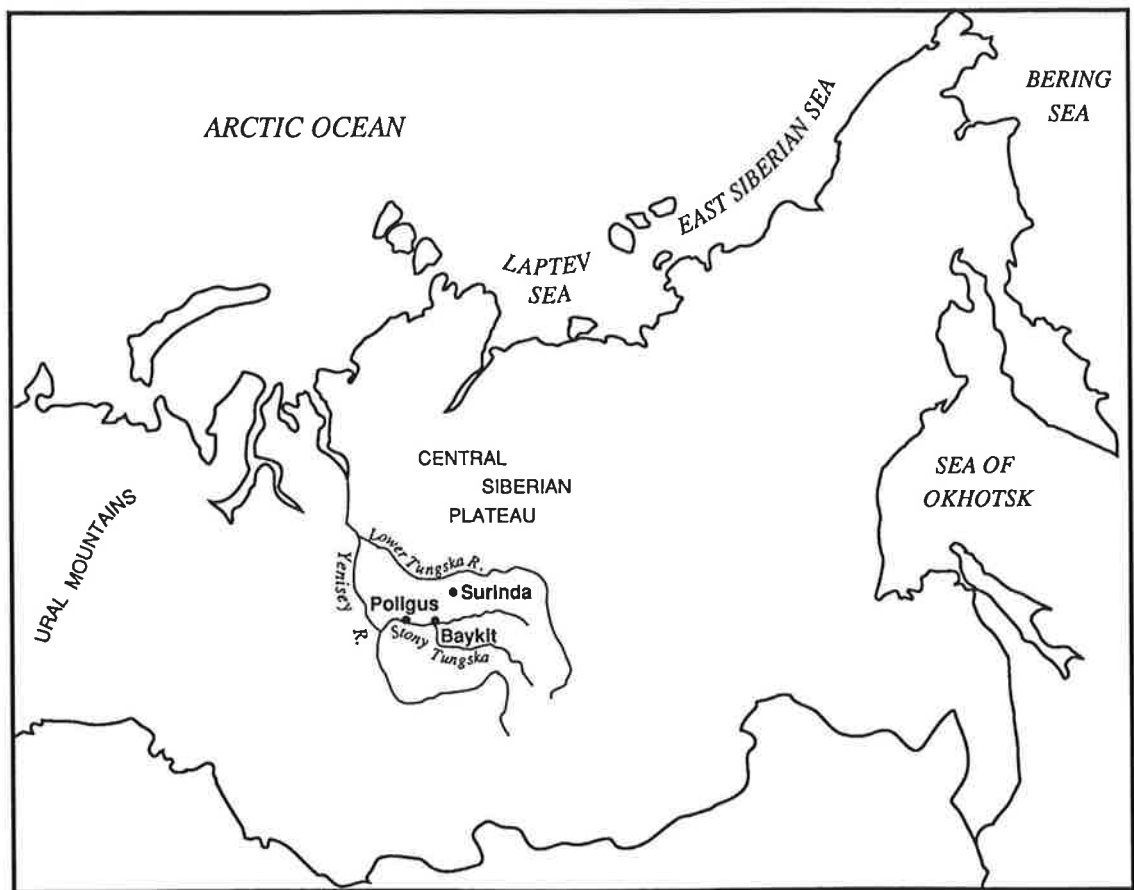
Diet and Nutritional Status

The Evenki diet is based heavily on reindeer products and is therefore relatively high in both protein and fat. During the summer, animal products such as meat, fish, butter and milk comprise 35–40% of their energy intake. The remaining 60–65% comes from foraged vegetable foods (such as wild berries, pine nuts and mushrooms) and market foods (such as flour, sugar, rice and noodles). The average daily energy intake among the adult Evenki appears to be about 2400 calories. According to the World Health Organization's most recent recommendations (1985), this is enough energy to support a moderately active individual of the Evenki's body size. With the heavy work demands placed on the more traditional Evenki during certain times of the year (for example, moving camp and constructing fences to contain the reindeer), it is likely that the Evenki experience seasonal energy deficits.

Such energetic constraints provide a partial explanation for the Evenki's small adult body size and distinctive growth patterns. Evenki men are, on average 5 feet 2 inches tall and weigh 125

Russian researcher with an Evenki family near the village of Surinda. The structure in the background is a traditional Evenki dwelling, called a chum.





Locations of the Evenki villages of Surinda and Poligus within central Siberia.

pounds, while the women average only about 4 feet 10 inches tall and 116 pounds. Thus, compared to U.S. reference standards, Evenki men fall below the fifth percentile for both stature and weight (about 7 inches shorter and 40 pounds lighter than the average U.S. male), whereas Evenki women fall below the fifth percentile for stature and between the 10th and 15th percentiles for weight (about 5 inches shorter and 24 pounds lighter than their U.S. counterparts). Despite their diminutive adult size, the Evenki are not particularly small at birth. Rather, it appears that their small adult size is achieved through slow growth during late childhood and adolescence. Such a pattern strongly suggests that environmental factors (such as cold and nutritional stress) are shaping the growth of body size in the Evenki.

Unlike in Western populations, meat consumption does not appear to be a strong predictor of cholesterol levels within the Evenki.

The cholesterol and triglyceride profiles of the Evenki are also intriguing. Despite their high consumption of animal products, the Evenki have low blood lipid levels compared to Western popula-

tions. Their total cholesterol averages 141 mg/dL for men and 148 mg/dL for women, with the ratio of total cholesterol to high-density lipoproteins (HDL, or "good" cholesterol) being favorable (2.99 for males and 3.15 for females). Evenki cholesterol levels are also low compared to other indigenous Arctic populations. For example, the total cholesterol levels of the Wainwright Inuit have been found to be 187 mg/dL for men and 205 mg/dL for women, and mean cholesterol levels of 183 mg/dL have been measured for a sample from the Chukotka region of northeastern Russia.

The level of acculturation is an important correlate of blood lipid levels. The more acculturated "village-living" Evenki have higher cholesterol levels than those living in the rural areas (156 vs 135 mg/dL for men; 151 vs 142 mg/dL for women). This trend is particularly interesting because village residents appear to eat far less meat (particularly reindeer meat) than the more "traditional" Evenki. Thus, unlike in Western populations, meat consumption does not appear to be a strong predictor of cholesterol levels within the Evenki. Instead, the reduction in activity associated with acculturation may be the most important "lifestyle" influence on serum lipid levels. Research during the 1992 field season addressed this issue by directly monitoring energy intake and expenditure.

Mitochondrial DNA

Mitochondrial DNA (mtDNA) has been widely used to reconstruct the evolutionary history of our species. Mitochondria are cellular bodies outside the nucleus that produce energy for the cell, and the DNA they contain is well suited for tracing the relationships between divergent populations such as the Siberian and New World because:

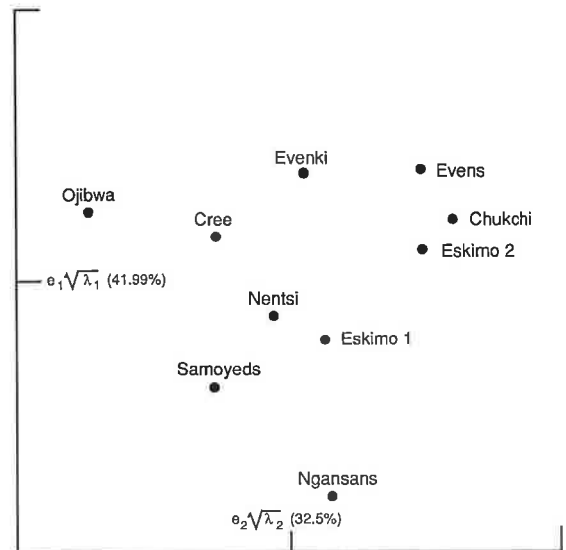
- It is primarily maternal in transmission and thus does not experience the reshuffling as with paternal genes;
- The absence of a repair mechanism in mtDNA allows sequential mutations to accumulate at an exceptionally high rate (up to 10 times as high as in nuclear DNA); and
- These mutations apparently accumulate at a constant rate.

Thus, mtDNA represents a molecular clock that can be used to measure the time of divergence of Siberian and Amerindian groups.

Three interesting findings were revealed by the mtDNA analyses of a series of New World and Siberian populations (done in collaboration with Douglas Wallace and Antonio Torroni of Emory University). The mtDNA characteristics shared by both the Siberians and Amerindians suggest a divergence date of between 35,000 and 44,000 years ago. The more conservative archeologically and linguistically established dogma is that the New World was peopled after the last glaciation, 12,000 to 14,000 years ago. Similarly a recent interpretation, known as the "tripartite consensus," assumes that there were three post-glacial migrations from Siberia into the New World. The Evenki data suggest that there were at least four separate population movements into the New World; these data support a similar conclusion based on gamma globulin variation in the New World and Siberia.

Research on Siberian indigenous populations (with a long evolutionary history in the Arctic) will help resolve some of the critical problems concerning human adaptation in the Far North.

The third finding is somewhat perplexing but highly significant for the interpretation of the peopling of the New World. It is based upon the presence or absence of a characteristic of mtDNA known as the Asian-specific 9bp deletion. One study concluded that this deletion was absent in Siberian populations except for three individuals from the Altai region of southcentral Siberia and that it was also absent in North American Atha-



Statistical measure of the genetic distances (R-matrix plot) between Siberian, Indian and Eskimo populations.

paskans, Eskimos and Aleuts. The Evenki research supports these findings. Yet, this deletion has been reported in some of the Native Americans of North and Central America, Oceania and Japan. The Asian-specific 9bp deletion is found at a frequency of 16–18% in East Asia as far north as Japan. It occurs at high frequencies in most of Oceania (including Polynesia, where it is present in 100% of the population), but this mutation is absent in Australian and highland New Guinea populations. Recent research has revealed both the presence and absence of the mutation in South American populations.

Peopling of the Americas

What do these molecular data tell us about the peopling of the New World? The most recent archeological, linguistic and molecular data strongly suggest the presence of humans in the New World more than 30,000 years ago. The earliest expansions into the Americas by people bearing the mtDNA deletion followed the coast of Asia and preceded the peopling of northern Siberia (20,000 years ago). The later expansions of Asian peoples into Siberia was by groups who had culturally and possibly biologically adapted to the Siberian tundra but lacked the Asian-specific 9bp deletion. It is still unclear whether the Eskimos and Athapaskans resulted from a single migration and the Eskimos were a maritime adaptation, while the Athapaskans were their inland extension. However, the molecular evidence is compelling that both the Eskimos and Athapaskans originated from the ancestors of current populations of northeast Siberia (who lack the Asian-specific mutation). After ex-



Typical Evenki meal, consisting of reindeer meat, rice, bread and tea with sugar.

pansion into the Siberian Arctic, the ancestors of the Eskimos and Athapaskans entered the New World across Beringia. It is possible that the Eskimos did migrate into the New World at a later date than the Athapaskans and filled in the maritime niche along northern Siberia and Alaska.

The addition of 18 New World populations and 10 Siberian indigenous groups to mtDNA analysis has supported the earlier conclusions of the existence of four DNA types, each of which was introduced into the Americas by population expansion from the coast of Asia or Siberia. These results

clearly support the conclusion that four expansions are required to explain the observed variation in gamma globulin in the New World.

Further field research in Siberia is planned for the next three years. It is hoped that the plethora of questions generated by the initial findings from the first field season will eventually be answered by additional research. Research on Siberian indigenous populations (with a long evolutionary history in the Arctic) will help resolve some of the critical problems concerning human adaptation in the Far North.

Publications

Readers may obtain further information on some of the research described in this article from the following publications:

- *The Settlement of the Americas: A Comparison of the Linguistic, Dental and Genetic Evidence*, by J. Greenberg, C.G. Turner and S.L. Zegura: *Current Anthropology*, vol. 4, pp. 477-497, 1986.
- The Biology of Circumpolar Populations*, by F.A. Milan: Cambridge University Press, Cambridge, 1980.
- Mitochondrial DNA*, by M. Stoneking and A.C. Wilson: In *The Colonization of the Pacific: A Genetic Trail* (A. Hill and S. Serjeantson, Eds.), Oxford University Press: Oxford, pp. 215-245, 1989.

Human Health Trends in the Arctic

GEORGE BRENNEMAN, JOHN MIDDAUGH, ROBERT WAINWRIGHT, BRIAN McMAHON AND DAVID TEMPLIN

Infectious diseases such as polio, diphtheria, measles and tuberculosis have had devastating effects on Native people. Efforts by Alaska and Federal health agencies have largely eradicated these diseases today. Now, Alaska Natives face new threats to human health, including diabetes, heart disease, cancer and Arctic pollution.

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In 1950 a special team sent by Congress to assess the health status of Alaska Natives reported that the situation in Alaska was a national disgrace. Extraordinary changes have taken place in Alaska and in the Arctic in the past 40 years. There have been significant reductions in life-threatening infectious diseases. Death rates, including infant mortality, have fallen to all-time lows. Only a short time ago the life expectancy of an Alaska Native was 47 years, similar to that in Ethiopia or Bangladesh today; now the life expectancy of Alaskans, especially Alaska Natives, has never been higher.

While there have been tremendous improvements in overall health status, new disease patterns have emerged. Until recently, public health and medical efforts in Alaska focused almost entirely on controlling infectious diseases, such as polio, measles, diphtheria, whooping cough, tuberculosis, streptococcal disease, rheumatic fever, botulism, bacterial meningitis, otitis media and bronchiectasis. Now chronic diseases, such as diabetes, heart disease and cancer, which were seen infrequently or not at all just 40 years ago, are common.

Arctic health research is shifting in response to these changing patterns. The Arctic Research and Policy Act of 1984 (ARPA) was a major influence in refocusing Arctic health research, and many of its recommendations have been implemented. Several Federal agencies have made significant changes in their orientation to the Arctic, particularly the Centers for Disease Control (CDC) and the Indian Health Service (IHS). The CDC has expanded its research activities in the Arctic beyond its ongoing infectious diseases program by establishing two new field offices in Alaska: the National Institute for Occupational Safety and Health, for investigating all occupational fatalities in Alaska, and the Center for Environmental Health and Injury Control, for investigating alcohol-related birth disabilities, including fetal alcohol syndrome and fetal alcohol effects.

ARPA has also improved communication and cooperation. International collaboration has increased, and the International Union for Circumpo-

lar Health has emerged as a major organization able to contribute to international Arctic health research. The State of Alaska has responded to the initiatives, and new collaborative relationships have emerged between Alaska Native health organizations, universities, state government and Federal agencies.

One of the most important benefits of the increasing attention to Arctic health research has been improvements in the relationships and communications between scientists and indigenous people. Institutional review boards have been strengthened, with an emphasis on involvement of Alaska Natives (Eskimos, Indians and Aleuts) as full partners in research studies. Funding agencies are beginning to recognize that results need to be communicated to the subjects of studies, and this will strengthen the partnerships necessary for successful future studies.

Alaska Native Health

The health and health care needs of Alaska Natives have been a primary focus of Federal health-related research in Alaska. Health status data collected in the 1940s and 1950s prompted this focus and clearly defined the need for Federal and State collaboration in conducting epidemiologic research. The changes since then have been dramatic:

- In 1950 the infant mortality rate of Alaska Natives was 101 per 1000 live births; in 1979–1980 the rate was 22.3, and in 1986–1988 it was 14.7.
- The Alaska Native death rate in 1950 was 1742 per 100,000; in 1980–1986 the rate was 726.
- The life expectancy of Alaska Natives in 1950 was 47 years; in 1986–1988 it was 68.7 years.
- In 1950 measles, whooping cough, rheumatic fever, syphilis, typhoid and polio caused many deaths; there were no deaths from these causes from 1980 to 1989.

- In 1953–1956 the annual tuberculosis (TB) mortality rate for Alaska Natives was 282 per 100,000; from 1980 to 1989 only 13 Alaskans died from TB.

Infectious diseases, primarily TB, were by far the most important causes of mortality and illness among Alaska Natives. In response to these serious problems, Federal and local health professionals started systematic epidemiologic research as first steps leading to intervention strategies. Populations with high disease rates provide an opportunity to implement innovative public health approaches and to study the effectiveness of new methods of treatment and prevention. These efforts were clearly successful.

One of the most important benefits of the increasing attention to Arctic health research has been improvements in the relationships and communications between scientists and indigenous people.

As the rates of acute infectious diseases decrease and life expectancies increase in the Alaska Native population, important demographic and social changes have become visible. New or previously unrecognized disease patterns have emerged. These changes are reflected in different directions and emphases in health-related research. For example, during the height of the TB epidemic in Alaska, some health professionals made anecdotal comments that Alaska Natives have no or low rates of cancer. But current data show age-adjusted cancer mortality rates of 167 deaths per 100,000 population among Alaska Natives, compared to 132.9 for the total U.S. population.

Arctic residents, and particularly Alaska Natives, are experiencing an alarming rise in the incidence of tobacco-caused cancer. In 1950 there were six deaths in Alaska from lung cancer; in 1988 there were 143. In 1950 only one Alaska Native died from lung cancer; from 1980 to 1989, 24 Alaska Native deaths each year were attributed to lung cancer. In 1950 the death rate from lung cancer was 5.6 per 100,000 population; the rate is now 89 per 100,000. As the use of smokeless tobacco has increased, more oral cancers in teenagers have been identified.

An investigation during 1983–1986 of a cluster of ten cancer cases in a remote Alaskan village of 207 residents found that seven residents diagnosed with lung cancer had significant exposure to cigarettes. Although villagers believed cigarettes were an important cause of cancer, many strongly believed the cancers were due to environmental causes, such as chemical contamination of drinking

water (for example, fluoride and chlorine), radioactive fallout from atmospheric weapons testing, changing from a traditional to a “Western” diet, indoor air pollution (including radon) and depletion of the ozone layer.

There are many other examples of the changing health patterns:

- The mortality rate in 1986–1988 due to injuries among Alaska Natives was 328 per 100,000, compared to 34.6 for the total U.S. population.
- The age-adjusted alcoholism mortality rate for 1986–1988 among Alaska Natives was 22.5 per 100,000, compared to 6.0 for the total U.S. population.
- The age-adjusted homicide and suicide rates in 1986–1988 for Alaska Natives were 15.5 and 32.4 per 100,000, compared to 8.6 and 11.7 for the total U.S. population.
- The estimated fetal alcohol syndrome rate among Alaska Natives is around 4.0 per 1000 live births; this rate is two to four times the estimated general rates.

The data illustrate the alarming trends in what may be referred to as “the new morbidity and mortality.” The fight against infectious diseases has been turned around, and new risk factors—those found in conjunction with rapid social change—have emerged. New technology and western lifestyles have entered into village life. Although many of these are important parts of modern society, others leave an extremely high burden on human health. Health research in the Arctic must meet these new needs.

Specific Health Problems

Tuberculosis

In 1946 TB was listed as the cause of death on 43% of Alaskan death certificates. From 1980 to 1989, only 13 of 19,820 deaths of Alaskans were due to TB. This significant decrease resulted from collaborative actions by the U.S. Public Health Service (USPHS) and the State of Alaska. In this collaboration the State of Alaska provided preventive services (TB control and surveillance), and the agencies of the USPHS provided hospital and clinic medical services and conducted basic epidemiologic research. Of particular importance in the reduction of TB mortality and morbidity and the spread of TB in Alaska Native communities was the use of antituberculosis chemotherapy, first available in the late 1940s and early 1950s. One of these antituberculosis drugs, Isoniazid (INH), quickly became one of the safest and most effec-

tive chemotherapeutic agents and was widely used to treat patients with active TB.

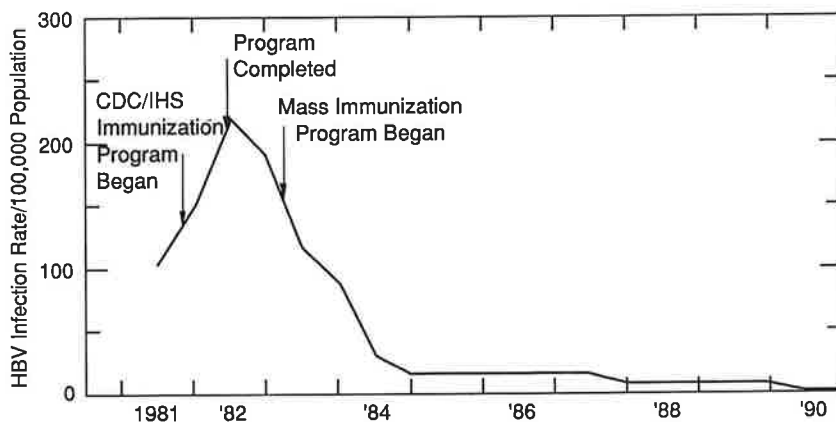
In classic epidemiologic research between 1949 and 1960 conducted cooperatively by three agencies in the USPHS (the Division of Indian Health [now the IHS], the Tuberculosis Branch and the Arctic Health Research Center) and the Alaska Department of Health and Welfare, extremely high rates of TB among Alaska Natives were documented:

- Tuberculin testing in 1948–1951 showed that 32–75% of Alaska Native children were infected with TB.
- From 1953 to 1956 the annual TB mortality rate for Alaska Natives was 282 per 100,000 population.
- In 1955 over 1000 Alaska Natives were hospitalized for the treatment of TB.

Based on these stark findings, the use of INH on a community basis was proposed. Studies to evaluate the effectiveness of INH in the prevention of TB, supported by the three USPHS agencies and the Alaska Department of Health and Welfare, were conducted from 1957 to 1959 in selected Alaska Native villages in the Yukon–Kuskokwim Delta. Over 7000 Native subjects from this region participated in a carefully controlled efficacy trial. The results were impressive: in the group receiving a placebo, 1.36% of the individuals developed TB, in contrast to 0.43% in the INH group, a 68% reduction in the incidence of TB. These findings led to the worldwide use of INH for preventing the spread of TB, and INH became an important tool in reducing the incidence of new cases of TB in Alaska Native communities.

The impact of the TB epidemic on the Alaska Native community was socially and psychologically traumatic. The social and emotional disruption resulting from this trauma would have been deeper without effective Federal and State collaboration in finding and implementing intervention methods, essentially eliminating a devastating health problem.

Incidence of symptomatic HBV infection in the Yukon–Kuskokwim area, Alaska.



Hepatitis B

A high number of cases of acute hepatitis B virus (HBV) infection among Alaska Natives led to studies involving the Indian Health Service and the Arctic Investigation Program of the Centers for Disease Control beginning in 1972. A survey of two communities in the Yukon–Kuskokwim Delta showed an overall prevalence of HBV infection of approximately 55% and a rate of hepatitis B surface antigen of 14%. There was evidence of household clustering, suggesting transmission within families. Additional studies in 1973–1975 of 12 villages in the area confirmed the high rates of HBV infection but showed a significant variation of HBV infection among villages, ranging from 5% to 70%. The study also found that about 18% of children younger than five years of age had evidence of HBV infection, and in the 10- to 19-year age group the number increased to 21%. Of those infected children younger than 12 years of age, 84% were positive for the hepatitis e antigen, which is more infectious than the surface, or s, antigen. This suggests that the children were the most recently infected and supports the hypothesis that transmission occurred in the household.

In a village study conducted in 1975, hepatitis B testing of specimens from patients and from the environment (for example, toothbrush racks, baby bottles, toys, kitchen counters and tabletops) identified the surface antigen in 1–50% of the samples. The investigators concluded that HBV infection may be transmitted to susceptible persons via body fluids and objects in the homes and schools.

A study of 1280 seronegative persons from eight villages, conducted between 1972 and 1976, showed that transmission was highest in young children, less than 10% of whom had symptoms of hepatitis. In addition, children infected under the age of five had a greater than 30% risk of becoming chronic surface antigen carriers. Perinatal transmission played only a minor role in the transmission of HBV, as most pregnant women who were positive for the surface antigen were not positive for the more infectious e antigen. Also, epidemiologic studies showed that Alaska Eskimos had a higher rate of life-threatening complications due to chronic hepatitis B infection.

In 1981 a hepatitis B vaccine demonstration project was initiated among Eskimos in the Yukon–Kuskokwim Delta to demonstrate that the newly licensed vaccine would induce protective levels of HBV antibody and prevent HBV infections among all age groups in this high-risk population and that the vaccine could be administered in remote, scattered communities under field con-

ditions. Laboratory tests performed on sera collected in May 1981 from 3988 residents of 17 remote Eskimo villages revealed that 2645 (66.3%) had no evidence of HBV infection. Because of a limited supply of vaccine, specific criteria for selection were used so that those at highest risk of infection would be immunized first. In November 1981 the first dose of vaccine was administered to 1693 carefully selected seronegative individuals; over 95% received all three doses of vaccine. The study indicated that the vaccine was safe (less than 0.5% experienced minor adverse reactions) and immunogenic (97% developed antibodies). Vaccine-induced antibody levels were significantly higher for persons less than 30 years of age and for females. Vaccine recipients were protected from HBV infection.

Follow-up studies of this group demonstrated the continuing protection provided by the vaccine. Eight years after receiving the first vaccine dose, 74% of those initially responding to the vaccine still had high levels of anti-surface-antigen antibodies. Only eight individuals showed serologic evidence of HBV infection, and none were positive for the surface antigen. None of the eight had symptoms of hepatitis B. In this study group the preimmunization annual incidence rate for HBV infection was 50 cases per 1000 population. Eight years after the first vaccine dose, the rate had declined to 0.85 cases per 1000 population.

The fight against infectious diseases has been turned around, and new risk factors—those found in conjunction with rapid social change—have emerged.

This research led to the development and implementation of an HBV prevention program with the following steps:

- Screen all Alaska Natives and immunize all susceptible individuals;
- Immunize all Alaska Native infants beginning at birth;
- Screen all pregnant Alaska Native women and give vaccine and administer an immune globulin to the newborns of all surface- or e-antigen-positive mothers; and
- Test all surface-antigen-positive Alaska Natives twice yearly for alpha-fetoprotein (AFP) to detect primary hepatocellular carcinoma (PHC) at an early stage. (A sharp rise in the serum levels of AFP can be detected when PHC is in the very early stages, before it can be detected by special radiologic or physical examination techniques.)

The implementation of these public health measures through the collaborative efforts of the IHS, the Alaska Division of Public Health and the Arctic Investigations Program (AIP) of the CDC has proven successful and has led to a statewide primary and secondary HBV control program for the Alaska Native population. This program includes primary prevention by HBV immunization of adults and infants and secondary prevention of PHC by AFP screening among surface-antigen carriers. The results of the intervention program have been dramatic. In the Yukon-Kuskokwim Delta, one of the areas of highest transmission, the annual incidence rate of symptomatic hepatitis B infection has declined from 214 per 100,000 population prior to the immunization program to no reported cases in the past year.

These programs have served as models for similar programs in other areas of the world where the incidence of HBV is high. Also, data from this research have been used in justifying a national program for universal HBV immunization.

Bacterial Meningitis Due to Haemophilus Influenzae Type B

In the United States the leading cause of bacterial meningitis among infants (birth to 11 months of age) is *Haemophilus influenzae* type b (Hib). Meningitis is inflammation of the tissue covering the surface of the brain. Other invasive diseases in young children caused by this organism include septic arthritis, pneumonia and septicemia. Every year in the United States around 20,000 children under five years of age have one of these serious Hib infections.

For many years clinicians serving in the IHS in Alaska reported high rates of invasive Hib diseases among Alaska Native infants. Of those diseases, meningitis due to Hib was observed to be a leading cause of mental retardation in this population. Studies supported by the IHS, the AIP and the Harbor-UCLA Medical Center described high rates and unique characteristics of Hib disease among Alaska Natives and non-Natives. The incidence rates of invasive Hib diseases among Alaska Eskimo and Indian children under five years of age were found to be 705 and 401 cases per 100,000 children of those ages. The rate among non-Native children was 129 per 100,000. For Alaska Natives the cumulative Hib disease risk for the first two years of life averaged 4%. Alaska Native infants also experienced this high risk earlier in infancy.

Until 1984 the available Hib vaccines were ineffective when administered to children under 18 months of age. Through a new technology, several

potent vaccines, known as conjugate Hib vaccines, were developed and tested. After appropriate safety testing in adults and older children, these new vaccines were approved by the Federal Drug Administration for large-scale efficacy trials in infants.

In 1984 the National Institutes of Health funded Harbor-UCLA Medical Center to conduct, in collaboration with the IHS and CDC, a vaccine efficacy trial using a new conjugate Hib vaccine in the high-risk Alaska Native infant population. In this double-blind and placebo-controlled trial, vaccine and placebo, in random distribution, were administered at two, four and six months of age to approximately 2000 infants. When the trial ended in 1988 and the blinding was revealed, it was found that the vaccine failed to show sufficient protective efficacy against invasive Hib disease. Subsequent efficacy trials, conducted elsewhere using other conjugate vaccines, demonstrated efficacy and led to the licensing of two Hib vaccines. These new vaccines are now being used routinely in infants under one year of age.

In addition to the high rates of invasive Hib disease, Alaska Native infants experience Hib diseases at an earlier age. About 25% of the invasive disease in Alaska Native infants occurs before six months of age and, therefore, before the age when infants are given the vaccine and active immunity is established. Studies with an immune globulin in Apache Indian infants demonstrated that a specific immune globulin, bacterial polysaccharide immune globulin (BPIG), conferred passive immunity when administered to young infants and protected them from Hib infections. Although the protection was transient, it opened the possibility for use in young Alaska Native infants during the vulnerable early infancy before the time the conjugate vaccines induce lasting immunity.

In 1989 the IHS and CDC collaborated in evaluating BPIG in Alaska Eskimo infants living in the Yukon-Kuskokwim Delta. The combined use of BPIG with a licensed active Hib vaccine has resulted in a marked decrease in invasive Hib disease among children in Alaska. In the Yukon-Kuskokwim Delta the occurrence of Hib meningitis has fallen from an average of 13 cases per year to only two in 1990 and no cases in the past year.

Rheumatoid Diseases

Physicians accompanying early explorers in Alaska reported the existence of "rheumatism" among some Alaska Native populations. In more recent years Alaska health care professionals have diagnosed and treated Alaska Natives with rheu-

matoid diseases, including rheumatoid arthritis, systemic lupus erythematosus, ankylosis spondylitis, Reiter's syndrome and juvenile rheumatoid arthritis. These conditions result in chronic and recurrent musculoskeletal pain, limitation of activity, disability and serious organ damage. Although these conditions apparently had been in the Alaska Native population for many years before exposure to Western cultures, they have become more obvious and important because more Alaska Natives are living longer. Approximately 1.5% of the Alaska Native population has been diagnosed with rheumatoid disorders.

Systematic epidemiology research over the past seven to eight years on rheumatoid diseases has documented incidence and prevalence rates among selected Alaska Native groups. This collaborative research, supported by the IHS, CDC and National Institutes of Health, opens the door to additional study of the characteristics of rheumatoid disease among Alaska Natives.

These epidemiologic studies have shown several interesting findings. In a Yup'ik Eskimo study population, the prevalence, incidence and clinical features of rheumatoid arthritis were similar to those described for the general U.S. population. Arthritic changes in the vertebrae were more frequent than rheumatoid arthritis, and many could not be classified by existing disease criteria. Of the adult patients with arthritic changes in the vertebrae, only half could be classified as having Reiter's syndrome, ankylosis spondylitis or psoriatic spondylitis. The remaining patients either did not meet the diagnostic criteria of any specific disease or had characteristics of more than one. Further studies are needed to define more clearly what appear to be unique features of the rheumatoid disorders in this population.

Unique characteristics in rheumatoid diseases also have been observed among the southeast coastal Indian populations in Alaska. The prevalence and incidence rates of rheumatoid arthritis were significantly higher, and the peak age of incidence was younger in the southeast Alaska Indian population than in Alaska Eskimo groups and the general U.S. population. The prevalence of systemic lupus erythematosus in the Alaska Indian population was about twice that reported for most Caucasian populations. The frequency of spinal arthritic disorders was similar in Alaska Indian and Eskimo populations. Comparative studies of the prevalence of spondyloarthropathy have not been conducted in Caucasian populations. The prevalence rate of ankylosis spondylitis, one of the major types of vertebral arthritis, in the southeast Indians did not differ significantly from rates in predominantly Caucasian U.S. populations.

Studies are underway to more fully characterize rheumatoid disorders among Alaska Natives. The IHS and National Institutes of Health, allied with Russian rheumatologists, are now in the third year of a study looking at the prevalence, characteristics, laboratory findings and other associated features of spondyloarthropathic disease among Alaska Eskimos. This longitudinal study is expected to lead to better definition of the disease and earlier diagnosis and treatment.

Arctic Pollutants

Monitoring of marine mammals for heavy metals has found high levels of mercury and cadmium for many years. Concerns have been raised that mercury levels in subsistence foods might increase and that bioaccumulation could result in methyl mercury poisoning. In 1986 a comprehensive health risk assessment by the CDC, IHS and Alaska Department of Health and Social Services found that the heavy metals reported were not absorbed by humans consuming these foods and that marine mammal subsistence consumption should not be discouraged. However, the emotional importance following media exposure of potential pollutants is great and often prompts the need for careful study and analysis.

There is good evidence that some heavy metals have been present in the Arctic for a long time. The remarkable discovery of extremely well preserved mummies in Greenland that are 500

years old has proven to be most valuable. Among the many analysis performed, several heavy metals were measured in hair from the bodies and from the sealskin garments. Remarkably, cadmium levels found in the 500-year-old specimens were similar to those found today. Mercury levels in the mummies were less than found today but were still comparatively high. Lead levels were higher in contemporary tissues. It is essential that we learn more about these metal and chemical contaminants in the Arctic.

The question of whether chemical pollutants are part of (or are assimilated by) nature or are becoming an unacceptable burden to humans and nature underlies the Arctic Environmental Protection Strategy signed by the governments of the eight Arctic nations. In that context, an Arctic Monitoring and Analysis Program is being designed.

Publications

Readers may obtain further information on the research described in this article from the following publications:

Alaska Health Facts: State of Alaska, Department of Health and Human Services, Division of Public Health, Section of Epidemiology, July 1, 1992.

Regional Differences in Indian Health in 1991: Division of Program Statistics, Indian Health Service.

Physiological Effects of Low Temperatures

H. LESTER REED, MICHELE D'ALESSANDRO, ANTONIA LOPEZ, ROBERT L. HESSLINK, ROBERT R. HARFORD, DAVID SHURTLEFF, JOHN R. THOMAS, JOHN SCHROT AND STEPHEN T. AHLERS

Life at the high latitudes exposes people to unique environmental challenges. The human body must adapt to extended exposure to low temperatures. Physiological changes affecting performance, mood, memory and cholesterol levels have been the focus of recent research sponsored by the Department of Defense.

H. Lester Reed is with the Madigan Army Medical Center, Tacoma, WA 98431-5000; Michele D'Alessandro is with the Chemistry Department, United States Naval Academy, Annapolis, MD 21402-5026; Antonia Lopez is with the Naval School of Health Sciences, Bethesda, MD 20889-5033; Robert Hesslink is with the Naval Health Research Center, San Diego, CA 92186-5122; and Robert Harford, David Shurtleff, John Thomas, John Schrot and Stephen Ahlers are with the Naval Medical Research Institute, Thermal Stress Adaptation Program, Bethesda, MD 20889-5055.

Polar T_3 Syndrome

Temperature and photoperiod may influence seasonal changes in mood, activity patterns, dietary preferences and the incidence of heart attack and stroke. Circulating hormones that adjust to environmental conditions may influence some of the annual physiological changes. Thyroid hormones, which regulate body temperature, lipid metabolism, energy use, cardiovascular function and mood, are likely candidates for determining these responses. The most active of the thyroid hormones is triiodothyronine (T_3), which mediates the majority of the tissue responses of this hormone family.

Residents of high latitudes show increases in energy intake and T_3 uptake into the muscle and fat tissue and decreases in sensitivity to cold air and brain content of T_3 . These characteristics are collectively called the Polar T_3 Syndrome, which is probably involved with regulating body temperature, cardiovascular function and mood.

To evaluate the role of cold air in producing this syndrome, researchers from the Madigan Army Medical Center, the U.S. Naval Academy, the Naval Health Research Center and the Naval Medical Research Institute recently carried out studies using climate chambers. Sixteen men were exposed to 4°C twice a day for two months, and T_3 activity was measured. Similar experiments with free-living subjects were conducted simultaneously in McMurdo, Antarctica, and in Bethesda, Maryland, to compare the responses at high latitudes and midlatitudes with those produced during the cold chamber experiments. The last two studies were conducted for 10 and 18 consecutive months, respectively, to identify seasonal influences.

The results show that exposure to cold air initiates a rapid increase in the removal of T_3 from the blood within weeks. This process is independent of normal thyroid functioning. With 3–5 months of cold exposure, the tissue uptake of T_3 is in-

creased, and effects are apparent within the central nervous system.

Another study of the Polar T_3 Syndrome looked at the effects of Antarctic residence on the levels of blood cholesterol, T_3 and TSH (thyroid-stimulating hormone, which is produced by the pituitary gland and appears to be essential for the correct functioning of the thyroid). Blood cholesterol levels are known to reflect the effects of thyroid hormone imbalance.

The study group consisted of nine healthy members of the U.S. Navy 1989-90 annual winter-over contingent at McMurdo, Antarctica. The subjects were studied once in Port Hueneme, California, to obtain basal values for comparison with data collected during Antarctic residence. After arrival at McMurdo, Antarctica, the subjects were studied each month from December through August.

The results demonstrated that humans may have different physiological responses to the Antarctic environment. One subset of individuals experienced significant increases in serum TSH, total cholesterol and low-density lipoprotein (a form of cholesterol); a second subset of individuals displayed a substantial decrease in low-density lipoprotein and insignificant decreases in TSH and total cholesterol. These discordant findings cannot be accounted for by changes in body weight or intake of cholesterol, fat and alcohol. However, the subjects, when considered as one group, demonstrated a correlation between TSH and total cholesterol and between TSH and low-density lipoprotein with Antarctic residence. These correlations suggest a common hormonal mediator.

Increased blood cholesterol levels are causally related to an increased risk of coronary heart disease. Further investigations are therefore suggested to identify individual sensitivity and environmental mechanisms responsible for these thyroidal and lipid alterations.

Humans clearly respond both physiologically

and metabolically to polar environments and cold air experiments, but hormonal adaptation appears to vary. One may expect thyroid requirements to increase in polar regions, and those persons unable to rapidly meet these demands would display clinical symptoms of mild central nervous system hypothyroidism, such as depression, memory deficits, changes in blood pressure and alterations of mood. Clearly more research is needed to better define the physiological and psychological ramifications of the Polar T₃ Syndrome and other environmentally mediated hormone responses.

Blood Cell Changes with Cold Air Exposure

Blood cell changes during exposure to cold are important because red blood cells carry life-sustaining oxygen and because physiological expressions of these changes include a decreased shivering threshold, decreased rectal temperature and increased peripheral vasoconstriction. Whole blood hematocrits (the percentage of red blood cells) are significantly lowered during chronic cold air exposure. Hematocrits are also reported to decrease after intermittent cold exposure. Two recent studies by researchers from the Naval School of Health Sciences, the U.S. Naval Academy and the Madigan Army Health Center have measured changes in blood cell characteristics with cold adaptation during repeated experimental cold air exposure and after extended Arctic winter field operations.

Humans clearly respond both physiologically and metabolically to polar environments and cold air experiments.

In the experimental cold air acclimatization study, 16 healthy male volunteers, comparable with respect to body weight, body surface area, age and mean blood pressure, were seated motionless in a climate chamber (5°C, with a wind speed of about 2.5 m/s) for 30 minutes, twice a day, Monday through Friday, for eight weeks. Blood samples were analyzed before the experiment and after every 20 exposures.

The study of extended Arctic winter field operations used nine normal healthy members of a Navy special forces unit as subjects; all were similar with respect to age, height, weight, skinfold thickness and body surface area. Blood samples were collected in November 1989 in Virginia be-

fore exposure to cold. The men then spent 12 weeks engaged in outdoor activities for approximately five days per week in Utah (four weeks) and Anchorage, Alaska (eight weeks at -13°C). During their final ten days, they spent approximately six hours per day in the field. Blood samples were again obtained after completion of the winter operations (March 1990).

The groups in the two studies had similar changes in blood profiles. These changes appear to be a consequence of repeated cold exposure since other environmental factors were quite different. Red blood cell levels were decreased. A stable total hemoglobin content of the blood suggested that the oxygen-carrying capability of the total pool of red blood cells had not been altered; there appears to be a compensating mechanism to maintain the basal oxygen requirements at the cellular level.

Cold-Induced Memory Loss

It has long been observed that people do not perform as well in cold environments. Research conducted at the Naval Medical Research Institute (NMRI) in Bethesda, Maryland, indicates that acute cold stress impairs performance on a delayed match-to-sample (DMTS) memory task. This finding has been attributed to the effect of cold on short-term, or working, memory.

Research conducted at the Thermal Stress Adaptation Program at NMRI suggests that cold-induced performance deficits may be improved with the amino acid tyrosine. Tyrosine is found in a variety of protein foods, and it is an essential precursor for the biosynthesis of a group of hormones and neurotransmitters called catecholamines, specifically epinephrine, norepinephrine and dopamine. The rate-limiting factor for catecholamine synthesis in the brain is determined partially by tyrosine availability.

Cold-stress-induced performance deficiency may be related to a change in the release of brain norepinephrine and dopamine. The inability of brain catecholamine neurons to sustain their normal levels of release during cold exposure could result in impaired cognitive performance. During acute cold exposure, it is possible that the availability of additional tyrosine could result in continuous biosynthesis and a sustained release of brain catecholamines, which could prevent cold-stress-induced performance deficits. In fact, studies have shown that tyrosine can increase the rate at which norepinephrine is synthesized in rats during acute cold exposure.

Research conducted at NMRI with rats showed that cold disrupted DMTS memory performance. Tyrosine administration partially prevented this

deficit. Cold stress research with humans, both under controlled laboratory conditions and in conjunction with cold-weather field exercises, showed the same result.

Ongoing research with rats is examining the effects of cold stress on time perception. Acute cold exposure has been shown to impair both time production and time estimation tasks. Tyrosine administration improved time perception in a dose-dependent manner during cold exposure for both these tasks. Research continues to examine the effects of cold exposure and tyrosine administration on time perception in humans.

Research suggests that cold-induced performance deficits may be improved with the amino acid tyrosine.

To date, tyrosine has been beneficial in alleviating cold-stress-induced performance deficits in DMTS memory and time perception tasks. Additional research will determine what other aspects of performance are disrupted by cold stress as well as the effectiveness of tyrosine in reducing these performance deficits.

Publications

Readers may obtain further information about the research described in this article from the following publications:

Changes in Serum Triiodothyronine Kinetics after Prolonged Antarctic Residence: The Polar T₃ Syndrome, by H.L. Reed, E.D. Silverman, K.M.M. Shakir et al.: *Journal of Clinical Endocrinology and Metabolism*, vol. 70, p. 965-974, 1990.

Pituitary and Peripheral Hormone Responses to T₃ Administration during Antarctic Residence, by H.L. Reed, J.A. Ferriero, K.M.M. Shakir et al.: *American Journal of Physiology*, vol. 254, p. E733-E739, 1988.

Hormone Response of Normal and Intermittent Cold-Preadapted Human to Continuous Cold, by M.W. Radmonski and C. Boutelier: *Journal of Applied Physiology*, vol. 53, p. 610-616, 1982.

Hematological Parameters Are Altered During Cold Air Exposure, by M. D'Alesandro, H.L. Reed and A. Lopez: *Arctic Medical Research*, vol. 51, p. 16-22, 1992.

Commercial Fishing in Alaska

A Very Dangerous Occupation

GUNNAR KNAPP

In recent years several studies have established that commercial fishing is the highest-risk industry for occupational fatalities. The research has identified the extent and nature of fishing vessel injuries, has raised questions about the extent to which fishery management regulations affect risk-taking and high fatality rates in the industry, and has helped move commercial fishing vessel safety to the front of the policy agenda. The author's research led to an active role with the National Academy of Sciences Marine Board investigations on the issue.

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Commercial fishing in Alaska may be the most dangerous occupation in the United States. Forty-six percent of all fatalities while on the job in Alaska in 1991 were in the commercial fishing sector. On average, more than 30 fishermen (including men and women) die each year in Alaska. The fatality rate is 3–10 times higher than for other high-risk industries in Alaska and more than twenty times the average for all Alaska occupations.* In one season a Bering Sea crab fisherman may face a one in one hundred chance of dying. Many more persons are severely injured.

The dangers of commercial fishing are no secret to anyone working in the industry or living in Alaska. Newspaper accounts of fishermen swept overboard, vessels overloaded with fish, sinking boats and hair-raising rescues are commonplace.

In one season a Bering Sea crab fisherman may face a one in one hundred chance of dying.

However, the process of establishing commercial fishing safety as a public policy issue has been difficult. Calculation of the fatality rates and identification of the contributing factors in fishing vessel safety have been important in establishing fishing safety as an issue that must be addressed.

Defining the Problem

The first formal calculation of fatality rates for Alaska's fishing industry was undertaken by Knapp and Ronan, in research supported by the Alaska Sea

Grant College Program. For the years 1981–1984, based on an average of 26 fatalities per year reported by the U.S. Coast Guard, Knapp and Ronan estimated a fatality rate of 320 deaths per 100,000 years worked—compared with an average of 15 for all other Alaska industries.

A later study undertaken by the National Institute for Occupational Safety and Health (NIOSH) reviewed Alaska death certificates as a source of fatality data. The researchers found that about a third of fishing fatalities are not included in Coast Guard statistics. They estimated an even higher annual fishing fatality rate of 415 deaths per 100,000 years worked for the period 1980–1984. The earlier Knapp and Ronan study, together with these data, helped to establish the magnitude of the problem of fishing vessel safety, where previously the rate and types of fatalities were not widely known outside the fishing industry.

Some fisheries are more dangerous than others. Salmon fishing, for example, accounts for about half of all time spent in fishing but less than one-fifth of fatalities, since it takes place close to shore in summer. Crab fishing, in contrast, takes place in the fall and winter, far from shore in the stormy waters of the Bering Sea, with fishermen handling crab pots that can weigh hundreds of pounds on decks washed by waves. The crab fishery accounts for about half of all Alaska fishing fatalities but only about 15% of the time spent in fishing. This suggests that the fatality rate may be over 1,000 per 100,000 years worked.

Nonfatal injuries are also common in commercial fishing, in particular, back injuries and cuts. Injury claims filed with the state-operated Alaska Fishermen's Fund suggest that injury rates are at least as high as in other dangerous industries, such as logging.

Fishing vessel losses extract a heavy financial

* For a discussion of occupational fatalities in all Alaskan industries, see p. 62.

toll. On average, more than 40 fishing vessels are lost each year to capsizings, flooding, grounding, fires and other causes. Many lives are saved—and some lost—in dramatic and risky rescues by other fishing vessels and the U.S. Coast Guard.

Commercial Fishing Safety Regulations

Until recently, safety regulation for the United States fishing industry was minimal. There were almost no requirements for safety equipment, vessel inspection or crew training for fishing vessels operating in some of the most hazardous waters on earth.

As the dimensions and magnitude of the human and financial toll on commercial fishing became better identified, pressure for the establishment of safety regulations grew. Estimates of fishing fatality rates helped to call attention to the seriousness

will significantly improve Alaska's fishing safety record. Seventeen fishermen died in Alaska during the first six months of 1992. However, the Coast Guard estimates that at least 78 lives were saved in 1991, in many cases by equipment such as survival suits and life rafts.

The safety regulations are only one aspect of a complex problem. Equally important for fishing crew and vessel safety are the decisions made by the captain or firm, and the incentives to take risk—that is, to leave port in stormy weather, to decide against returning to port in gale-force winds, and other dangerous situations—that are influenced by fishery management regulations.

Fisheries Management and Fishing Safety

Many people view danger as inherent to the Alaska fishing industry because of the harsh natural environment in which fishing takes place. The new safety regulations are designed to make fishermen better prepared to survive this harsh natural environment. However, the dismal safety record of the industry may be encouraged by the economic, social and political environment in which fishing takes place in Alaskan waters. These "anthropogenic" factors also affect safety in the fishing industry by affecting the economic opportunities available to fishermen and the risks associated with the opportunity to fish.

Good examples are the management systems for fisheries such as halibut, sablefish and crab. The management regulations themselves may significantly aggravate the inherent risks of fishing. Halibut fishing, for instance, is limited to short, intensive "seasons" of only a few days (or part of a day) during which fishermen may work continuously for more than 24 hours, regardless of weather conditions.

The dismal safety record of the industry may be encouraged by the economic, social and political environment in which fishing takes place in Alaskan waters.

of the problem—and illustrate how a little research can go a long way in influencing public policy. The U.S. Congress passed the Commercial Fishing Industry Vessel Safety Act in 1988. The act directed the U.S. Coast Guard to develop regulations for safety equipment and operating procedures on commercial fishing vessels. New Coast Guard regulations went into effect in 1991, requiring vessels operating offshore to carry life rafts, emergency position-indicating radio beacons, survival suits for all persons on board and other emergency equipment. Monthly safety drills are also required.

It is too early to tell whether the new regulations

Estimates of Alaska fatality rates.

Industry	Period	Average annual fatalities	Estimated fatality rate*	Data sources	Study
Commercial fishing	1981–1984	26	320	Coast Guard	Knapp and Ronan
	1980–1984	33	415	Coast Guard; death certificates	Schnitzer et al.
	1991	36	224	Coast Guard; death certificates	NIOSH
Lumber and wood products	1981–1984	3	141	Workers' compensation files	NIOSH
Air transportation	1981–1984	5	82	Workers' compensation files	NIOSH
All other industries	1981–1984	28	15	Workers' compensation files	NIOSH

* Rate per 100,000 years worked. Employment estimates vary between studies.



*Fishing boats in the port of
Kodiak, Alaska.*

Short, intensive seasons result from the “open-access” nature of fisheries. The North Pacific Fishery Management Council has had to shorten the seasons to prevent overharvesting. In addition to potential safety problems, this kind of management results in economic waste, as the capital investment far exceeds that needed to harvest the fish, and most of the catch must be frozen rather than sold as higher-valued fresh fish.

The continuing human toll in Alaska fisheries provides a sense of urgency absent from most social science research.

In the halibut and sablefish fisheries, management changes under discussion would change open-access fishing. Under the prospective Individual Fishing Quota (IFQ) system, rights to shares of the total quota would be issued to fishermen, who

would be free to harvest their individual quotas whenever they wished. Quota rights could be bought and sold. Based on experience in other countries, it appears that IFQ systems would lead to an economically more rational fishery, with a smaller fleet fishing throughout the year. However, IFQs are bitterly opposed by some fishermen, who fear that IFQs would reduce employment and result in the control of the fishery by large, Seattle-based boats.

During the intense political debate over the adoption of IFQs for halibut and sablefish, advocates have repeatedly claimed that IFQs would result not only in more profitable but also in safer fisheries, because vessels could choose when to fish, waiting out bad weather in safe harbors. They have argued that IFQs would allow fishing to occur in better weather at a calmer pace from larger boats with better-trained crews. Whether IFQ-managed fisheries would be safer is an important policy issue. Halibut openings frequently result in fatalities,

injuries and many incidents in which fishermen are evacuated from sinking vessels. If IFQs are adopted for halibut and sablefish, this will provide an opportunity to test whether fatalities, injuries and vessel losses decline when short, intensive seasons are eliminated. If they do, it will strengthen the arguments for similar management changes for other, more dangerous fisheries, particularly crab.

Safety Research Issues for the Future

As perhaps the most dangerous industry in America, commercial fishing poses numerous im-

portant safety research issues. What are the most serious safety problems? How can they most effectively be addressed through education, regulation, new fishing technologies, new management strategies, emergency response systems or other means, and what are the proper roles of the public and private sectors? How effective will the newly enacted Coast Guard regulations be in reducing losses, and what additional measures, if any, are needed?

Lack of data severely hampers our ability to address these questions. The lack of fishing safety data illustrates a common problem in social science research. Occupational fatality and injury data that could be obtained at relatively little cost are often not collected or are collected in an unusable format, because the persons in charge of data

Summary of halibut fishery safety incidents reported in the *Kodiak Daily Mirror*, 1986–1991.

<i>Date</i>	<i>Weather reported</i>	<i>Incidents reported</i>	<i>Newspaper comments</i>
4 May 1987	Calm seas, moderate winds and good visibility at start of opening, changing to 26-mph winds and 20-ft seas by end of opening.	One death, three crew missing, three vessel sinkings, nine crew rescued from sinking vessels, two crew evacuated for illnesses, two vessels disabled.	"Fishing boats, their holds plugged with halibut and their crews exhausted, continued to limp into port this morning after the close at noon of the first of the frantic 24-hour fishing marathons known as 'halibut openings.' Coast Guardsmen were exhausted too, today, after working diligently to pull unlucky or unwise fishermen from trouble."
2 September 1987	Winds at 25 mph and gusting.	Two groundings, three crew rescued.	"Two vessels fell victim to the rocks and shoals during the just-completed 12-hr halibut opening."
30 September 1987	16-ft seas and 30-mph winds predicted, with weather calming.	(no incidents reported in newspaper)	"Gale force winds battered the fleet in the hours before the opening... The predicted gale convinced some skippers of the smaller boats that it just was not worth the risk to life and limb... Meanwhile, some fishermen said they fished in 12- to 14-ft seas and they have the bruises and boat damage to prove it."
23 May 1988	"Unusually good weather for a first halibut opening."	Two vessels lost, crew rescued; three vessels taking on water assisted.	
20 June 1988	Small craft advisory, northeast winds to 22 mph, seas to 10 ft.	Two crew evacuated with injuries.	
3 October 1988	25-ft seas, winds gusting to 44 mph.	Three crew abandoned ship; rescued.	
15 May 1989	High winds and seas; "howling westerly winds."	One vessel lost, five crew rescued.	"One skipper said, 'I risked my life for pennies.' Some smaller vessels turned back when faced with high seas and larger vessels had their windows blown out."
12 June 1989	Winds at 10 mph.	One death, two vessels lost, nine crew rescued.	
10 Oct 1989	Winds to 20 mph.	Two vessels received assistance from Coast Guard.	

collection do not use the data for research or consider how the data might be used for research.

The lack of data also reflects a broader jurisdictional problem: no single agency—neither the Coast Guard nor the various state and Federal agencies responsible for fishery management and occupational health—has full responsibility for commercial fishing safety. Each perceives its role as limited to only part of the problem, and none has undertaken the coordinated data collection and research needed to fully understand or address the problem.

Estimates of fishing fatality rates helped to call attention to the seriousness of the problem—and illustrate how a little research can go a long way in influencing public policy.

In 1991 the National Institute for Occupational Safety and Health (NIOSH), Division of Safety Research, established a field station in Anchorage, Alaska. NIOSH has identified fishing safety research as a major priority, and it may play an important role in filling the gap in fishing safety research.

But the story on fishing vessel safety doesn't stop with social research. Numerous Federal agencies, universities, state and nonprofit industry organizations are involved in an extensive delivery system in coordination with the U.S. Coast Guard to increase the knowledge of recent regulations (1988 Commercial Fishing Industry Vessel Safety Act), promote the use of safety devices and provide safety training. NIOSH is actively involved, as well as NOAA's National Marine Fisheries Service (NMFS). NMFS has funded, through Saltonstall-Kennedy grants, a study of fishing vessel safety and has funded safety training programs directly. The Alaska Sea Grant Marine Advisory Program, through the Alaska Marine Safety

Education Association (AMSEA) in coordination with the U.S. Coast Guard, NIOSH, the Alaska Department of Public Safety, the Alaska Department of Health and Social Services, the Southeast Alaska Regional Health Corporation and Emergency Medical Services Council and other organizations, develops standards, curricula, training programs and recordkeeping for certification. AMSEA has established a network of over 100 trained safety instructors in Alaska. The volunteer instructor program is considered a model for developing regional training associations nationally under the Commercial Fishing Industry Vessel Safety Act. The instructors present an ongoing series of classes and workshops to meet the short-term training needs of commercial fishermen in Alaska.

The continuing human toll in Alaska fisheries provides a sense of urgency to this work. The week this article was written, Alaska newspapers reported the drowning of two salmon fishermen and severe burns to another from an on-board explosion. Greater attention to fishing safety problems cannot come too soon.

Publications

Readers may obtain more information about the research described in this article from the following publications:

- Fishing Vessel Safety: Blueprint for a National Program*, by the Committee on Fishing Vessel Safety, Marine Board, National Research Council, Washington, D.C., 1991.
- Fatality Rates in the Alaska Commercial Fishing Industry*, by G. Knapp and N. Ronan: Alaska Sea Grant College Program Report 90-03, 1990.
- Occupational Injury Deaths in Alaska's Fishing Industry*, by P.G. Schnitzer, D. Landon and J. Russell: Paper presented at the 40th Annual Epidemic Intelligence Service Conference, Atlanta, Georgia, 1991.

Management of the Groundfish Fisheries Off Alaska

The Race for Bycatch

TERRENCE SMITH

Economic analysis plays an important role in managing the groundfish fisheries off Alaska. As domestic groundfish harvesting has dramatically expanded, the effect on species that are caught incidentally (called bycatch) has made management of the harvest much more complex. Economists have been developing models that allow us to understand the interdependence between the harvesting activity related to target species and the bycatch constraints.

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The commercial fisheries off the coast of Alaska are the largest fisheries in the United States. The offshore groundfish fishery accounts for the majority of this harvest. This fishery primarily uses trawls, longlines and pots; it targets pollock, Pacific cod, flatfish, rockfish, sablefish and other offshore species. In 1990 the Alaskan groundfish fleet harvested about 2 million metric tons, or 51% of U.S. finfish landings.

The growth of this domestic fishery has been dramatic. In 1980 foreign fleets dominated, capturing 98% of the groundfish taken in Alaska's 200-mile fishery conservation zone. By 1990 the "Americanization" of the fishery, as provided for under U.S. law requiring domestic preference be given in allocating stocks, was complete. The foreign harvesting fleet was phased out first, followed by the elimination of "joint ventures" in which domestic harvesters had been delivering their catch to foreign processors. In the ten years between 1980 and 1990, the Alaska domestic groundfish catch increased 60-fold, reaching an ex-vessel value of \$475 million.

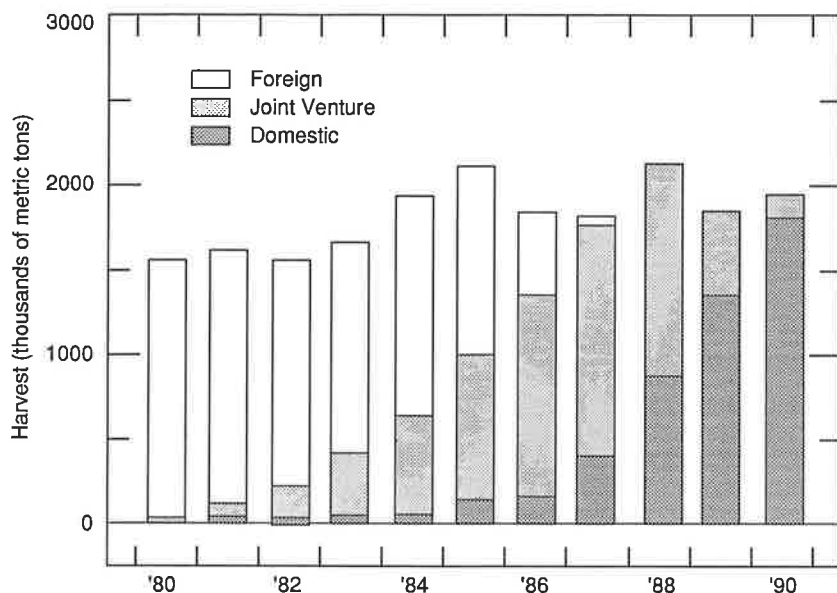
the same time, regulations designed to limit "bycatch"—the incidental harvesting of other offshore species—have become increasingly important in determining harvests in the groundfish fishery. Bycatch occurs because groundfish gear is not selective enough to prevent the harvest of nontargeted species, such as crab, halibut and herring. But these incidentally harvested fish are targeted by others in the industry and so must be returned to the sea immediately. Thus, the allocation of crab, halibut and herring between fisheries that target these species and groundfish fisheries that take them incidentally explicitly recognizes the right of capture by both fleets.



Unloading halibut from a fishing boat.

Regulations designed to limit "bycatch"—the incidental harvesting of other offshore species—have become increasingly important in determining harvests in the groundfish fishery.

Unfortunately recent developments threaten this success story under open-access management. Rapid expansion of fleet size and vessel capacity have led to overcapitalization—there is more harvesting capacity than necessary to efficiently harvest the catch. An important consequence is a "race for fish" as vessels rush to harvest their share of the fish before the overall catch quota is reached. At



Growth of the domestic groundfish industry off Alaska.

The North Pacific Management Council has since 1986 controlled the amount of bycatch that can be taken incidentally by the groundfish fleet. These imposed limits, called the Prohibited Species Catch (PSC) Limits, result in the closure of the target fishery when exceeded. Currently it is these bycatch limits and not the total allowable catch of groundfish that effectively controls how many groundfish may be caught, where they can be caught, and during what seasons the fleet may operate.

Since the total bycatch limit cannot be exceeded, groundfish fleets are involved in a zero-sum game. The bycatch taken by one part of the fleet reduces the amount of bycatch available for other vessels in the fleet. For this reason the Council apportions parts of the total PSC to defined segments of the groundfish fishery on a seasonal basis. The race for fish has become a race for bycatch, and the bycatch allocation is an important determinant of the region's social and economic benefit derived from the offshore fisheries.

Simulation Models of the Fishery

To facilitate the Council's bycatch allocation process, Federally sponsored research has focused on developing Bering Sea fishery simulation models. The simulation models predict the temporal and spatial distribution of bycatch, given the Council's planned groundfish allocations. The first-generation models were spreadsheets that calculated the expected bycatch for planned groundfish targets based upon historical bycatch rates.

Simulation results provide vivid insight about the constraints bycatch places on the groundfish

fishery. For example, in 1989 the model predicted a reduction in the groundfish harvest of almost 900 thousand metric tons if the Council's proposed bycatch restrictions were enacted. This was more than half of the total allowable catch for groundfish, which translated into foregone profits of about \$275 million. In contrast, the value of the crab and halibut bycatch saved was only about \$24 million. If, however, halibut bycatch rates could be reduced by 50%, no groundfish catch would be foregone.

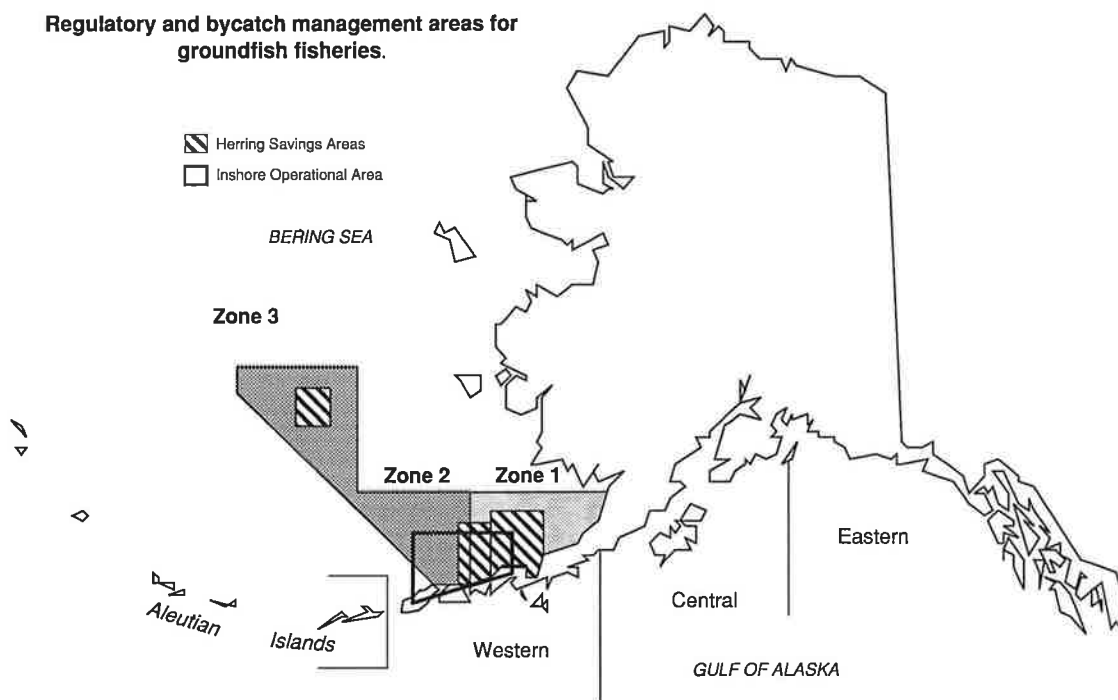
The bycatch regulations have become more complex, now recognizing several seasons, many regulated areas, several distinct groundfish fisheries and more species subject to bycatch controls. The second-generation simulation models are more sophisticated, designed to handle the increasing complexity of the groundfish-bycatch system. The most recent version depicts the weekly performance of 13 target fisheries in 20 areas. The model simulates the fishery by predicting the pattern and timing of closures as bycatch limits are reached and then estimating the value of the bycatch saved and the change in the profitability of the groundfish fleet as it relocates to a new fishing area.

In a simulation of the 1992 fishery, for example, the model estimated that the Council's plan would lower the net revenues to the groundfish fleet by \$12 million compared to a \$1 million gain to the fisheries for crab, halibut, herring and chinook salmon.

Performance Versus Prediction

Not surprisingly the actual fishery performance during the period 1989–1991 has tended to fall between the "worst case" and "best case" scenarios described above. Clearly the fleet is modifying its behavior so as to reduce bycatch rates. Unfortunately there is no available information on how fishing costs have changed in response to the increasingly segmented and restrictive bycatch management regime. What is clear, however, is that considerable groundfish catch has remained unharvested due to the PSC limits. For example, in 1991 the actual catch was less than the total allowable catch for rock sole, yellowfin sole, pollock and Pacific cod. Although some of this foregone groundfish catch may be due to inability to harvest the total allowable catch, all the named fisheries were closed in every quarter of the year because PSC limits had been reached. As an example of the costs of "managing by bycatch," the value of the foregone rock sole and cod, two species currently much in demand, was about \$48 million using 1991 prices.

Regulatory and bycatch management areas for groundfish fisheries.



Current Research

Current research, funded by NOAA's National Sea Grant program, is directed at overcoming several model limitations. For example, one difficulty is that the models are designed to be predictive rather than behavioral. Since they rely on historical bycatch rates, the important question of the optimal allocation of the PSC to minimize bycatch costs or maximize the value of groundfish cannot be addressed. Currently if a fishery has experienced high bycatch rates, the model apportionments

and time. The predictive models are therefore unable to provide guidance on the likely bounds of predicted impacts or on the risks involved in choosing a particular set of apportionments.

Consequently the research goals are to understand how the fleet will respond to changes in the groundfish-bycatch management system and to pursue new approaches for estimating behavioral relationships for the groundfish fisheries. This would allow analysts to say something about how prices, costs and markets will be affected by changes in the bycatch management system. Technically the research is directed at the general problem of cost-benefit analyses of fishery management changes. The objective is to be able to describe how the fleet will modify its behavior under changes in bycatch management and how the new behavior will affect markets and hence net benefits. Given a behavioral framework, it will also be possible to determine optimal allocations of bycatch, where "optimal" may be defined as the set of allocations that maximize net benefits to the U.S.

It is expected that this type of research will provide direction on how the scarce bycatch species can best be allocated, as well as a more reasoned examination of the tradeoffs between the groundfish fishery and those fisheries traditionally catching crab, halibut and herring.

The race for fish has become a race for bycatch, and the bycatch allocation is an important determinant of the region's social and economic benefit derived from the offshore fisheries.

a larger share of the relevant bycatch limit to this fishery. In fact, people in the industry try to reduce bycatch while fishing, but the behavioral incentives to reduce bycatch rates are not built into the models.

Also, the models do not capture the stochastic nature of bycatch rates and groundfish capture, both of which can vary considerably across space

The Alaska Salmon Price Crash of 1991

An Econometric Analysis

MARK HERRMANN

The dramatic price decline for Alaska salmon in 1991 raised questions about the future of the industry. With growing production of cultured salmon abroad and international markets that are linked in ways not previously possible, we need to understand the factors that affect salmon prices from a global trade perspective. The research on which this article was based provided important insights for Alaska's salmon enhancement programs.

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There has been much public and private concern in Alaska over declining Pacific salmon prices. These concerns came to a climax in 1991 when initial offerings of \$0.47 per pound of sockeye salmon were rejected by the fishermen, and 2500 Bristol Bay salmon fishermen went on strike. The settlement price of \$0.70 per pound was still substantially lower than the 1990 price of \$1.04, the 1989 price of \$1.24 and the 1988 price of \$2.25. Also, the price offered for pink salmon fell below the fishermen's breakeven point, and six million pounds of Prince William Sound "pinks" were harvested only to be dumped back into the ocean, given away to local citizens, or canned and given away in a much publicized airlift to the Soviet Union for humanitarian purposes.

As a result, Alaskans are very concerned about the future of the salmon industry. One positive response to the crisis has been an increase in research toward developing new products and marketing Alaskan salmon. To meet these goals, the Alaska Seafood Marketing Institute is placing a greater emphasis on salmon advertising and on developing

new outlets for salmon, such as school lunch programs. The University of Alaska-Fairbanks, through its Fisheries Industrial Technology Program located in Kodiak, is researching vacuum-packed pink salmon fillets, TV dinners, salmon nuggets, pink salmon surimi and so on. Facing an industry that is directly and indirectly responsible for 33,000 jobs, the governor of Alaska created a special Governor's Salmon Strategy Task Force to study these issues and to recommend ways to stabilize the industry.

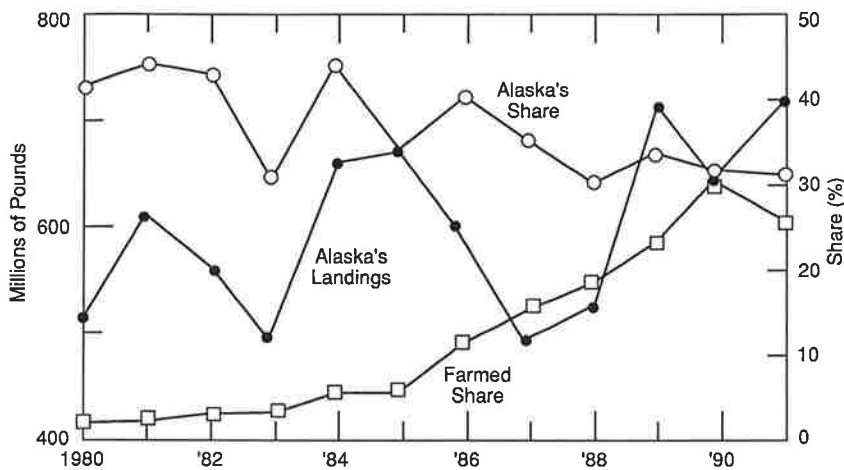
Salmon Markets

Understanding the current price crash and modeling salmon markets accurately requires a global perspective because of the international level of wild and farmed salmon production and consumption. For example, Japan consumes more salmon than any other nation—in excess of 600 million pounds of salmon annually. Also, the proliferation of farmed salmon supplies coming from Norway, Chile, Canada, the United Kingdom and others has had an effect on world production and potentially on prices. In 1980 only 1% of the world's salmon supply came from farmed salmon; in 1990 an estimated 28% originated from farmed supplies. Since 1980 the world supply of salmon has increased from 1.2 billion pounds to approximately 2.3 billion pounds, and Alaska's production share during this time period has declined from 44 to 32% despite a nearly 50% increase in landings.

To help answer why the 1991 Alaska salmon prices crashed and to project future salmon prices, an econometric supply-and-demand equilibrium model of world salmon markets is being enhanced using NOAA and University of Alaska Sea Grant funds to address these questions. The model, finished at Washington State University in 1990,

Fishing boats in Kodiak, Alaska.





Alaska's salmon production and its share of the total world production of salmon for 1980–1991. The contribution of the world's farmed salmon to the world's supply is also shown.

focuses on major international market factors affecting salmon prices, and it simultaneously models interactions with farmed Atlantic and wild Pacific salmon to determine how supplies and prices are related. The results indicate that farmed and wild salmon are readily substituted in the marketplace in the United States, Japan and Europe. This supports an earlier Alaska Sea Grant survey that found farmed Atlantic salmon to be substitutes for fresh chinook, coho, sockeye and chum salmon at the wholesale level.

An earlier version of the model was originally constructed to predict the profitability of farming Atlantic salmon in Puget Sound in Washington, and its accuracy has been demonstrated. At the end of 1987 the price of Norwegian-farmed Atlantic salmon (in Norway) was \$3.94 a pound. Many people considered the outlook for farmed salmon prices to be excellent, and they were skeptical when the model predicted a \$0.98-per-pound drop in prices by the beginning of 1989. The actual drop was \$1.04 per pound.

About three-fourths of the decrease in prices from 1989 to 1991 for high-valued Pacific salmon (chinook, sockeye and coho) can be attributed to increased Alaskan landings of these species.

Alaska Prices

The current working model has been used to determine why the 1991 Alaska salmon prices decreased from the 1988 price levels. The preliminary findings indicate that the majority of the downward pressure on prices were related to supply. For example, about three-fourths of the decrease in prices from 1989 to 1991 for high-valued Pacific salmon (chinook, sockeye and coho) can be

attributed to increased Alaskan landings of these species. The rest of the decrease was mainly attributed to increased world farmed supplies, unfavorable international exchange rates and the U.S. economic slowdown. Two-thirds of the ex-vessel price decline for low-valued Pacific salmon (chum and pink) was estimated to result from increased salmon landings of these species. The remaining third was from increased high-valued Pacific salmon landings, the buildup of Japanese chum-salmon inventory, unfavorable exchange rates and the U.S. recession.

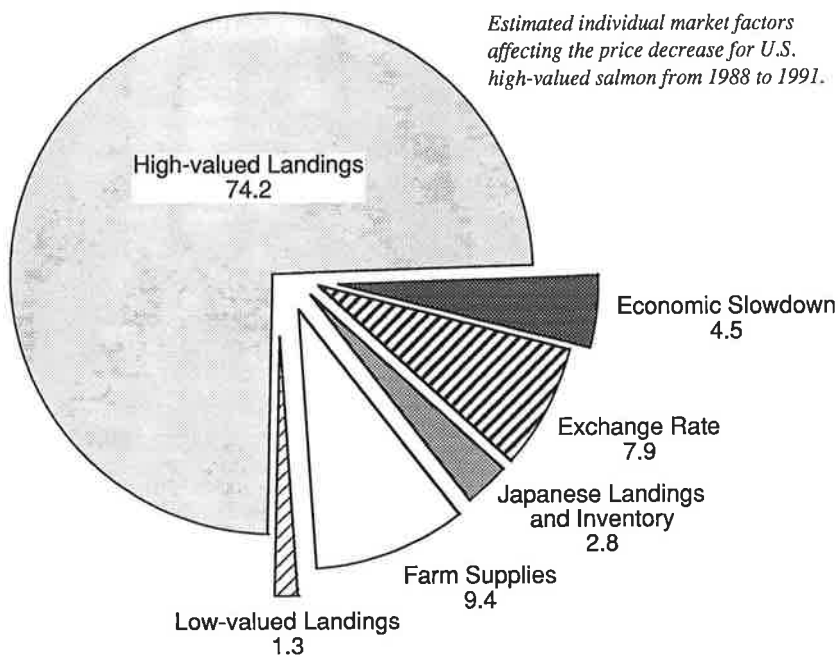
The effect of increased farmed salmon supplies is probably much larger than indicated. The analysis started with 1988 conditions, which already included a large world farmed salmon supply. Without international salmon farming, Alaska salmon

Without international salmon farming, Alaska salmon prices might well be higher today, despite the increased consumer demand for salmon in general that has resulted from the availability of fresh salmon year-round.

prices might well be higher today, despite the increased consumer demand for salmon in general that has resulted from the availability of fresh salmon year-round. It appears that the high levels of farmed salmon from Norway, Scotland, Chile, Canada and others have decreased the ability of the marketplace to absorb the increased Pacific landings of the last three years. This is supported by the model's significant sensitivity of ex-vessel price to landings.

As a result of this research the Alaska State Legislature has requested researchers at the University of Alaska–Fairbanks to examine the state's salmon enhancement program. This program is a joint state and private nonprofit effort to release salmon from hatcheries to replenish wild stock and ensure adequate salmon return for fishermen. This study will combine a biological model with an economic production model, and it will tie these to a salmon market model. The model focuses on the following fisheries: Prince William Sound drift gill net and purse seine; Cook Inlet drift gill net, purse seine and set net; Kodiak purse seine and set net; and Juneau hand and power troll. The integrated model will easily be the most comprehensive salmon supply-and-demand model now in use.

Preliminary findings have been presented be-



fore the Alaska Senate Special Committee on Domestic and International Commercial Fisheries as part of a comprehensive salmon enhancement review. The early results indicate that Alaska ex-vessel salmon prices may be more responsive to Alaska landings than previously believed. This finding suggests that, in higher-yielding years and in the absence of any significant market expansion, the possibility exists that Alaska's hatcheries may be producing at or beyond the economically optimum number of salmon. This research, which is being funded by the Alaska State Legislature and Alaska Sea Grant, is scheduled for completion by November 1992.

The next important threat to Alaska salmon prices may well come from Russia, which produced approximately 320 million pounds of salmon in 1990. If a good portion of this salmon ends up in Japan as expected, the Alaskan salmon industry may be facing another challenging competitor in the future. Additional work under Sea Grant will incorporate Russian salmon supplies into the model.

Traditional Alaska Eskimo Whaling and the Bowhead Quota

STEPHEN R. BRAUND

Traditions surrounding the hunting of bowhead whales have deep roots in Eskimo culture, reinforcing family ties and village cohesion. How do cultural needs for whaling become integrated with the international management of threatened whale stocks? The International Whaling Commission has sought to clarify the subsistence and cultural needs for Alaska Eskimo bowhead whaling. Over a period of more than a decade, anthropological research has identified and quantified those needs.

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Inupiat and Yup'ik Eskimos of Alaska have harvested bowhead whales for over 2000 years as the large mammals migrate through nearshore leads that develop in the Bering, Chukchi and Beaufort seas each spring and as the whales return south in the fall. The bowhead harvest represents not only a major food resource but also a cultural focal point in Eskimo communities, and it is important in confirming social ties within and between communities.

The Eskimo pattern of hunting these marine mammals is to intercept them at the edge of the open leads as they migrate north, and a successful capture requires several boat crews in an organized, cooperative hunt. Since the whales are one of the first mammals to migrate north in the spring, they represent the beginning of the annual subsistence cycle. The harvest is celebrated at feasts and ceremonies. The meat and other products from the whale are systematically distributed to the partici-

pating whaling captains, who in turn share their portion with their crew members, who then share with relatives and friends. The status of the successful whaling captain is very high in these communities, and crew members are proud to be associated with a successful boat. Crew members are generally relatives and close friends, and a long training period for a crew is standard procedure. Whaling equipment, including skin-covered boats, darting guns and harpoons, as well as traditional knowledge and skills, are transferred from generation to generation. The traditions of bowhead whaling have evolved over centuries, and they continue to be the basis of Inupiat and Yup'ik Eskimo social and cultural systems in Alaskan bowhead whaling communities today.

Hunter preparing to strike a bowhead.

Why Social Science and Whaling?

In 1931 the Convention for the Regulation of Whaling instituted an international ban on commercial hunting of bowhead whales, but no limit was placed on the Alaska Eskimo subsistence harvest. Since its formation in 1947 the International Whaling Commission (IWC) has regulated the commercial hunting of whales. However, an exemption for subsistence hunting enabled Alaska Eskimos to continue their subsistence harvest of western Arctic bowhead stock free of IWC regulation until 1977.

Due to the excessive commercial harvests of the late 19th and early 20th centuries, the IWC in the mid-1970s determined that all bowhead stocks, including the western Arctic population upon which the Alaska Eskimos depend, should be considered seriously depleted. Beginning in 1972 the



IWC requested that the U.S. provide data regarding the status of the western Arctic bowhead population and the Alaska Eskimo hunts of this whale. As a result, in 1973 the U.S., through the National Marine Fisheries Service (NMFS) of the Department of Commerce, began to gather biological information on the bowhead and to monitor the Alaska Eskimo subsistence hunt.

The bowhead harvest represents not only a major food resource but also a cultural focal point in Eskimo communities, and it is important in confirming social ties within and between communities.

Increasing concern among conservation groups and some IWC members over the effect of the unregulated Alaska Eskimo subsistence hunt on the endangered bowhead population was due to:

- The depleted bowhead stocks;
- The lack of data on the size and health of the bowhead population;
- Reported increases in the number of bowheads landed and the number struck but lost; and
- Reported increases in the number of Eskimo whaling crews in three major Alaskan whaling

communities during the early to mid-1970s.

At that time the bowhead population was estimated to be so low that in June 1977 the IWC banned the subsistence harvest of bowhead whales for the 1978 season. At that point, whaling captains from nine Alaskan whaling communities (Gambell, Savoonga, Wales, Kivalina, Point Hope, Wainwright, Barrow, Nuiqsut and Kaktovik) met in Barrow and formed the Alaska Eskimo Whaling Commission (AEWC). The AEWC attended IWC committee meetings, initiated a bowhead census and worked with the U.S. delegation to the IWC to build a case for rescinding the moratorium on subsistence whaling. In a December 1977 special meeting the IWC removed the ban due to cultural and subsistence dependence on the bowhead by the Alaska Eskimos, and it implemented a 1978 quota of 12 whales landed or 18 struck, whichever occurred first. In addition the IWC asked the U.S. for further research on the biology of the bowhead, as well as on the cultural and subsistence needs of the Alaska Eskimos to hunt this species.

Foremost on everyone's mind was an answer to the question, "How many bowheads were there?" In the mid-1970s, little, if any, population data existed for the Bering Sea stock of bowhead whales. Beginning in 1976 the National Marine Fisheries Service (NMFS) conducted studies to determine



Villagers in Barrow pulling a whale out of the water and onto the ice using a large block and tackle. It takes a community effort to accomplish this arduous task.



that population. Because of the difficulty of counting the passing bowheads in changing ice conditions, some years' data were not considered suitable for deriving a population estimate. In 1978 favorable viewing conditions enabled an estimate of 2200 animals. In 1981 the North Slope Borough took over responsibility for the bowhead census and added acoustic techniques. The 1988 bowhead census, which is the most recent, yielded a "best estimate" of approximately 7500. The North Slope Borough is conducting a major field census in 1992.

Identifying Cultural and Subsistence Needs

In addition to the question of how many bowheads there were, questions related to "cultural and subsistence" dependence or need by Alaska Eskimos for these animals also required an answer. Because of its trust relationship with Native Americans, the U.S. Department of Interior (USDOI) initiated research on this topic. An Inter-agency Advisory Committee on Bowhead Whaling was formed to oversee the research. The research had two directions: defining the cultural and subsistence importance of bowhead whales to Alaska Eskimos, and quantifying the cultural and subsistence need for bowhead whales.

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Thus the U.S. government had a dual research agenda related to bowhead whales and the Alaska Eskimos subsistence harvest of them. One was biological: what was the status of the bowhead stock? The other was social: did the Alaska Eskimos in the 1970s still have a cultural need for

these marine mammals and, if so, how many were required to satisfy that need? The ultimate decision on whether the Alaska Eskimos continued to receive a quota (based on cultural need) and how large that quota would be (based on both the quantification of cultural need and the number of bowheads available) rested with the IWC.

In 1980 the U.S. submitted a report compiled by the USDOI entitled *Interim Report on Aboriginal Subsistence Whaling of the Bowhead Whale by Alaska Eskimos*. Based on the information then available, the report examined the cultural and nutritional importance of the bowhead to the Eskimos, assessed historical bowhead harvests by community, and recommended a method of estimating Eskimo need for bowheads based on cultural requirements and historic catch. The IWC responded to this report by requesting a more thorough investigation of these issues. The information in the 1980 report on the cultural importance of the bowhead to the Eskimos was primarily based on historic data, not current information. Consequently the USDOI Bureau of Indian Affairs (BIA) sponsored a household survey conducted by Alaska Consultants, Inc. and Stephen R. Braund and Associates in 1982-83 in the nine Alaskan whaling villages identified at that time. This study set out to examine the present importance of bowhead whaling in these communities and determine whether the substitution of other subsistence and store-bought meats for bowhead whales was feasible.

Quantifying Needs

Respondents from 370 households in the nine whaling villages were surveyed with a formal questionnaire. This sample represented 37% of the total 1980 Eskimo households in the nine villages. Whaling captains resided in 73 of the surveyed households and represented 60% of the AEWC-registered whaling captains. The 1984 report from this study, *Subsistence Study of Alaska Eskimo Whaling Villages*, indicated a high level of interest and participation in bowhead whaling, as well as other strong indicators of cultural importance. Culturally important activities are the sharing of bowhead whales, participation in feasts and ceremonies featuring bowhead whales, and whaling as a means of reinforcing kinship ties. Particularly important are the status conferred by being captain and the intergenerational ties between fathers and sons, mothers and daughters that are strengthened through the transfer of knowledge and participation in community events. This study also found that neither store-bought meat nor any one species

or combination of wildlife resources was a practical substitute for the bowhead whale.

The 1984 study documented the importance of bowhead whaling to the Alaska Eskimo culture and the subsistence economy. The next step was to determine the number of bowhead whales necessary to fulfill this cultural need. Consequently the BIA asked Stephen R. Braund and Associates to prepare a position paper for providing a quantifiable determination of cultural and subsistence need for bowhead whales in Alaska Eskimo populations in the nine recognized whaling communities; the resulting paper was titled *Report on Nutritional, Subsistence, and Cultural Needs Relating to the Catch of Bowhead Whales by Alaskan Natives*. The factors considered most important in quantifying need were the Eskimo population, the number of whaling crews and the efficiency of their hunts. Because effective whaling requires numerous crews, a relatively large Eskimo population is necessary for cooperative hunting. Prior to contact with commercial whalers, the Eskimo populations in the whaling villages were large enough to support effective subsistence whaling. However, these populations dropped severely between 1885 and the early 20th century due to disease and famine, and they are only now recovering from this dramatic decline. Because of this trend the report concluded that the quantification of subsistence should be based on present Eskimo population levels, which represent the re-establishment of once-larger populations. The IWC accepted the report's per capita method of quantifying the cultural and subsistence need for bowhead whales. The report determined that the nine communities needed a minimum of 26 bowhead whales. Based on this assessment the U.S. and the AEWI adopted the position of requesting an allowance of 35 strikes.

were compiled and reviewed to ensure that the best base period was used (1910 to 1969, a period free of both the commercial whaling influence and the effect of increased Eskimo whaling crews in the 1970s), to be sure that selective use of data did not occur, and to review the data for accuracy. The resulting 1988 paper, presented at the IWC meeting that year, was titled *Quantification of Subsistence and Cultural Need for Bowhead Whales by Alaska Eskimos*. This paper determined that the cultural need for the nine AEWI whaling communities was 41 landed whales. Based on this report the IWC granted the nine whaling communities 41 landed whales or 44 strikes, with a carry-forward provision for up to three unused strikes. This 1988 quota was for three years (1989–1991). At the 1991 IWC meeting the quota of 41 landed bowhead whales for cultural and subsistence need remained in effect for the 1992–1994 seasons, with minor adjustments to the strike and carry-forward provisions.

The Omission of Little Diomed Island

Recent social research related to the bowhead quota issue has centered on Little Diomed Island. Little Diomed, a small island in the Bering Sea, is very isolated from the rest of Alaska. The community is only accessible by boat during the ice-free summer months and by planes landing on the ocean ice between January and March, weather permitting. Because of isolation, lack of data and lack of communication, the community of Little Diomed was not included in quota requests to the IWC, the 1980, 1983 or 1988 analyses of subsistence and cultural need presented to the IWC, or the 1982–83 household survey. Those reports dealt only with the nine whaling communities identified at that time. In the 1988 report, whaling data for seven traditional whaling sites or communities (no longer occupied in 1988) were consolidated within the nine AEWI whaling communities based on the current community's continued use of that site or on a demographic pattern in which the population of the now-abandoned site had resettled to one of the current whaling communities. However, Little Diomed had maintained a discrete population, so historical data for Little Diomed were not combined with those of any of the nine AEWI communities. Some historical whaling data for Little Diomed had been collected, but these data represented only partial information; Little Diomed's whaling history had not been studied in depth and little was known about it. Also, Little Diomed was not a member of the AEWI and

Although biological considerations are fundamental to any sustained harvest of whales, the social science approach to documenting and quantifying subsistence and cultural needs has played an important role in this global forum.

In response to this paper, IWC member nations raised a number of questions about the methodology of data collection. The BIA again engaged Stephen R. Braund and Associates to refine the 1983 report to address those questions. Significant additional research attempted to fill data gaps related to historical bowhead whaling activities in Alaska Eskimo communities. All relevant data



Butchering a bowhead whale, Wainwright, Alaska. The crew shares are in the foreground. Note the whale's baleen.

was not an IWC-recognized whaling community. The combination of these factors left this community outside the formal processes that had been applied to Alaska Eskimo subsistence whaling.

However, the community has been attempting to obtain a bowhead quota ever since they learned that a quota was necessary to hunt bowhead whales. In 1986 the Diomedes City Council passed a resolution requesting a whaling quota and stating that their isolation had caused them to be excluded from the existing whaling quota, that they relied primarily on marine mammals for their food and livelihood, and that they have hunted whales since time beyond their memory. In 1988 Little Diomedes was granted membership in the AEWI.

However, for Little Diomedes Island to receive a bowhead quota, the community must be recognized as a bowhead whaling village by the IWC. This process includes an AEWI request for a quota on behalf of Little Diomedes Island. Before the AEWI will make this request, they must prove to the IWC that Little Diomedes, like the other nine IWC-recognized Alaskan whaling communities, "needs" a bowhead whale hunt. Once this need is established, the AEWI will request that the IWC allocate an additional quota to fulfill that need. Hence, a study and report on Little Diomedes's subsistence and cultural need for bowhead whales is required. Towards this end, the AEWI received a grant from the BIA and contracted with Stephen R. Braund and Associates, which has initiated research for this report.

The research team gathered information on Little Diomedes Island bowhead harvests, the Eskimo population, their bowhead hunting history and the cultural significance of bowhead whaling. As with the 1988 study, the team relied on repository, library and archival sources as well as field data collection. The data indicated a rich whaling history

and numerous parallels to whaling practiced by the other Alaska Eskimo whaling communities. These parallels include the cooperative nature of the hunt (organized around the skin boat crews based on kinship ties and the village), the communal, formalized patterns of sharing ensuring participation of the whole village in securing and processing the whale, and participation in feasts and ceremonies in which the bowhead whale was eaten. Hence, the taking of a whale and distribution of the meat and maktak* integrated the community and reinforced mutual interdependence and cooperation.

Also similar to the other whaling communities, Little Diomedes's fluctuations in whaling activities correlate with human population declines and increases. The Little Diomedes population reached a low point in 1969 (also a time of little or no whaling activity), but it has increased steadily since that time. During periods of low human population, it is difficult to cooperatively hunt, tow, land and butcher bowhead whales. Combined with poor economic conditions, a lack of whaling equipment and many poor ice years, Little Diomedes had a period of relatively unsuccessful whaling beginning in the 1940s. The population of Little Diomedes Island has been increasing since 1960. This increase has been accompanied with a cultural resurgence in the 1970s and 1980s, similar to other areas of Alaska. The Diomedes population is now above the historic threshold for successful bowhead whaling. However, this renewed interest and high population level have occurred at a time when regulations prevent Little Diomedes Island residents from whaling. In the nine IWC-recognized Alaska Eskimo whaling communities, the IWC has accepted the method of quantifying need based on present population levels, which represent the re-establishment of once-larger populations.

In 1991 Little Diomedes had eight active boat crews, whaling equipment, five walrus-skin boats, two aluminum boats and a wooden boat. Residents were making and acquiring whaling equipment in anticipation of a bowhead quota.

The study team applied the IWC-accepted method of quantifying cultural and subsistence need for bowhead whales by Alaska Eskimos to the Little Diomedes landed bowhead whale and human population data. This involves matching the number of bowheads landed each year with the community population for the same year. Then, dividing the sum of the total bowheads landed by the sum of the total population (for years landed data are available) yielded the mean number of bowhead landed per capita. Multiplying this mean number of bow-

* Maktak is bowhead whale skin with a layer of attached blubber and is the most esteemed food in these communities.

head by the 1990 population of the community resulted in the present subsistence and cultural need for Little Diomedes to be one landed bowhead whale. The Little Diomedes Island estimate of need for an additional (tenth) Alaskan whaling community represents an addition to the 41 landed whales fulfilling the need of the nine IWC-recognized whaling communities.

This study, performed in support of Little Diomedes residents' bowhead quota request, was submitted to the AEWI in May 1991. The AEWI submitted the report to the BIA, and the U.S. distributed it as a draft report at the 43rd IWC annual meeting in 1991 at Reykjavik, Iceland. In June 1992 at the 44th IWC annual meeting in Glasgow, Scotland, the U.S. officially presented the final version of this report at the Aboriginal/Subsistence Subcommittee. The U.S. proposed that the IWC recognize Little Diomedes's need but not amend the subsistence bowhead quota at this time. Thus, the IWC has recognized Little Diomedes Eskimos' cultural and subsistence need for bowhead whales but has not yet granted a formal quota in support of this need.

Conclusion

Social science research has played an important role in both documenting the human need for a resource and quantifying that need. The IWC addresses both the biological status of whale stocks and the social and cultural needs of the people

who use these stocks. Although biological considerations are fundamental to any sustained harvest of whales, the social science approach to documenting and quantifying subsistence and cultural needs has played an important role in this global forum. The IWC has granted a bowhead quota to the Alaska Eskimos, acknowledging the validity of cultural needs in global resource allocation issues.

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Readers may obtain further information about the research discussed in this article from the following publications:

Subsistence Study of Alaska Eskimo Whaling Villages, by Alaska Consultants, Inc. and Stephen R. Braund and Associates: Prepared for Bureau of Indian Affairs, U.S. Department of the Interior, 1984.

Subsistence and Cultural Need for Bowhead Whales by the Village of Little Diomedes, Alaska, by Stephen R. Braund and Associates: International Whaling Commission Report IWC/44/AS2, prepared for the Alaska Eskimo Whaling Commission, Barrow, Alaska, 1991.

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A Clearinghouse for Circumpolar Education

ANN VICK

Educational resources developed in southern contexts have often proven unsuccessful in the North. There is a need today to develop educational programs that build on the strengths of northern culture and experience. The scope of this challenge is international. The Roger Lang Clearinghouse for Circumpolar Education has sought to stimulate educational exchanges and develop educational resources throughout the circumpolar region.

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The Roger Lang Clearinghouse for Circumpolar Education, named for the Alaska Native leader who originated the clearinghouse idea while serving as President of the Alaska Native Foundation in the late 1970s, was initiated in 1989 to identify and share experience in elementary and secondary education in the Arctic, particularly in Native communities. The Clearinghouse, an NSF-supported Science and Mathematics Education Networks project, is primarily concerned with locating educational resources and providing them to communities for use in village schools.

The 1987 U.S. Arctic Research Plan painted a bleak but historically accurate picture of Arctic elementary and secondary education. The village school was, and still too often is, a Westernized formal institution that has excluded the knowledge and values of the community it serves and has done a poor job of preparing young people for future roles.

Educational policy and instructional programs in the Arctic tend to have been developed in the south and shipped north. Historically these materials have gone into northern classrooms with little

Substantial efforts of Natives and non-Natives have been put into improving the quality and expanding the scope of village education. However, few of the best ideas have been shared outside the communities in which they were created, even within the same school district. A small number of successful programs have become known to others within their own state or territory. Virtually none of the success stories have crossed international boundaries. What is shared is often random, the result of workshops, conferences or chance conversations. The primary purpose of the Clearinghouse is to create a regular exchange of information across the Arctic on what has worked and, just as important, what has not worked.

Issues in Circumpolar Elementary and Secondary Education

Increased local control, which includes a recognition of the need for Native teachers and administrators to take the lead in reshaping northern education, is one of the strongest factors evident in Arctic elementary and secondary education today. In the last 20 years, Arctic residents have increasingly achieved recognition of their rights to create and manage their own governments, to manage lands and other assets and to control the institutions providing them education and health care. As part of this increasing local control, several school districts have begun to redefine the purposes and approaches to schooling from Native perspectives. The Baffin Divisional Board of Education's policy statement, *Our Future is Now: Directions for Education in the Baffin*, provides a model of this redefinition. Drafted in 1987, it continues to be the working document guiding the day-to-day operations of that school system.

Another trend evidenced by Clearinghouse re-

Alaska has a total enrollment of just over 100,000 students in 54 public school districts, 33 city and borough and 21 Rural Education Attendance Areas; Alaska Natives represent about 20% of the school-age population.

adaptation. In recent years, with increased local control and a growing recognition that effective education begins with the child's world and radiates outward, programs and materials have been reshaped to reflect the culture and environment of Arctic communities. Entire programs and processes have been developed using northern contexts rather than adapting southern designs.

The key components of the Clearinghouse include:

- The creation and maintenance of a network of individuals and organizations concerned with the quality of education in the Arctic and willing to share their experiences and approaches with others. The Clearinghouse's International Office maintains contact with all network participants and matches them up with others seeking or providing information.
- The publication of a newsletter three times a year.
- The development of a Circumpolar Curriculum Library, composed of materials contributed by Canadian, Greenlandic, Scandinavian and Alaskan educators and institutions. Materials are shared but also safeguarded so that what has been accomplished will not vanish.
- The establishment of a set of criteria and a nomination process for exemplary programs, which are described annually in the *Whole Pole Catalogue*.
- An exchanges of educators. These intensive visits allow for the transfer of effective programming and the tailoring of circumpolar models to individual community or regional needs. During a visit made to Alaska in October 1991, N.W.T. Teacher of the Year (1990) John Jamieson made a presentation on his approach to teaching science through cultural processes to teachers and administrators from five Alaskan school districts participating in a Clearinghouse-sponsored workshop in Anchorage. He then traveled to the Alaska Gateway School District for two days of meetings with district staff, classroom teachers and Native leaders. During the visits to Tok, Northway and Mentasta Lake, Jamieson shared his teaching experiences in Sanikiluaq (Belcher Islands), Iqaluit (Baffin Island), Wrigley and Fort Simpson while learning about Alaska Gateway initiatives that might be of use in N.W.T. schools.

search is a recognition of parental and community input and involvement as an essential element in effective schools. In a 1985 study of 162 of Alaska's small rural high schools, University of Alaska researchers Judith S. Kleinfeld, G. Williamson McDiarmid and David Hagstrom found school-community relations and relations among local professionals, community members and central office administrators to be two of five major factors in differences between good schools and poor schools. In effective schools, community members are consulted by professional educators, and a partnership is formed to set and achieve educational goals.

There has also been dissatisfaction with what has been offered historically in village schools and a belief that coursework is not as demanding or comprehensive as that offered elsewhere. A recently completed evaluation of elementary and secondary schools in northern Quebec by the Nunavik Educational Task Force found that "the only time our students' achievements levels are seriously evaluated is when they transfer to southern schools, or go on to post-secondary or adult education programs that require an assessment upon entry. The evidence from these sources indicates that our students are at least 2-3 years behind their southern counterparts in the same grade level." Across the North, parents and community leaders are calling for significantly higher expectations for student performance, including tougher coursework, devel-

opment of research and report writing skills, and regular assessment of skills development.

Another concern is that graduates should be able to function "in both worlds"—confident in their cultural identity and proud of their people while possessing the academic skills they will need to have choices for future studies and careers. The objectives for schooling adopted by the Baffin Divisional Board of Education include "developing human relations skills; developing a strong Inuit identity along with a sense of pride and confidence in oneself; preparing students to function well in their own communities; developing knowledge of and skills in aspects of Inuit culture such as survival on the land; developing competency in Inuktitut; preparing students to function in the English language; developing basic skills in reading, writing and mathematics in both Inuktitut and English; developing in students a strong personal value system; preparing students for college or university level training; and developing physical fitness."

A similar concern is that students are not receiving a firm grounding in either the Native or a second language. Educators recognize that students who have strong skills in their first language will more easily acquire language skills as well as the content of upper-level courses taught in English. In a report prepared under contract with the Government of the Yukon for presentation at the Circumpolar Education Conference at Umea, Sweden, in June 1990, Jim Cummins of the Ontario Institute for Studies in Education reviewed a number of programs supporting aboriginal language development among school children and concluded that "the research data are very clear that reinforcement of the

Across the North, parents and community leaders are calling for significantly higher expectations for student performance, including tougher coursework, development of research and report writing skills, and regular assessment of skills development.

aboriginal language in all of these types of programs will have no adverse effects on developments of English or French academic skills. Many of the international examples of bilingual programs, in fact, suggest that academic skills in the major school language are enhanced when the child continues to develop his/her aboriginal language."



Illustration from Kwikpagmiut, a student-produced magazine from the Lower Yukon School District.

Another recent influence on Arctic elementary and secondary education is the acknowledgment of indigenous scientific world views, including systems of land and resource management. This acknowledgment is coupled with a recognition that the experiential approach that southern educators are increasingly using in science education is a traditional Native teaching and learning style. The Dene Cultural Institute (DCI) in the Northwest Territories has focused on traditional environmental knowledge as an area of major research since 1987. DCI initiatives include a pilot project documenting this knowledge in the communities of Fort Good Hope and Colville Lake. DCI staff report that data from the project (which may provide new information to scientists) include "the use of winter food caches by marten, the difference in winter temperature between valley and upland, and the response of marten to it; the presence of a small variety of subspecies of barren-ground caribou that has not been 'recognized' in the scientific literature; and the possible presence and use of mineral licks by barren-ground caribou." DCI has also worked with the N.W.T. Department of Education and the Northern Heritage Society to integrate traditional knowledge into social studies and science curricula.

The most innovative projects and materials are being developed for the elementary level. Most school systems have begun at the primary level and worked their way up, both in restructuring instructional programs and in developing materials. The holistic, interdisciplinary approach to teaching and learning is one that is common both to Native traditions and to elementary programs. It is at the secondary level that the educational system begins to compartmentalize knowledge. At the forefront

in the development of innovative instruction is the Baffin Divisional Board of Education's Piniqta-vut ("Where We Are Going") Program, a program of studies for grades K-9 that suggests a methodology and content for developing relevant, culture-based schooling for Baffin children. A HyperCard stack developed to introduce new teachers to the program describes how

"the interaction of the Inuit world view with cultural identity and social customs, the cycle of the seasons, history (past, present and future) and geography (local, regional, N.W.T., Canada, world) form the philosophical base for Piniqta-vut. This philosophical base underlies a developmental learning framework of how children learn which spirals upward and outward to provide appropriate learning experiences for a child's age and cultural background.... The Piniqta-vut Program suggests thematic units for each grade that are consistent with the underlying philosophical base and developmental teaming framework."

Tasks for the Future

In the Arctic, formal schooling has traditionally been the purveyor of cultural change. As elementary and secondary education increasingly comes under local control, respect for traditional ways and the use of human and other resources within communities is increasing. There is still, however, a tendency in any community—whether a southern metropolis or a village north of the Arctic Circle—to leave schooling to the trained professionals or to expect formal education to be the way it has always been, rather than to develop new ways of teaching and teaming.

Many challenges face communities, educators and researchers in the Arctic. Among these is the development of genuinely Inuit, Dene and other approaches to education, not just sprinkling cultural materials into approaches designed for southern systems. Native and other northern educators, most of whom have been trained in southern systems, will have to think outside the boundaries of the systems in which they were trained.

Even more basic is the need to redefine the purposes of schooling. Southern goals espoused by non-Native teachers are not necessarily the goals of Arctic residents. Parents and educators, both Native and non-Native, must agree on goals. Movement is needed on both sides. Some parents do not recognize the value of formal education. Some teachers and administrators see preparation for college as the only desirable goal. The goals of schooling must be agreed upon and then reflected in ongoing school district operations.

New materials and programs need to be devel-

oped. Over the years many materials have been lost. Institutional memory is lacking. Exemplary materials are few, particularly in math and sciences and for upper-level coursework in all subjects. The processes and commitment for the creation of culturally based programs and materials are in place in some school systems, particularly Baffin, but inadequate funds and staffing are limiting development.

Research and development is needed in instructional processes and materials that investigate and teach traditional Native sciences and technologies, including methods of land and resource management. The relationship between Western and indigenous science must be more fully explored and defined.

Another recent influence on Arctic elementary and secondary education is the acknowledgment of indigenous scientific world views, including systems of land and resource management.

Deficiencies in science and math education identified elsewhere in the U.S. (for example, inadequate teacher preparation, fewer students choosing upper-level courses, too much reliance on textbooks and not enough on experiential approaches, students seeing little "real-life" use for science) are mirrored in the Arctic and need to be corrected. Research done by scientists and other professionals in Arctic communities need to be translated into materials for school and community use, including elementary and secondary education.

Of course, funding continues to be a problem. Severe budget cuts at the state or provincial, district

or divisional board and individual school level are retarding the development of new approaches to elementary and secondary education. This drop in public sector funding is compounded by limited private foundation support in the Arctic. Private sector support is restricted by the perception that revenues and income from oil and other resources have generated sufficient funds for education and other needs.

Conclusion

In its 1992 report and recommendations on the status of education in the Inuit communities of northern Quebec, the Nunavik Educational Task Force identified the importance of the relationship between the control of schools and Arctic self-government and summarized the challenges facing Arctic residents in education:

"The education system in Nunavik should be restructured and refocused to make it work for us, to ensure that it prepares us to handle the problems and opportunities of living that we actually face—not just the ones the school board has been mechanically structured to deal with. We are not asking someone else to create this system for us. Creating it ourselves is a necessary step to self-government in Nunavik. Self-government and education go hand in hand just as independence goes with wisdom. The restructuring of our education system in Nunavik is part of our learning and development as a people. There are many challenges ahead of us, but we have many advantages. We are small in number and are not burdened by a heavy load of inflexible institutions. We have the potential to be world leaders in education, not for the recognition, but because it is in us to do."

A Native View of Culturally Relevant Education

An Invited Essay

OSCAR KAWAGLEY

Western education is based on epistemologies, or "ways of knowing," that are very different from those of Alaska Natives, and the resulting conflicts have had profound effects on northern societies. In this essay, Mr. Kawagley argues that Native education should be based on holistic principles in line with the Native view of society and Nature.

Oscar Kawagley, a Yup'ik Eskimo, was born in 1934 in Bethel, Alaska, and educated in Bureau of Indian Affairs and Territorial schools. He has a B.Ed. and M.Ed. from the University of Alaska and is working on a Ph.D. at the University of British Columbia. In addition to working as a rural teacher for many years, he has served as chief executive officer for various enterprises, including a Native corporation. From 1980 to 1986 he was a member of the Executive Committee of the Inuit Circumpolar Conference, and he has been on numerous state and regional task forces on Native education. This essay describes some of the philosophical framework for his doctoral dissertation

The indigenous peoples of the world have experienced varying degrees of disruption or loss of their traditional lifestyles. This disruption has contributed to the many psycho-social maladies that are extant in indigenous cultures today. The Western schooling system, coupled with compulsory school attendance, has brought about many of these cultural and psychological disruptions. This process of acculturation has also altered child-rearing practices, changed nomadic lifestyles to sedentary ones, shifted dietary orientations from natural foodstuffs to store-bought goods (often with less nutritional value), created a dependence on inefficient housing, and brought numerous government institutions into play.

This is not to say that modernity has brought only negative effects—it has done much good. Infant mortality is down in areas with sufficient food, and childhood diseases are greatly diminished. There are rapid modes of transportation and improved means of communication with telephones, radio, television etc. However, with all the psycho-social and health ailments, housing problems, dysfunctional parent-child relationships, violence, suicides, alcohol and drugs, and new patterns of diseases, there is a pervasive sense of powerlessness among Alaska Natives.

While many studies have addressed these concerns, nearly all have been from a Western per-

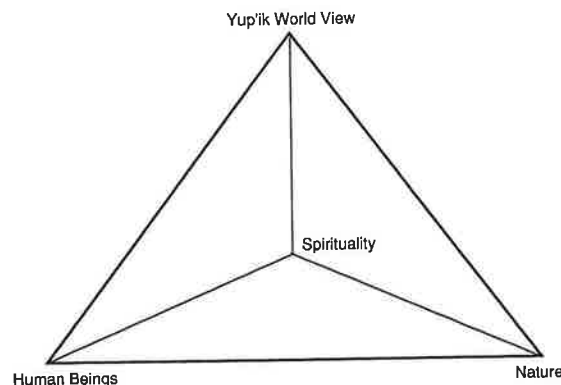
spective. Rarely has an attempt been made to approach these issues from an indigenous perspective by examining the world view and value structure of indigenous people.

The Yup'ik World View

We must start with the context of a Yup'ik world view, because basic philosophical questions are raised in the course of observing and questioning local people with respect to science as inquiry, science as explanation, science versus technology, and science and religion, especially with respect to Yup'ik lifeways.

"Ella" is a Yup'ik word that epitomizes the philosophy of the Yup'ik people. This base word can be modified to change its meaning by adding a suffix or suffixes. Examples are: *Qaill' ella auqa?*—How's the weather?; *Qaill' ellan auqa?*—How are you feeling?; *Ellam nunii*—The world's land; *Ellagpiim yua*—Spirit of the Universe; *Ellapak*—Universe; *Ella amigligtuq*—The sky is cloudy. One can quickly conclude that it can be made to mean weather, awareness, world, Creative Force or God, universe and sky. The key word is "awareness," or consciousness. All knowledge depends on consciousness, be it perception or inference. A human being must possess self-knowledge to be able to make sense of the cultural values and traditions, which are juxtaposed with the "objects" of the universe.

To help illustrate the interrelationship between human nature, Nature and supernature (or spirituality) in the Yup'ik world view, I will use a tetrahedral metaphor. The structure of the tetrahedron allows several important dynamic forces to be examined in relation to one another. If we use the three corners of the base to represent the human being, Nature and spirituality, we can visualize the apex as representing the indigenous world view that overarches and unites the base components of



our existence. The lines connecting these “poles” can be seen as the life forces that flow all ways between and among the human, spiritual and natural worlds and the human being’s world view. The two poles representing the spiritual and natural realms are essential supports to the Yup’ik world view.

This model allows for triangulation, whereby human beings can locate themselves in relation to the other domains of their existence and check to make sure that the values and traditions are in balance. It shows that the Yup’ik world view is established on an alliance and alignment of all elements

The spiritual and natural realms are essential to the Yup’ik world view.

and that there must be constant communications between the three realms to maintain this delicate balance. When everything is in alignment, it is an exceptionally strong structure. It does not require a very earth-shaking change, however, to upset the balance.

The human being is a participant–observer in this universe. We human beings, having consciousness and reasoning ability, are the ones who pose questions and methodologies for doing research. We, therefore, are the keys to understanding life and living things and trying to solve the conundrums of Nature and our inner worlds. Natural laws are placed in the universe to guide the human beings’ thoughts and actions.

What are the conditions in which this world view works with efficiency, economy and purpose?

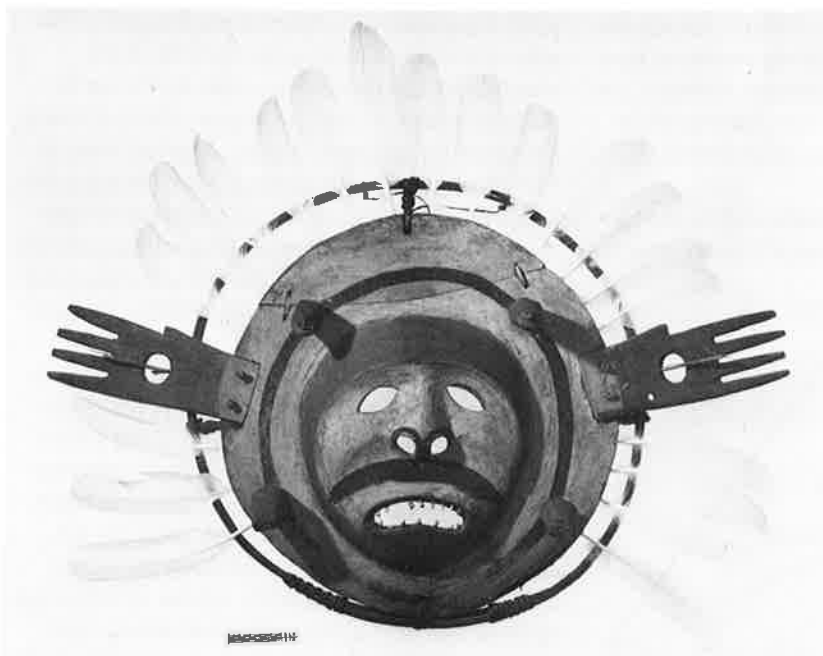
The traditional Yup’ik people were given as young children specially ground lenses through which to view their world. The resulting cultural map was contained in their language, myths, legends and stories, science and technology, and role models of community members. This verbal orientation and learning by observation worked to their advantage. To hear stories being told in the qasegiq (community house) allowed the children and other hearers to savor the words, visualize the events and, for the duration of the story, became part of the imagery. The modern written word is useful for many things, but it removes the reader from the human interaction element. In the qasegiq the hearer became a part of the story, a participant–observer in the events. This was truly living history. Good behavior of all participants in the storytelling was expected, not only by the elders, but by all community members. So the child was not only listening quietly but was learning self-discipline and respect for the rights of others. The children learned and the grown-ups were reminded of who and what they are, where they came from and how they are to interact with others, with natural things and with spirits.

The Yup’ik world view requires a respect for the wisdom of the elders. There were always a few elders in each community who reached a very old age. Some were so old that when they sat on the floor of the qasegiq with their knees bent and elevated, their heads would extend below their knees. There were others whose teeth had been worn to the gums. Those who had lost their teeth required food to be chewed by family members for consumption. These people were well cared for and were honored and respected for their knowledge and wisdom. The attainment of knowledge was based on their reasoning ability and experience.

For matters of survival the Yup’ik found it necessary to learn much about their immediate landscape. Of course, a few of their people had made exploratory forays into other parts of the world; sometimes the “explorer” did not have a choice because he might have been blown off course by a storm or caught by ice and forced to go wherever it went. The Yup’ik have many stories of this type. It seemed best to know intimately the land on which they dwelled.

As the tetrahedron suggests, the Yup’ik infrastructure had to include a dynamic sense of sacredness. This sense caused the Yup’ik to develop a nature-mediated technology in which the hunting implements and tools were made of natural materials so as not to offend the hunted animal. To ensure that balance was always maintained or regained, the Yup’ik created rituals and ceremonies with songs, dances and all the needed accoutrements.

Ceremonial mask. The Yup’ik view the relationship between humans and animals as collaborative. The animals give themselves to the hunter in response to respectful treatment. The thumbless and perforated hands of the mask symbolize restraint by the hunter to prevent over exploitation of nature.



The paraphernalia included masks, which were often an attempt to reify a vision, dream or unusual experience. They always includes a story and attendant values. Very often the mask represented an experience that a shaman had; he or she would render it into a mask using wood, stone, bone, feathers and natural paints. If the shaman was not given to carving, a carver would prepare the mask under the shaman's careful guidance. This was a way of preserving the knowledge for future generations.

Alaska Native Views of Technology and Education

Traditionally Alaska Native people developed a nature-based and nature-mediated technology to suit their needs, compatible with their environment and nature. As Natives have learned Western scientific and technological processes, it has been with an inclination toward "soft technology," which provides a means to temper Western technology and use it as a tool for adaptation to local culture and ecology. The focus of this "soft technology" can be to upgrade and update traditional skills, to develop tools that can be easily repaired, to conserve and be nonpolluting in the use of renewable resources for energy and raw materials, and to fine-tune the subsistence lifestyle. In searching for examples of implementing soft technology, Harrison, in his book *The Third World Tomorrow*, offered the following as representative criteria for its use:

- Improving an existing traditional technique;
- Modifying a modern machine;
- Inventing a new machine from scratch;
- Finding a useful and economical Western antique; and
- Applying a bit of indigenous wisdom to the solution of a new problem.

Soft technology is intended to help people become the producers of those things that are needed for human support and comfort.

As Natives have learned Western scientific and technological processes, it has been with an inclination toward "soft technology," which provides a means to temper Western technology and use it as a tool for adaptation to local culture and ecology.

In the past, Native people tended to view formal education as a hindrance to their traditional ways, but now they must look at it in a different light. They must modify education and give it direction to accomplish the goals they set for it, strengthen-

ing their own culture while simultaneously embracing Western science as a second force that can help them maintain themselves with as much self-reliance and self-sufficiency as possible. They can make it easier to thrive in a tough environment, first as humans, then as scientists, with a carefully developed technology.

The Western educational and scientific paradigms developed over the past several hundred years need not be dispensed with. However, a shift needs to be made toward a more holistic education in which a teacher-student-community collaborative approach is developed to address the needs of a fast-changing society. To achieve this, the formal educational system needs to reassess and redirect education to a holistic mindset, in which education is viewed as multi-disciplinary, multi-directional and multi-sensory, with the total environment serving as the laboratory. The critical task is to find ways to help people, especially teachers, to begin to recognize (and re-cognize) that the earth is indivisible and that it must be understood as a whole. To do so can help the learning process of the Native students, who enter school with all the linguistic and intellectual tools of their culture at their command but are seldom called upon to put them to full use in the classroom setting.

I have observed and taught in rural and urban classrooms in which science was taught from textbooks, using the scientific method and time-tested science experiments. My own undergraduate science education was derived from textbooks and laboratory manuals. These teaching-learning processes do not, however, take advantage of the students' environment or the environment's ecological processes. Nor do they prepare the students to recognize a "Creative Force" flowing in and around them at all times. This removal of the mystical force from scientific processes has created a society that places primary credence and faith on human's observational and rational faculties. Once this happens, we have a society in which the quality of humans and life diminishes, a society that no longer honors and reveres Nature but often misuses, abuses and disrespects Nature.

It is apparent that there is a significant contrast between Western scientific and Native world views. The former is formulated to study and analyze objectively learned facts to predict and assert control over the forces of Nature, while the latter is oriented toward the synthesis of information gathered from interaction with the natural and spiritual worlds so as to accommodate and live in harmony with natural principles. Native reciprocity with the natural and spiritual realms implies communication, which perhaps must be relearned by the Native, as it is now being learned by West-

ern scientists. As Caduto and Bruchac said in their book *Keepers of the Earth*, "The science of ecology, the study of the interactions between living things and their environments, circles back to the ancient wisdom found in the rich oral traditions of American Indian stories. Time and again the stories have said that all of the living and nonliving parts of the Earth are one and that people are a part of that wholeness. Today, ecological science agrees."

Native people must modify education and give it direction to accomplish the goals they set for it, strengthening their own culture while simultaneously embracing Western science as a second force that can help them maintain themselves with as much self-reliance and self-sufficiency as possible.

Consider, for example, the Yup'ik Eskimo fish camp setting as a model for exploring a more holistic approach to science education. The summer fish camp season is a time of happiness and warm weather, and it is a place for orderly Yup'ik industry. It also presents a cornucopia of traditional and modern technologies. Although the Yup'ik people do not always have technical names for the natural processes involved, the annual fish camp routines reflect the most concentrated situation in which they use many sophisticated scientific principles in activities such as preparing food, catching and preserving of fish, reading river currents and tides, assessing weather and wind conditions, classifying plants, fish and animals, using solar energy and adapting to seasonal transformations. These principles are an inherent part of daily life in fish camp. In the natural context of the camp environment, Yup'ik people feel they are in the realm of science, the world of inquiry and the process of discovery. For the people to live in harmony with Nature, they have to learn the skills to live with Nature. The secrets of Nature have to be learned for mutual nurturing and sustenance and to develop a holistic world view of the universe.

In the fish camp the environment becomes the laboratory and thus all teaching and learning are drawn from an ecological perspective. The sensory data that are collected in the mind are used to formulate conclusions based on values, perspective, philosophy of life and relations to the world. Over

thousands of years the Yup'ik culture has established a way to make the world accessible to reasoned inquiry and discovery, including ponderous questions about what is real, what is truth and what is good and beautiful. This knowledge flows and is channeled through Native science, art and sacred practice. The natural phenomena in the Native world are explained in terms of characteristics easily observable or experiences involving a high degree of intuitive thought.

The day-to-day subsistence activities of the summer fish camp can provide insight into the Yup'ik understanding and practice of "science," which can then serve as the basis for proposing a more integrative approach to teaching science to Native people.

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Subsistence Practices in the Bristol Bay Region of Alaska

JOANNA ENDTER-WADA, LYNN A. ROBBINS AND DOUGLAS W. LEVINE

There are strong links between community viability in rural Alaska and the continued availability of local renewable resources for subsistence activities. Subsistence hunting, gathering and fishing are important complements to local cash economies and provide social ties and cultural meaning for both Native and non-Native peoples.

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In 1975, in response to a lack of published information on which to base environmental impact statements, the Minerals Management Service (MMS) began to sponsor a series of social and economic studies in a variety of offshore areas. The goal of these studies is to provide information necessary for developing accurate and defensible environmental assessments and for monitoring possible environmental effects from Outer Continental Shelf development. Because harvests of naturally occurring, renewable resources are important to rural Alaskan communities, much work has focused on subsistence issues. The need for Bristol Bay subsistence-harvest and sociocultural information had been identified in several MMS Alaska Regional Studies Plans.

The Subsistence Division of the Alaska Department of Fish and Game (ADF&G) has had an active research program in Bristol Bay since 1980. The department has completed baseline studies for most communities in the region, documenting subsistence harvests and describing subsistence activities. Recently MMS contracted with these researchers to analyze the computerized database and technical papers resulting from these studies, review secondary literature and conduct research in seven Bristol Bay communities. The purpose of the research was to describe and analyze the harvests and uses of subsistence resources for the Bristol Bay region. The objectives were to:

- Identify subregions within the Bristol Bay area based on subsistence harvesting and processing practices;
- Examine the ethnographic meanings and context of subsistence; and
- Analyze the key political, economic, social and cultural factors that affect subsistence pursuits.

The naturally occurring resources used for subsistence fall into seven categories:

- Birds (grouse, ptarmigan, several species of

ducks and geese and their eggs);

- Small game (chiefly beaver, hare and porcupine);
- Big game (caribou, moose and bear);
- Marine invertebrates (clams and crabs);
- Marine mammals (seals and occasionally walrus);
- Plants and berries (many species); and
- Noncommercial fish (over 18 species of salt-water and freshwater fish, mainly salmon).

Two variables were consistently available for the Bristol Bay communities in the ADF&G data sets: the percentage of households harvesting various types of resources (a rough indication of involvement in subsistence activities and of the relative mix of resources harvested); and the average number of pounds per household harvested (a measure of nutritional dependence on particular foods). Community comparisons based on the percentages of households harvesting particular resources indicated three distinct subregions: the Pacific side of the Alaska Peninsula, the coastal communities on the Bristol Bay side of the Alaska Peninsula, and inland or "upriver" communities. Comparisons based on the amounts harvested per household often produced finer distinctions within those subregions. For example, in some analyses the Bristol Bay Borough communities clustered separately from other communities on the Bristol Bay side of the Alaska Peninsula. Similarly, in some analyses the inland communities could be broken into a Nushagak River cluster and an Iliamna Lake cluster. The clusterings are largely geographical, indicating that people generally harvest the resources available in their environment.

Based on this analysis of the ADF&G data and a review of secondary literature, seven communities were selected to represent the subregions: Chignik Lake, Dillingham, Naknek, New Stuyahok, Nondalton, Port Heiden and Togiak. The populations of these communities ranged from 2017

for Dillingham, the regional center, to 119 in Port Heiden, a small community on the Alaska Peninsula. Ethnic compositions included various mixes of Eskimos, Athapaskans, Aleuts and non-Natives. Fieldwork was conducted in these communities during August and September 1990, involving observations of subsistence practices and interviews with members of randomly selected households (212 households representing 778 household members) and with institutional officials (98 people).

Subsistence Cooperation and Sharing Networks

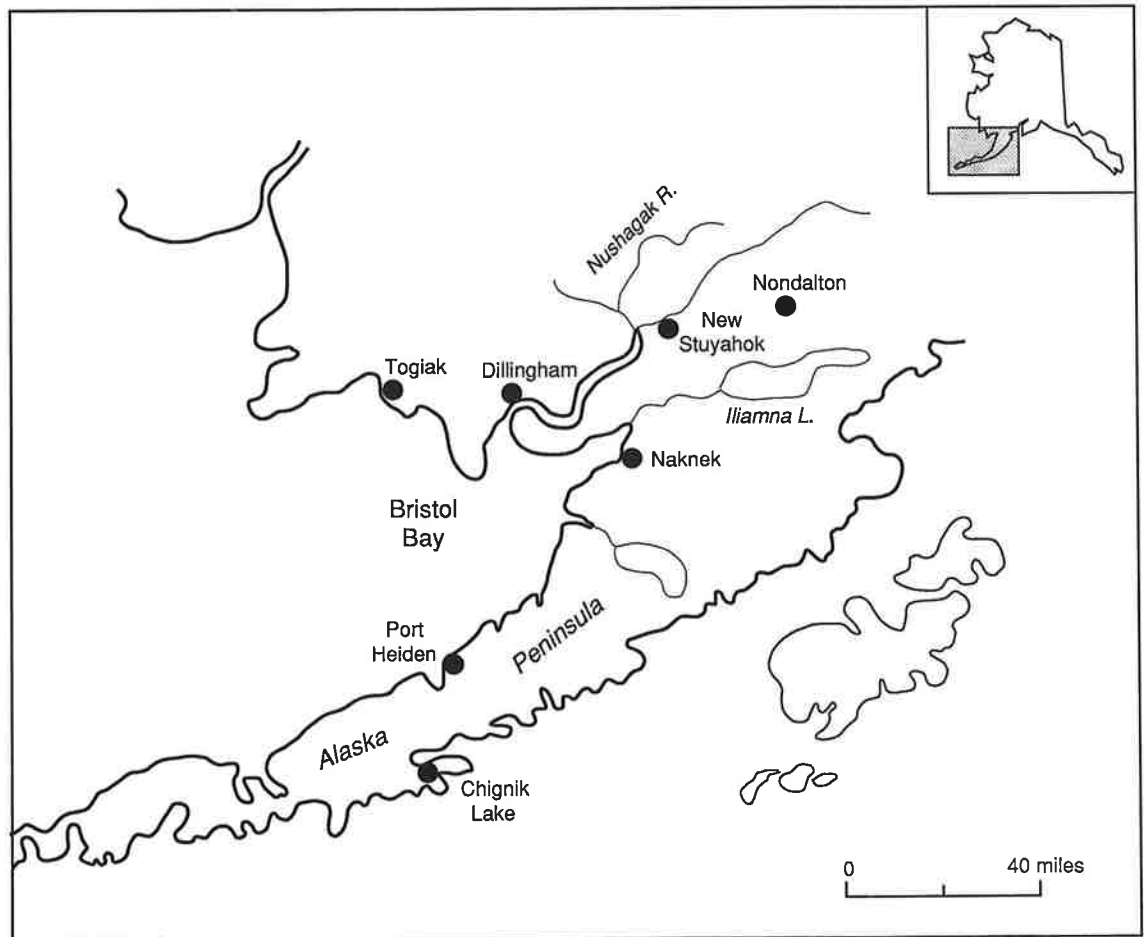
The data collected in this study differed from data collected in most previous Alaskan subsistence studies in that the connections between households that cooperate in subsistence activities and share subsistence resources were documented by calculating the percentages of households in each community that have harvesting, processing, giving and receiving ties to households in various locations (geographic networks) and to households that are related to them (kinship networks). The geographic extent of these networks and the kin-

ship relations on which they are based were analyzed to illustrate the importance of subsistence activities to community and regional social and cultural structures.

In terms of geography, cooperation and sharing networks are most concentrated within communities but extend to other communities throughout the Bristol Bay region, to other areas of Alaska, to the lower 48 states and, in a few instances, to foreign countries. Households tend to engage in subsistence harvesting and processing activities with people who live in the same or nearby villages, with cooperation generally decreasing as the distance between communities increases. Harvesting networks are more extensive than processing networks, that is, people from different villages get together more often to harvest resources than to process them. Processing generally occurs within household groups.

Sharing networks are more extensive and intricate than cooperation networks and exhibit a different geographic pattern. While the strongest ties for giving and receiving subsistence resources are between households within the same community, the strength of sharing ties does not decrease with distance outside communities. The next strongest receiving ties are generally between the

Study communities in the Bristol Bay area.



sample communities and other communities within Bristol Bay (not necessarily neighboring ones), indicating that the subsistence needs of Bristol Bay residents are generally provided for from within the region. However, the next strongest giving ties are to communities outside Bristol Bay, especially for noncommercial fish, big game, plants and, to a lesser extent, small game and birds. Bristol Bay is a net "exporter" of subsistence foods, and resources that are abundant in Bristol Bay provide for the subsistence needs of people in other areas as well.

The geographic extent of subsistence cooperation and sharing networks and the kinship relations on which they are based illustrate the importance of subsistence activities to community and regional social and cultural structures.

Differences in geographic patterns for cooperation and sharing were observed across the sample communities. Communities with the highest percentages of Alaska Native inhabitants (Chignik Lake, New Stuyahok, Nondalton and Togiak) generally exhibited the greatest intracommunity cooperation in subsistence activities and sharing of subsistence resources. Dillingham (the regional center) and Naknek (a subregional center) have more extensive intercommunity harvesting and processing networks, largely due to connections maintained by people who have moved from villages to those centers. Several communities occupy important positions in regional sharing networks: New Stuyahok shares resources of all kinds with other upper Bristol Bay communities; Togiak has extensive sharing connections with the Kuskokwim region; Port Heiden has the most sharing connections with the three major subregions of Bristol Bay and serves as a crossroads between them; and Dillingham and Naknek generally receive more subsistence resources from other communities in Bristol Bay than they give.

Differences in cooperation and sharing patterns also were observed across resource groups. People most often cooperate to harvest noncommercial fish, plants, big game and birds. The harvesting networks for these resources extend beyond the region and, except for birds, outside of the state. Cooperation in processing between households is greatest for big game and noncommercial fish, the two most important subsistence foods in Bristol Bay. Communities generally share the resources they have in abundance and receive resources they lack, need and desire. Big game, plants and non-

commercial fish are widely shared within and between communities, even though these resources are harvested by the highest percentages of households in all sample communities. This is because people share to avoid waste, to meet the immediate needs of other households, and to increase the overall variety in their diet by using species that are different or resources that are preserved or prepared in different ways. Even though plants and birds generally add only a small amount to local diets (in terms of edible pounds), the high level of cooperation in their harvest, and of sharing in the case of plants, indicates that these resources are more important to the overall subsistence economy than their bulk would indicate.

Kinship is the primary basis for cooperating in subsistence pursuits and sharing subsistence resources. Harvesting is most often conducted alone, followed by harvesting with other household members or with friends, relatives by marriage and siblings from different households. More harvesting is done among persons related matrilineally than through the male lines of descent. Most of the intergenerational harvesting networks are found within households, while interhousehold, intergenerational networks are most often composed of relatives by marriage and extended kin. The large percentage of harvesting among friends and siblings indicates that harvesting is often done with contemporaries and is a form of recreation and social activity. It also suggests that availability, skill and reliability, in addition to kinship, help determine the formation of harvesting groups. Harvests of birds, big game, plants and noncommercial fish are more group activities, with a wider variety of harvesting group compositions than harvests of small game, marine mammals or marine invertebrates.

Subsistence processing is generally done alone or with other members of the same household. Interhousehold processing networks are fewer and smaller than harvesting networks. Processing noncommercial fish is the activity that involves the most intergenerational kin groups and the widest variety of relatives by marriage and extended kin.

The kinship networks for sharing subsistence resources are more extensive than the kinship networks for harvesting and processing subsistence resources. Subsistence resources are widely distributed among family and friends, and sharing subsistence resources connects more households than harvesting or processing those resources. More households give subsistence resources to parents and offspring than harvest those resources with them, which suggests that interhousehold, intergenerational groups (parents, offspring, grandchildren) are more connected in distributing and

consuming subsistence foods than in harvesting and processing them. Parents and grandparents tend to receive resources that are harder for older people to process (birds, small game, big game and marine mammals) and to give resources that they are able to continue harvesting (plants and non-commercial fish). Parents and grandparents generally receive more subsistence foods because of need, because they usually know best how to prepare subsistence foods, and because their houses tend to be gathering places, ensuring the widest distribution of the food among relatives.

Factors Affecting Participation in Subsistence Activities

Several factors seem to be related to the likelihood of participation in subsistence activities. Of the four factors studied (gender, ethnic background, length of residency and age), the most significant was length of residency. People who have lived in the area longer are more likely to engage in subsistence activities, a relationship that held for all seven of the major resource categories and for both harvesting and processing. This indicates that subsistence is a regional way of life influencing all residents to some degree.

In general, men are more involved in all aspects of subsistence activities (harvesting and process-

ing) than women, although there are some variations in different resource categories. The only resources that women harvest more than men are plants and berries; women are much less involved

Length of residency was the strongest predictor of subsistence activities, indicating that subsistence is a regional way of life influencing all residents to some degree.

than men in hunting and trapping. While women process subsistence resources much more often than they harvest them, men and women spend nearly the same amount of time in processing. Women are much more likely than men to process plants and berries, only slightly more likely to process noncommercial fish and marine invertebrates, about equally likely to process birds and marine mammals, and less likely to process small game and big game. More women are wage earners and work full-time, limiting their ability to engage in subsistence activities, while more men are involved in seasonal commercial fishing, which leaves the rest of the year free to hunt, trap, fish and process what they harvest.

Ethnic background (recorded as full Native, part Native or non-Native) is significantly related to participation for some resource categories and some subsistence activities. Natives and part Natives are more likely to harvest and process marine mammals (restricted to Natives by law) and to harvest marine invertebrates than non-Natives, while full Natives are more likely to harvest and process small game and birds than either part Natives or non-Natives. There are no statistically significant differences based on ethnic background for harvesting big game, noncommercial fish or plants and berries, the three main subsistence resource categories. In general, ethnic differences are significant for subsistence activities that are not normally undertaken for sport.

Age group was also a significant factor. Over 90% of the individuals between the ages of 21 and 60 harvest or process at least one subsistence resource. Participation remains high (over 80%) for those over the age of 60. Youth under the age of 20 are much less likely to be involved in harvesting (60%) and especially in processing (35%).

Regression models were used to analyze the data. The model for respondents indicated that males participate in subsistence more than females, involvement in subsistence activity increases as the years in commercial fishing increase, young adults

Native woman cleaning a ringed seal skin using a traditional ulu knife.



engage in more subsistence activity, and persons with more education have increased involvement in subsistence (which is not surprising, since education is negatively correlated with age). The model for sampled households indicated that larger households harvest and process more resources, household involvement in commercial fishing is associated with higher subsistence involvement, and single-parent households are less involved in subsistence even when controlling for household size.

Meanings of Subsistence and Perceived Threats to Subsistence Activities

Much of the data collected through the interviews was descriptive and not easily analyzed statistically. Interviewees stressed the meaning and importance of subsistence in their lives. The meanings of subsistence are based on cultural continuity (the need and preference for naturally occurring foods, sharing, relationship with place, family traditions and recollections). The social and recreational pleasures of subsistence activities are important, as is the contribution that subsistence makes to economic security and stability and psychological well-being. Subsistence foods are widely shared at community events, religious occasions, celebra-

Conclusions

This research produced several significant findings. Harvests of naturally occurring resources were generally high in all communities. Comparisons between sample communities indicate that geography as well as socioeconomic characteristics account for resource harvesting patterns. Subsistence activities are an important foundation of regional social structure, provide intra- and inter-community integration and cohesion, and help to maintain Native cultural traditions. More Bristol Bay residents send subsistence resources outside the region than receive subsistence resources, indicating that Bristol Bay's naturally occurring resources provide for both local and nonlocal subsistence needs. Those individuals most likely to engage in subsistence activities are long-term residents, males, younger adults and Natives, although there are variations in this pattern for some resource categories. There is a positive relationship between involvement in commercial fishing and involvement in subsistence, indicating that the two activities are integrated and suggesting that changes in the commercial fisheries could impact subsistence activities. Finally, open-ended discussions with interviewees revealed that subsistence adds meaning to people's lives, people desire to maintain subsistence lifestyles, and people are concerned about perceived threats to subsistence.

Publications

Readers may obtain further information on the research described in the article from the following publications:

- Bristol Bay Subsistence Harvest and Sociocultural Systems Inventory*, by Joanna Endter-Wada, Lynn A. Robbins, Douglas W. Levine, Daniel L. Boxberger, Paula D. Nohalty, Joseph G. Jorgensen and Steven L. McNabb: OCS Study, MMS 92-0036, Technical Report No. 150. U.S. Department of the Interior, Minerals Management Service, Alaska OCS Regional Office, Anchorage, 1992.
- Oil Age Eskimos*, by Joseph G. Jorgensen: University of California Press, Berkeley, 1990.
- Contemporary Alaskan native Economies*, by Steve J. Langdon: University Press of America, Lanham, Maryland, 1986.
- Effects of Renewable Resource Harvest Disruptions on Socioeconomic and Sociocultural Systems: St. Lawrence Island*, by Ronald L. Little and Lynn A. Robbins: OCS Study, MMS AA851-CT1-59, Technical Report No. 89. U.S. Department of the Interior, Minerals Manage-

Subsistence contributes to cultural continuity, social and recreational pleasures, economic security and stability, and psychological well-being.

tions and gatherings of family and friends, and consumption of subsistence foods often provides the main reason for people to get together. For some, subsistence is an expression of aboriginal rights.

The threats to subsistence resources and activities most commonly mentioned were increases in government regulations, federal take-over of resource management in the wake of the McDowell decision, resource depletion due to increased human population, increased competition from sport hunting and fishing, and oil exploration. Changes in subsistence practices overlapped threats, but many persons also mentioned new devices and machines, changes in diet and food preferences, changes in the composition of harvesting groups, and shorter hunting and fishing excursions. Most of the residents contacted for this study believe subsistence activities will persist indefinitely despite perceived threats, and discussion with school children suggested a strong desire to continue subsistence pursuits and to favor subsistence foods.

ment Service, Alaska OCS Regional Office, Anchorage, 1984.

Effects of Renewable Resource Harvest Disruptions on Socioeconomic and Sociocultural Systems: Chukchi Sea, by Harry Luton: OCS Study, MMS AA851-CT1-59, Technical Report No. 91. U.S. Department of the Interior, Minerals Management Service, Alaska OCS

Regional Office, Anchorage, Alaska, 1985. *Subsistence-Based Economies in Coastal Communities of Southwest Alaska*, by Robert Wolfe, Joseph Gross, Steve Langdon, John Wright, George Sherrod, Linda Ellanna: Technical Paper Number 89, Alaska Department of Fish and Game, Subsistence Division, Juneau, Alaska, 1984.

NPS Ethnographic Studies of Subsistence

Prepared from information contributed by Linda J. Ellanna and George K. Sherrod, University of Alaska—Fairbanks.

The U.S. National Park Service's Regional Office in Alaska manages both natural and cultural resources in parks, preserves and monuments on about 200,000 square kilometers. Identifying and protecting the array of resources challenges the Service to understand how local people ensure the vitality of their environment along with their ways of life. One response to this challenge is the sponsorship of ethnographic studies in which cultural anthropologists work with community cultural experts to describe the human context of resources under NPS stewardship.

In 1988 Linda Ellanna and George Sherrod, Department of Anthropology, University of Alaska—Fairbanks, and associates, began work on a major study, called the Northwest Areas Ethnographic Study, managed through the auspices of the Division of Cultural Resources, Alaska Region, National Park Service. The study sought to determine subsistence relationships of populations within and between communities. This meant that the researchers needed to collect extensive genealogical, demographic and kinship data. In the absence of such information, it would not be possible to understand phenomena such as the intercommunity and intracommunity distribution and exchange of local resources, rights to particular harvesting areas, human population fluctuations through time and space, trading and hunting partnerships, the significance of place names in relationship to socioterritorial boundaries, marriage patterns, ideologies in relationship to particular areas and species, and many other significant questions. Non-subsistence economic data, such as available wage employment and participation in commercial fisheries, and the relationship between the subsistence and cash sectors of the economies of smaller communities and the overall region was collected to help delineate the significance of local resources. Since economic and political systems are closely connected and the region is driven, to a large extent, by the dynamics of world systems, data regarding external and internal politics were essential. Clearly the research needed a holistic perspective.

The study is still in progress but has resulted in some preliminary findings. One finding is that studies of subsistence necessarily extend beyond administrative boundaries of parks, preserves and monuments. At the outset the study focused on the public lands in Kobuk Valley National Park, Noatak National Preserve and Cape Krusenstern National Monument, which all lie within the Northwest Alaska Native Association region created by the 1971 Alaska Native Claims Settlement Act. Howev-

er, to document the Inupiat resource uses within the park, preserve and monument, the study had to extend the documentation and analysis to the Inupiat's use of resources beyond the administrative boundaries of the Service's Northwest Areas. Eventually the study area exceeded 93,240 square kilometers and included 10 small Inupiat villages and the regional center of Kotzebue. Preliminary findings support the idea that patterns of resource use for park, preserve and monument lands cannot be understood outside of a larger context, including the systematic seasonal use and occupancy of a particular area through time, as well as short-term and long-term resource fluctuations.

A second preliminary finding is based on new data on socioterritorial boundaries and use rights. Three study communities—Noatak, Kiana and Ambler—were selected as examples for generalizing about the larger study area. In Kiana and Ambler, for example, lifetime map biographies recorded for the majority of elders indicate that people from the Kobuk River throughout the historic period have continued to regularly use territories previously associated with Inupiat of the Arctic coast (Tagiaqmiut), interior-dwelling Inupiat (Nunamiut) and Koyukon Athapaskan Indians of the upper Koyukuk River. Previously documented socioterritorial boundaries and rights to resources associated with these diverse populations were challenged as a result of this research.

The study has also produced new data on regional cultural homogeneity. Scholars have long assumed that the Inupiat of the Kotzebue Sound area were relatively culturally homogeneous. The data from this research raise questions about these assumptions. Kinship terminologies, Inupiat place names, annual subsistence seasonal rounds and overall cultural data provided strong evidence refuting regional homogeneity. The preliminary data indicate that at least three Inupiat kinship terminological systems were functioning within the study area in the early 1990s. The variety of ecological niches occupied by Inupiat are reflected in diverse seasonal rounds. Finally, the diversity of place names for the same sites reflects linguistic, cultural and even ethnic variation throughout the region.

The study shows that land and resource uses cannot be accurately conceived of as merely economic or ecological. Overall Inupiat social and cultural organizations and ideologies are central to understanding resource uses and, to a large extent, the processes involved in related subsistence activities.

Social Impacts of Resource Development on Arctic Adolescents

CAROLE L. SEYFRIT AND LAWRENCE C. HAMILTON

Rapid social change has become a fact of life for much of the Arctic, particularly near areas of mineral and oil development. This study focuses on how change affects the expectations and aspirations of rural youth in Alaska, providing clues about the future of many rural northern communities.

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Much development-related social science has been done in the Arctic, including impact assessments accompanying mineral and oil projects, regional employment and unemployment analyses, and studies supported by the Minerals Management Service tracing subsistence activities and social networks for sharing subsistence harvests. Relatively little research has focused specifically on how change affects adolescents, whose life choices and beliefs about their future foreshadow the destiny of many Arctic villages.

Alaska's Northwest Arctic Borough recently became the site of a large mining operation, promising to alter the local economy substantially. During the spring of 1992, as part of ongoing research about how rapid social change driven by mining and oil development affects Arctic young people's expectations and aspirations, funded in part by the National Science Foundation, a team from Old Dominion University and the University of New Hampshire surveyed high school students and recent high school graduates in the Northwest Arctic Borough (NWAB) and in the Bristol Bay region. The Bristol Bay area has experienced no recent industrial development and continues its traditional dependence on its fishing industry.

Boats and dog team, Kotzebue. During much of the year Kotzebue Sound in icebound, and the city is accessible only by air.



Adolescence—A Developmental Stage

Adolescence is a critical developmental stage, during which children form their own identities and progress toward adulthood. In slow-changing homogeneous societies, where societal expectations are clear and there is broad agreement on the proper socialization of children, adolescents have little difficulty knowing how they will live their adult lives. The social changes brought by modern technology and cultural fusion, however, make adolescence more confusing. In rural areas, rapid development of natural resources confronts adolescents with new challenges and opportunities, while at the same time threatening cultural traditions and parental models. Adolescents' choices about their future can directly affect the viability of whole communities and the continuity of Native culture.

Despite increasing research on adolescents and resource development, few studies have sought data directly from the youths themselves. Among those few, conflicting findings emerge. Some studies report significant social disruption, with impact-area youths having higher levels of alienation and more negative attitudes toward their families, communities or selves. Other studies found little or no attitudinal difference. Several studies find support for the widely held idea that expanded employment opportunities reduce migration of rural youth to other areas. Research in Scotland's Shetland and Orkney islands, however, concluded that North Sea oil development did not appreciably affect the long-term migration intentions among students. Students with high educational and occupational aspirations were more inclined than others to leave their rural homes. Similar findings came from a study of Newfoundland students near the Hibernia oilfield development.

High school students in Deering (population 165) query the survey database to see how their responses compare with students from other schools.



Alaska as a Research Site

Rural Alaska offers further opportunities to study the consequences of rapid resource development for adolescents' life choices. The environment is harsher, more remote and less populated than either Newfoundland or the northern Scottish islands. Residents are primarily natives (Inupiat and Yup'ik), with cultural and economic ties to subsistence hunting, fishing and gathering activities. There are few full-time cash job opportunities, especially for young people. Although settlement

In rural areas, rapid development of natural resources confronts adolescents with new challenges and opportunities, while at the same time threatening cultural traditions and parental models.

of aboriginal land claims through the Alaska Native Claims Settlement Act (1971) created regional and village for-profit Native corporations, few have been financial successes, and some observers argue that Alaska Natives lost more in land use and subsistence rights than they gained.

The Northwest Arctic Native Association (NANA), a Native regional corporation, entered into an agreement with Cominco Alaska, Inc., to develop Red Dog Mine. The Red Dog deposit, which sits on NANA-owned land, contains a reserve of 85 million tons of 17% zinc, 5% lead and 24-oz/ton silver. The agreement includes a com-

mitment from Cominco to hire and train local people, "with the intent that by the twelfth year of operation [2002] the mine will be run 100% by natives from the region." This goal forges a connection between the mine and local youths, who must make up its future workforce.

To study the effect of this major change, the research team collected data on high school students through surveys administered by the schools and through small-group interviews. Recent high school graduates were surveyed by telephone or face-to-face interviews. The principal investigators visited Kotzebue and Dillingham (the sites of the Northwest Arctic and Bristol Bay school district offices) four times over 1991-92. They also visited three of the four village schools in the Southwest Region School District and seven of the nine village schools in the Northwest Arctic School District.

As set forth in the guidelines for Arctic social science research,* Natives in the research areas provided input. The Northwest Arctic School District School Board and school superintendents from the Dillingham City School District and the Southwest Region Schools offered suggestions for improvement before approving the study design. Ten school principals in the Northwest Arctic and five in the Bristol Bay area then took responsibility for administering questionnaires to their students in grades 9-12 during March and April 1992. At that time the Northwest Arctic School

* See p. 78 of this issue.

District reported 381 students enrolled; 282 returned questionnaires, for a 74% response rate. From the Bristol Bay region the response rate was 67% (148 out of 221 students). The data thus encompass large majorities of the high school students in both districts.

The high school surveys from the two regions tell what the currently enrolled students expect and hope to do after finishing high school. To compare their expectations and aspirations with actual post-graduate experiences, six local residents (Inupiat from the NWAB and Yup'ik from the Bristol Bay area) were trained as interviewers to collect data from people who graduated from these same schools between 1987 and 1991. This phase of the project is still underway, and since data collection and analysis are not yet complete, the results described below must be understood as preliminary.

Education

The Northwest Arctic students, especially females, express fairly high educational aspirations. Half of the female students and 36% of the males say they expect to attend university. More males (22%) than females (15%) expect to attend technical school, and more females (16%) than males (7%) expect to attend community college. However, only 38% of the students think their high school education is preparing them for college, 30% feel they are receiving adequate career counseling, and 30% feel they are receiving adequate financial aid information. Almost two-thirds (63%) would change the courses they are taking in high school if they could.

Retrospectively, 75% of the graduates said that there were classes they wish they had taken in high school but didn't. On an open-ended follow-up question, graduates most often cited additional

math and science classes (34%), specifically mentioning algebra, geometry, trigonometry and chemistry. Computer training and typing/business skills (each 12%) were the second most-cited categories.

Of the ten Northwest Arctic schools studied, Kotzebue High School is the largest and one of the few high schools (most are K-12). Kotzebue students are significantly more likely to expect to attend a university. Among the smaller village schools, the percentages of students with university aspirations vary widely, but none are close to Kotzebue's 63%.

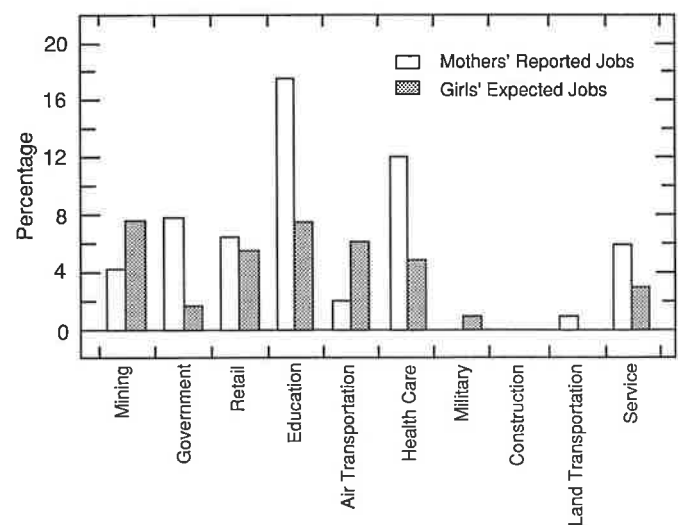
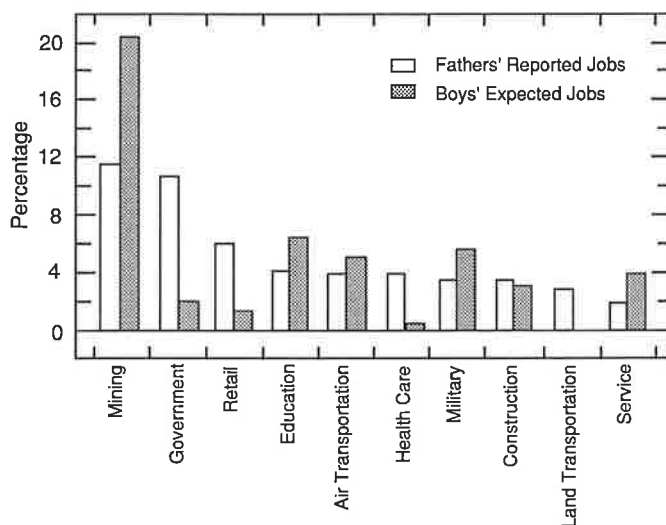
When completed, the Northwest Arctic and Bristol Bay surveys should provide school personnel with practical information about career aspirations, job preparation and counseling. (Some of these personnel contributed to the questionnaire design.) For example, graduates' often-expressed wishes that they had taken (or been offered) more math and science courses should be considered seriously.

Jobs

Only 6% of the students report that their fathers hold professional or technical jobs, but 20% of the boys expect to have such jobs ten years from now. Similarly 10% of the students report that their mothers hold professional or technical jobs, but 20% of the girls expect them. A growing interest in these jobs helps explain the university aspirations and the desire for more math, science and computer education.

When boys were asked in what industries they expect to be working ten years from now, mining (21%) was the most common choice. Government, retail and health care employ many fathers, but relatively few boys expect to work in these fields.

Industries in which Northwest Arctic high school students expect to be working ten years from now and industries in which their parents work.



Few boys and no girls expect to be subsistence providers. The concentration of mothers in education and health care is not matched by daughters, who more often than their mothers look toward air transportation (as airline flight attendants or ticket agents) or mining.

Clearly the Red Dog Mine looms large in the students' planning. About a third believe that the mine improves their employment prospects, and 26% (36% of the boys, 17% of the girls) say they expect to work in mining at some time in their lives. More students expect to work for Red Dog than for any other employer.

For both males and females the percentage of students expecting to work in mining ten years from now exceeds the percentage of their parents so employed. When the students were asked what job they expected immediately after high school, interest in mining was even more pronounced. These expectations bode well for Red Dog Mine's goal of drawing its workforce from the Northwest Arctic. Students appear well aware of this promise, and many anticipate that it will shape their future.

Log building with snowmobile, Kotzebue. Snowmobiles are more common than cars on Kotzebue's streets.



Migration

Outmigration of ambitious young people is the bane of many rural areas. Residents often hope that economic development can slow or reverse outmigration by providing incentives for local youth to stay in the area. Testing this "beneficial retention hypothesis" by studying youth migration intentions is a focal point for this research.

Overall, 62% of the high school students say that they expect to live most of the rest of their lives away from the Northwest Arctic Borough (though many still plan to stay in Alaska). The

proportion expecting to leave NWAB is significantly higher among students who are:

- Attending Kotzebue High School;
- Not planning to work in mining;
- Hoping to attend a university; and
- Not born in Alaska.

Interviews with students and educators reveal that many students aspiring to higher education do not complete degrees, partly because the difference between their villages and Anchorage or Fairbanks is so great and the ties are so strong. During group interviews, students in the Bristol Bay area first said they wanted to leave their village (only 2 out of 25 wanted to stay), but after the initial comments about how "boring" their village is, they began suggesting choices that would bring them back. For example, many said they want to come back and teach. In another village, most students mentioned two occupational choices: one that would almost certainly take them away from the village and another they might pursue closer to home (for example, law and teaching, agriculture and bush pilot). These and other interviews elicited comments indicating the strong pull of community, family and the familiar.

Discussion

Preliminary analysis of the Northwest Arctic data finds divergence between the life choices of high school students and their parents. Many students expect to benefit from hiring and training commitments at Red Dog Mine. Many also aspire to higher education and to professional or technical jobs. Later analyses will compare students with high school graduates, and Northwest Arctic with Bristol Bay, in more detail.

Although Bristol Bay is a comparison area for this project, there has been recent speculation about mining there as well. If large-scale development eventually takes place there, this study will provide a rich source of pre-impact baseline data. Students in the Bristol Bay area expressed worries about the environmental consequences of mining:

- "If they mine here it will affect nature's cycle. The runoff would go into the water. First it would hurt the plants. No plants; it would hurt the animals. No animals; it would hurt the people."
- "Mine people came to talk to us, but they don't use words we understand and they don't understand us and our concerns."

Their concerns mirror those of Northwest Arctic students, who hoped for mining jobs yet agreed (56%) that industries should be shut down if they pollute.

This study addresses several topics of broader social-science interest, beyond the immediate concerns of Northwest Arctic and Bristol Bay residents. Much has been written about the experiences, sometimes unhappy, of 1970s energy "boomtowns" in the western U.S. Social impact assessment research studies the social problems that can arise when rural areas undergo rapid development, attempting to diagnose and anticipate the problems and recommend ways to avoid them. Learning from social impact research, planners in other communities have sought to mitigate potential boomtown problems. The mining agreement between NANA and Cominco is one example where planners tried to ensure that development would bring long-term benefits to local residents without harming their way of life.

Alaska, Newfoundland and the Shetland and Orkney islands all have unique histories and cultures, they also face some common problems as isolated and resource-dependent northern communities. Similarities and contrasts among these areas, particularly as they relate to the different impact-mitigation strategies of local governments and planners, will be of considerable interest. Eventually these comparisons can be extended to other circumpolar areas, continuing research on how development affects adolescents and society.

Publications

Readers may obtain further information about the research described in this article from the following publications:

- Generation: Social Impacts of Oil Development on Adolescents in Newfoundland*, by Carole L. Seyfrit: Institute of Social and Economic Research, Memorial University of Newfoundland, St. John's, Newfoundland, 1992 (forthcoming).
- Social Impact of Rapid Energy Development on Rural Youth: A Statewide Comparison*, by Carole L. Seyfrit and Norma C. Sadler-Hammer: Society and Natural Resources, vol. 1, p. 57-67, 1988.
- Who Will Leave? Oil, Migration, and Scottish Island Youth*, by Carole L. Seyfrit and Lawrence C. Hamilton: Society and Natural Resources, vol. 5, no. 3, p. 263-276, 1992.
- Village Journey: The Report of the Alaska Native Review Commission*, by Thomas R. Berger: Hill and Wang, New York, New York, 1985.
- Red Dog Facts—Overview*, by Cominco/NANA, July 1990.
- Arctic Social Science: An Agenda for Action*, by Committee on Arctic Social Sciences: National Academy Press, Washington, D.C., 1989.

Learning from social impact research, planners in other communities have sought to mitigate potential boomtown problems.

Rural-development research typically focuses on "hard" economic and demographic variables, ignoring difficult-to-measure subjective factors such as peoples' ties to family and community, quality of life and environmental values. This research explores ways to measure several subjective factors, such as the importance of ties to family and community, and incorporate them in statistical models estimating the probability of migration.

The Alaska study's design encourages several broad comparisons: Northwest Arctic with Bristol Bay; local centers (Kotzebue, Dillingham) with villages (Kiana, Togiak, etc.); high school students with graduates. Previous research in Newfoundland and Scotland presents an opportunity for international comparisons as well. Although rural

Occupational Fatalities in Alaska

THOMAS R. BENDER, JAMES C. HELMKAMP AND PAUL R. KEANE

Economic development and technological change in the last 50 years have altered the way humans interact with Arctic environments. These changes have been accompanied by alarming increases in occupationally related accidents and deaths in Alaska, an aspect of shifting health patterns known as "the new morbidity and mortality." In response, the National Institute for Occupational Safety and Health established an Alaska Office, which is using social science tools to find ways to lessen the personal and economic toll of occupational fatalities.

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There have always been elements of danger and adventure associated with work and life in the Arctic. This has been recognized and even celebrated throughout the Alaskan experience; history is filled with the ballads and stories of men and women who came to Alaska to find wealth, a home or a new beginning—and often died in the harsh conditions of the gold rush, the fur trade or the fishing fleets. The working conditions in Alaska have been among the most adverse known to humans, and this has contributed towards unusually high workplace injury and fatality rates.

Occupational Fatalities in the 1980s

Data for 1980–1988 from the National Traumatic Occupational Fatality (NTOF) surveillance system clearly showed these elevated rates for Alaska. Overall fatality rates for workers in the private sector were nearly five times the national average (33.1 per 100,000 workers compared to

During the nine-year surveillance, Alaskan occupational fatalities showed the following characteristics:

- Alaska had 479 fatalities, an average of 53 worker deaths per year.
- Of these, 96% were male and 4% female.
- In Alaska, 79% of the fatalities were Whites, 10% Alaska Natives, 6% Asians, 1% each for Hispanics and Blacks and 3% other races.

In the U.S. as a whole, most (22.5%) workers were killed by motor vehicles. Machines were responsible for 13.3% of the fatalities, and homicide was the third leading cause (12.1%). In Alaska, water transportation was the leading cause of death, at 25.5%; air transportation was responsible for 21.9% of the deaths, and motor vehicles was third, with 9%.

The agriculture, forestry and fishing industry division experienced the most fatalities in Alaska; the commercial fishing sector accounted for many of these deaths, particularly due to water transportation (69%) and drowning (13%). In the rest of the nation, construction was the industry division with the most deaths; transportation, communication and public utilities was second; manufacturing third; and agriculture, forestry and fishing fourth. Interestingly, although the agriculture, forestry and fishing industry division represents high-risk work both in Alaska and in the U.S. in general, the reasons differ. In Alaska, commercial fishing and forestry appear to represent higher risk than farming. However, farming appears to represent the highest risk in most other states and in the U.S. as a whole.

The NTOF surveillance system is the only nationwide registry of traumatic occupational deaths, and it determines, in large measure, where and how the National Institute for Occupational Safety and Health (NIOSH) allocates its resources. The compelling NTOF data alerted epidemiologists at

Alaska had the highest occupational fatality rate of any state in the U.S., as well as the highest rates in specific industrial divisions.

the national average of 7.2 per 100,000). Fatality rates in the agriculture, forestry and fishing industries were seven times the national average (132.2 vs 19.1). Rates in the transportation, communication and public utility industries were nearly three times the national average (61.3 vs 23.9). Alaska had the highest occupational fatality rate of any state in the U.S., as well as the highest rates in specific industrial divisions.

NIOSH to the unique problems in Alaska and led its Division of Safety Research to establish a field office in Alaska. This Alaska Office, which opened in May 1991, was conceived and funded for a single purpose: to find the best way of lessening the personal and economic toll of occupational fatalities in the forty-ninth state.

NIOSH Research in Alaska

To develop accident prevention strategies, it is imperative to know to whom the accidents happen, where they occur and what is causing them. The best way to achieve this purpose is to apply the four stages of the public health model to the problem:

- Identify the sources of injuries and fatalities;
- Determine the best intervention to prevent them;
- Implement prevention interventions; and
- Inform workers and employers about the interventions.

The activities of the Alaska Office are still at the first of these four stages.

Three high-risk occupations accounted for 60% of the fatalities; 36 were commercial fishing workers, 10 were pilots and 4 were loggers.

Alaska presents some special difficulties in data collection and injury surveillance. One of the most significant issues is how to determine the extent of the population at risk. Much of Alaskan economic activity is seasonal, especially in the commercial fishing industry. Nonresidents, students and other itinerant workers frequently seek seasonal or temporary employment in Alaska and leave after the work season. Other workers split their employment during the year, making it difficult to determine the size of the labor force at any given time.

Fishing, the industry with the highest risk, poses special problems.* There is, at present, no census of professional workers in the fishing industry; this information is extrapolated from such information as vessel size, commercial fishing permits and crew member licenses. Determining this "denominator" data relating to the size of the workforce at risk can be especially difficult. "Numerators," data relative to the occupational fatalities, can also be difficult to obtain. Many Alaskan deaths, especially

in the fishing industry, are presumptive. If there is a death at sea and no body is recovered, a presumptive death certificate is completed. However, these death certificates have generally omitted an "injury at work?" identifier. Since NTOF relies on this identifier to categorize records, their statistics almost certainly undercount commercial fishing deaths.

In its initial phase the Alaska Office has concentrated on collecting data on fatalities determined to be work-related. The heart of the descriptive phase is an in-depth investigation of the circumstances surrounding a fatality; this investigation follows guidelines of the Fatality Assessment and Control Evaluation (FACE) program of the Division of Safety Research. This is a national program to identify the factors associated with occupational traumatic fatalities.

In the past, FACE has focused on selected cause-specific fatalities due to falls, electrocutions and confined spaces. With the initiation of FACE investigations in selected states such as Alaska, this approach was expanded to encompass industry-specific fatalities in which many different causes of death may be encountered. In Alaska, all known fatalities that appear to be work-related are actively investigated, and data are collected through an on-site visit or personal contact with agencies such as the Office of Occupational Safety and Health of the Alaska Department of Labor, the U.S. Coast Guard, the National Transportation Safety Board or the Federal Occupational Safety and Health Administration.

1991 Occupational Fatalities

In 1991 there were 72 "provisional" work-related incidents ascertained by the Alaska Office research staff. Fifty-eight of these were "verified" as occupational, and they resulted in 83 fatalities. The agriculture, forestry and fishing industry division accounted for 38 fatalities, and the transportation, communication and public utilities division for 21. Three high-risk occupations accounted for 60% of the fatalities; 36 were commercial fishing workers, 10 were pilots and 4 were loggers. The causes of death in commercial fishing included the following: 6 drowned, 28 were presumed drowned (including one in a plane crash while spotting fish) and 2 were crushed between objects on deck during crab pot operations. Although 24 persons were killed in aircraft crashes in 1991, only 10 were employed in the air transportation industry; the other 14 were passengers on work-related travel.

* For a more complete discussion of occupational risk and fatalities in the fishing industry, see p. 26.

The four logger fatalities were all single-fatality incidents. Three were involved with tree felling, and a log shifting on a slope during logging operations caused another fatality. A fifth incident involved a helicopter that was engaged in logging operations.

Ninety percent of the fatalities were male. The mean age at the time of death was 34 years in fishing, 40 in aviation and 43 in logging. Seventy-nine percent of the fatal incidents resulted in single fatalities, and 9% had three or more fatalities; one commercial fishing incident and one air crash had

six deaths each. In the latter incident five park rangers died.

Active and timely identification and investigations of on-the-job fatalities in Alaska are a direct result of the national surveillance data from NTOF, which identified work-related fatalities as a critical area of concern. The Alaska Office and NIOSH have begun to serve as a useful catalyst in the Nation's highest-risk state. This small group hopes to contribute to an emerging consciousness about worker safety and thereby help make Alaska a safer place to work.

Culture and Communication in the Alaskan Courtroom

A Place to be Made to Talk

PHYLLIS MORROW

This project analyzed the ethnographic context of legal proceedings involving Yup'ik Natives in western Alaska. Three researchers, a cultural anthropologist, a trial lawyer and a legal interpreter, have studied public record tapes, conducted interviews and observed proceedings in session. The purpose has been to test the hypothesis that cultural differences and translation problems influence trial outcomes.

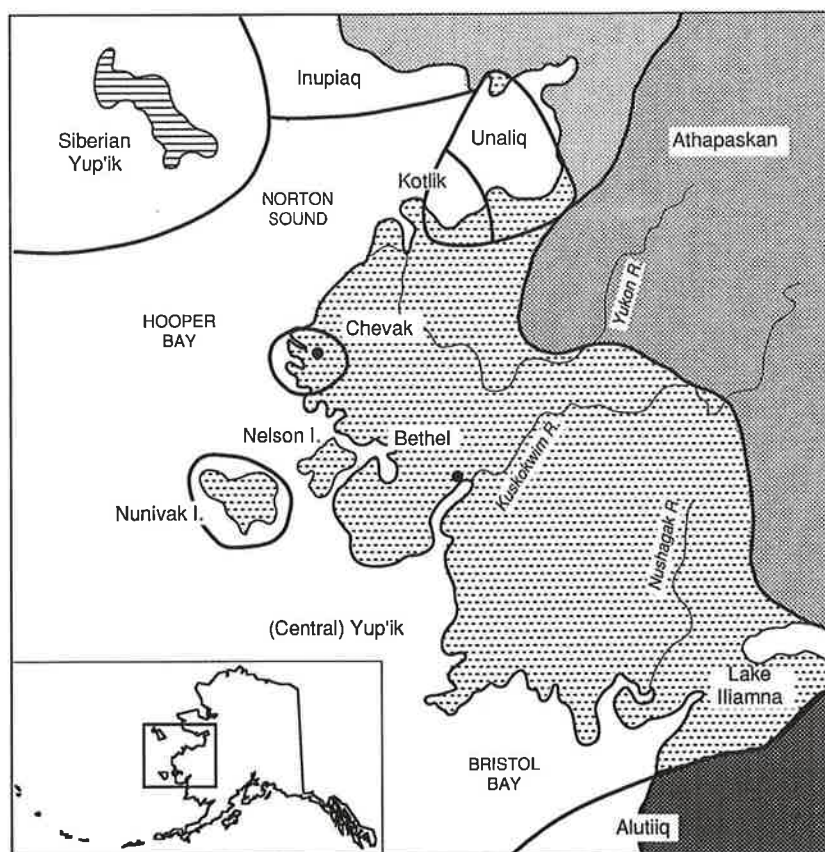
Phyllis Morrow is with the Department of Anthropology, University of Alaska—Fairbanks; the other researchers are Galen Paine, Public Defender, Sitka, Alaska; and Elizabeth Harnum, Languages Commissioner of the Northwest Territories, Yellowknife, Canada.

As the population of the United States becomes increasingly diverse, it becomes more difficult to administer justice in ways that are simultaneously effective, equitable and culturally sensitive. The operation of the U.S. legal system is complex, and its outcomes can be problematic, especially for minority populations. With its formal language and protocol rooted in European traditions, the system poses particular problems for those groups whose cultural practices, including methods of

conflict resolution, derive from non-European traditions. Native Americans are among those who experience such conflicts with the justice system. Understanding the nature and sources of these conflicts is critical to the administration of justice in the U.S.

In 1991-92 the National Science Foundation and the University of Alaska—Fairbanks funded preliminary research on relationships between cultural and linguistic differences and the outcomes of various legal proceedings in an Alaska Native setting. The researchers hoped to isolate factors that may be contributing to a high confession rate in western Alaska, the disproportionate incarceration of Alaska Natives and general cross-cultural tensions surrounding the justice system. Alaska Natives make up 16% of the state's population but 32% of the inmate population. The research team included a cultural anthropologist, a trial lawyer and a linguist with extensive experience training aboriginal-language-speaking court interpreters.

Bethel, Alaska, with a population of approximately 4700, was chosen as the research site. The service and transportation hub of the Yukon—Kuskokwim Delta, Bethel is often described as the intersection of two cultures. Its population is approximately two-thirds Alaska Native and one-third non-Native, the latter primarily originating from other states. While there is a stable core of residents, there is also a high percentage of transients who are drawn to educational and employment opportunities in the town but maintain their primary social affiliations elsewhere. The non-Native population fills the majority of administrative and other white-collar service positions, in-



The Central Yup'ik region of western Alaska, showing the dialect areas.

cluding those in the legal system, and is particularly impermanent.

Central Alaska Yup'ik Eskimos, who make up the Native population of Bethel, currently number about 21,000 people, inhabiting approximately 70 communities extending from southern Bristol Bay

Overall the court is seen as an inherently intimidating place, literally "a place where one is made to talk" (qanercetaarvik).

to northern Norton Sound along the Bering Sea coast and up the major river systems flowing into the Bering Sea. The Bethel trial district covers the heartland of this area, the size of the state of Oregon.

There are no roads connecting any of the communities; transportation is by commercial aircraft throughout the year, by boat in months of open water, and by snowmachine or dog team in winter. Consequently the importation of goods and services into the region is very costly, contributing to a cost of living about twice the national average. The relative isolation has, however, also contributed to the maintenance of the Native language and many other sociocultural traditions. People remain proud of their heritage and continue to work concertedly towards adapting new tastes and technologies to local values and the exigencies of life in an extreme climate.

At the same time the area is a troubled one. Like other rural regions of Alaska, the western part of the state has a high incidence of violent crime: the per capita murder rate is one of the highest in the country. From 49 to 70% of Alaska's homicides in 1975–1991 occurred in rural communities, which represent less than 50% of the total Alaskan population. According to State Police statistics, 90% of violent crime is alcohol related. Being primarily engaged in a fishing and hunting economy, the people are resource rich but cash poor. Therefore, 85% of the criminal cases are handled by the Public Defender. The courts handle few property crimes. Many civil matters, such as tribal adoptions, are resolved locally without recourse to state adjudication. Tribal courts are beginning to develop as part of a Native sovereignty movement but have not yet had a significant impact on the number and types of cases heard by the state system.

In many ways the legal system is at the crux of the cultural intersection in the area, and it clearly reflects the ambivalence of the cross-cultural relationship. On one hand the courts offer a method for dealing with serious offenders that may minimize disruption in small, interrelated communities. Many of Bethel's legal professionals are dedicated individuals who express a personal commitment to this setting so remote from their families and natal culture. On the other hand the Western legal system remains unfamiliar to its Yup'ik clients, and the alien customs and formality of

Court clerk assisting a local resident. Without additional pay or specialized training, many court clerks and secretaries also serve as interpreters.



legal proceedings deter many from voluntary recourse to it. Frequently there is resentment or consternation when the state enters cases that communities might prefer to resolve by themselves. Overall the court is seen as an inherently intimidating place, literally "a place where one is made to talk" (qanercetaarvik).

Language and Cultural Conflicts

"Talk" accurately sums up the character of the law, for it is through verbal forms—questions and narratives—that the courts determine guilt or innocence and pronounce judgment. Because cultural conflicts on a number of levels frequently center on language, the researchers looked carefully at the ways people used and evaluated speech in legal settings. During an initial field period in the summer of 1991, the team observed court proceedings in

Unlike the Northwest Territories, where jurors monolingual in aboriginal languages are now allowed, western Alaskan jurors are required to be English speaking.

Bethel and some itinerant village sites and analyzed audio recordings of those proceedings. Interviews were also conducted with legal professionals, other employees of the court and related agencies, prospective jurors and a variety of people who took part in proceedings. An informal sense of inmates' concerns and perceptions of the legal system was obtained by holding a series of workshops on legal procedures at the correctional center.

The most obvious linguistic concern was that English was the language of the court, while Yup'ik Eskimo remains the first or preferred language for most people in the region (making it one of the most viable Native American languages). Unlike the Northwest Territories, where jurors monolingual in aboriginal languages are now allowed, western Alaskan jurors are required to be English speaking. Defendants and witnesses who want Yup'ik interpreters, unless they are obviously monolingual in Yup'ik, must request them. About 80% of those going through legal proceedings (in any capacity, from defendant to juror) said that they would understand more and feel more comfortable if the proceedings were bilingual. Those who worked in the legal system, by contrast, estimated that only 10% "needed" interpreters. Since the need perceived by the institution is low, and since proceedings are slower when everything is interpreted,

there has been no pressure from the legal establishment to develop a corps of trained interpreters. Instead, bilinguals who have full-time jobs as court clerks and secretaries double as legal interpreters. In addition to specific misunderstandings that tend to occur, the emphasis on English suggests, to many local people, a disregard for their culture in an area where it is the English speakers who are the immigrants.

It might be argued that since most people can speak English, the convenience outweighs the cultural slight. However, the use of English does not obviate cross-cultural communication problems. This is because speech patterns and conventions common to Yup'ik also characterize the local varieties of English. These patterns and conventions reflect ideas about the value and force of speech that are culturally Yup'ik and that differ in significant ways from the cultural assumptions that are part of the speech of non-Native attorneys and judges.

Again, the Yup'ik word for the court suggests one of these assumptions. The court is not only a speech-centered place but a place where one is *made* to talk. Those who participated in legal proceedings frequently responded as if they felt coerced. This was true not only in situations where pressure was intentionally applied, such as the police confession, but also in more neutral courtroom situations, such as the voir dire questioning of prospective jurors.

Compliance and Confession

To determine whether subjective impressions of a high confession rate were true, Galen Paine conducted a preliminary analysis of 155 reportable cases in Bethel. Of these, 59% of those who were questioned confessed to the crime under investigation. Paine characterized 49% of those confessions as "truthful," that is, the person volunteered or elaborated on incriminating information, according to court records. The degree to which they elaborated on confessions seemed independent of the degree of coercion applied by an interrogator. Paine contrasted this sample with 118 reportable cases from Sitka, Alaska, where the criminal suspects were primarily non-Native (those who were Native were from an unrelated Alaska Native group, Tlingit Indians). Only 51% of this sample confessed to the crime at hand; even more strikingly, only 32% volunteered incriminating details.

The confession rate in the Bethel area was thus not only comparatively high but contained significantly more voluntary confessions that had incriminating detail. Both Natives and non-Natives attributed these characteristics of Yup'ik confession to

the fact that "Yup'iks are honest."

Indeed, Yup'ik values and cultural practices described by nineteenth century observers and contemporary elders undoubtedly reinforce this honesty. At the once-traditional Messenger Feast, or Kevgiq, offenses committed during the previous year were revealed in metaphorical songs, an exposure considered necessary for rebalancing relationships among humans and with the supernatural. Since miscreance (particularly unconfessed) was thought to result in disease or misfortune, it was generally not necessary for other humans to administer punishment, although the humiliation of public exposure was sometimes extreme. In one account a man died of a heart attack shortly after he was publicly accused of stealing food.

Today first-time offenders seem to expect that confession will ameliorate the crime and the punishment. These defendants apparently assume that everyone else is honest, too. When told that others have incriminated them, they often confess to actions they said they do not remember. Furthermore, prison inmates are distressed to find out that "promises" police made to them are not legally binding ("We are honest; don't they have to be?"). Learning from their experiences with the legal system, repeat offenders tend to act more self-protectively, leading some inmates and attorneys to say that the system "taught people to lie."

Compliance in Scripted Interchanges

Confession, however, represents only one form of compliance with the legal system. Researchers also observed compliance in more routine types of questioning. During these proceedings, defendants almost always answered the court's scripted questions with predictably "correct" responses. The question "Do you understand?," for example, was answered affirmatively, even when subsequent discussions or events made it apparent that the person did not understand several of the points to which he had agreed. When defendants did give an unpredicted answer, they tended to withdraw it quickly when it became obvious that the response attracted attention. A segment from one change of plea serves to illustrate:

JUDGE: Have you had time to think about what you wanted to do in this case, these cases?

DEFENDANT: (No answer)

JUDGE: Have you had time to think about all this?

DEFENDANT: No.

JUDGE: You haven't? You want more time to

think about it?

DEFENDANT: No.

JUDGE: OK. Have you had enough time to think about it?

DEFENDANT: Yes.

This pattern, too, appears to be culturally based and longstanding. An anecdote recounted by Catholic priest Francis M. Menager in 1927 details a similar exchange, where an authority's questions are intended to cue certain responses (contemporary spellings and English translations are added in brackets):

One day I scheduled an examination for about twenty adults. Among them was Chungalrea, an old seal hunter, who was anything but bright. After he had recited the prayers I asked him the first question of the catechism: "Agayun attauhiugok ka?" [Agayun atauciuguq-qaa?/Is there one God?]. The old man being very bashful answered with an expression which the Eskimos use when they are nervous or nonplused: "Nau mike," [Naamiki] which means, "I don't know." "Why," I said annoyed, "you don't know, and all these months I have been teaching you about God. Get out of my sight and don't come back until you know!" When the old man had gone out into the hall the other Eskimos asked him, "Did you pass?" "No," he said, "I was very foolish. The priest asked me if there is a God and I answered, 'Nau mike' and he threw me out." This made a deep impression on all and I never got that answer again.

Whether Chungalrea felt more certain of the nature of God after this encounter is unknown; what is clear is that he (and everyone else) quickly adjusted to the script for this interaction, for it was humiliating to produce the wrong answer. In the court, as in the catechism, questions and responses are scripted, but for the most part it is only the "regulars" who know the script. Witnesses and defendants must surmise the correct responses. To do this they need to interpret linguistic and paralinguistic cues, such as intonation and gestures, across a cultural gap. The strategy of compliance "works" in that interrogators, whether judge or priest, seem satisfied as long as everyone replies "correctly."

Compliance in the Voir Dire

Was there a compliance pattern, then, in less-scripted settings, where the costs of noncompliance were lower? The voir dire, a process that results in a prospective juror's acceptance or disqualification from a case, provided the data to answer this question. Here, there were clear contrasts between question-response sequences with people whose interactive style reflected more local Yup'ik ("Y") patterns and those who accommodated to wider



Building containing the district and magistrate's courts in Bethel, Alaska. These courts serve an area almost the size of Oregon.

English ("E") patterns. The E jurors tended to be people who were raised more biculturally and who held bureaucratic jobs in Bethel. Tapes of a voir dire sequence in the judge's chambers indicated that although each prospective juror stated the same reasons for excuse (that he or she knew some of the people involved and could not be fair), the two groups were treated differently. Y jurors were questioned up to five times as long as E jurors and expressed considerably more discomfort. Research suggests that differential treatment was related to differences in jurors' communication styles.

E jurors stated their biases directly: "I feel I already have my mind made up... against the defendant." Y jurors, by contrast, made their assertions indirectly. They opened with statements such as: "I don't think I could, you know, be fair." Interpreting their qualifications ("I don't think that...") as hesitancy, attorneys pressed for more definitive statements. Y jurors tended to resist reformulating their positions in more direct terms. They used two resistance strategies. First, they addressed the issue of fairness: "I think I'd just listen to the case and try to be fair for both sides but I'd be, you know—I mean—knowing these people." Second, Y jurors often shifted the topic to their general willingness to comply: "I mean I've been willing to help all this time in a big city" or "I'd be glad to serve any other case, but..."

A detailed analysis of juror-attorney verbal exchanges suggested that the Y jurors essentially faced a compliance dilemma: to be excused they had to state unequivocally that they could not be fair, yet this demonstrated a general noncompliance with the expectations of a juror and, perhaps, with those of a good person. Attorneys, faced with what appeared to be inconsistent or equivocal responses, tended to pursue questioning until the Y

jurors reluctantly expressed their biases directly or became so uncomfortable that they did not respond at all. Ironically the people who seemed most distressed by continuous interrogation were thus the ones most persistently interrogated.

Interrogation and Compliance in Cultural Contexts

One negative consequence of cultural and linguistic mismatches such as those observed in Bethel is the development of stereotypes. The Yup'ik people sometimes misperceive English monolinguals as inherently aggressive. The reverse stereotype casts the Yup'ik people as passive. In fact, what happens in such cross-cultural settings is that speech conventions that developed separately within the two societies, and that express the power relationships in each society, are misapplied across cultures. Listeners interpret linguistic and behavioral cues in terms familiar to their own linguistic group but different from those intended by speakers. Misinterpretations are compounded as each evaluates the other's response and tries to repair the communication.

Within Yup'ik society, for example, the primary exchange of information is not through questions and answers but through observation and volunteered talk. Direct questions in Yup'ik are considered more impolite than they are in common English usage. Direct questioning is only expected where the speaker is entitled to pressure the listener's compliance to some degree (such as parents with children, or elders with juniors) and generally evokes deferential or intimidated responses. Instead, Yup'ik and Yup'ik-English speakers generally use indirect forms to convey their wishes and thoughts. Indirection is thus used more extensively and in different situations than it is in most English conversation.

It has been suggested that implication and indirection are not just politeness strategies but reflect a philosophical stance that acknowledges the individuality and multiplicity of human experience and perception for the Yup'ik people. This recognition makes certain types of generalization, statements of knowledge and assessments of others' motivations misguided or impossible. As a result, Yup'ik speakers tend to qualify most statements. There is also a deep sense that words are inherently powerful and may make bad things more real. In the court these cultural preferences make attorneys assess Yup'ik-style speech as evasive and imprecise when it is, from a Yup'ik perspective, accurate and careful.

The cultural underpinnings of attorneys' speech are equally complex, too much so for elaboration here, although they are a critical component of the research. Perhaps the most salient contrast, however, is an opposing preference for certainty and definition.

Conclusions and Research Recommendations

When speakers operating on these two differing sets of assumptions interact in the powerful setting of the courts, there are a number of consequences. First, the tendency to comply with interrogation leads to ready confessions and frequent use of the no-contest plea. It follows that if more cases were brought to trial, the conviction and incarceration rate, as well as the length of sentences, would decrease. While this would increase the burden on the already overworked court system, it would serve justice better, especially when elaborated confession is more the result of compliance than of guilt, as, for example, when the defendant does not remember committing a crime.

Second, in these cross-cultural interactions, there is an unequal power relationship. The minority culture is suppressed and changed, adding to overarching cross-cultural frictions. If the courts "teach people to lie" and only reward direct, unqualified statements about personal biases and the motivations of others, they unwittingly undercut basic Yup'ik cultural assumptions about human relations. The following steps might be taken to alleviate problems such as these:

- Both legal professionals and the general public can be generally educated about cultural differences and their potentially profound effects. For the Yup'ik public, this education might lead to discussions about the different consequences of confession within the Native community versus within the legal system; for legal professionals, alternative strategies for eliciting and communicating information might be developed.
- Specific legal education for the public is also recommended. Mock trials with discussion of legal processes have proven to be effective educational tools in both high schools and prisons. Again, cultural issues can be addressed in this context.
- Training and regularly using interpreters would facilitate understanding. While interpretation is not a panacea in cross-cultural courtrooms, unskilled or nonexistent interpretation exacerbates conflicts and misunderstandings and may

lead to miscarriage of justice. Bilingual, bicultural attorneys might have a better understanding of culture-specific concepts (such as intention, intimidation, guilt and innocence) and styles (such as indirection) central to the resolution of cases.

- Understanding and fairness should be as clear a priority for the legal system as an unambiguous court record and efficient management of cases.

While the conflicts analyzed in this research are specific to the interaction of Yup'ik Eskimos and non-Natives, these conclusions are widely generalizable. It is to be expected that attorneys' arguments and appeals on the basis of cross-cultural difference will rise dramatically as linguistic and cultural issues continue to surface in America; research will provide an essential fund of information in the just resolution of these cases.

Publications

Readers may obtain further information on some of the activities described in this article from the following publications:

- The Bilingual Courtroom: Court Interpretation in the Judicial Process*, by S. Berk-Siligson: University of Chicago Press, Chicago, 1990.
- Eskimo Law and Order*, by A. Fienup-Riordan: In *Eskimo Essays*. Rutgers University Press, New Jersey, 1990.
- Alaska Native Languages: Past, Present and Future*, by M. Krauss: Alaska Native Language Center Research Papers, no. 4, University of Alaska-Fairbanks, 1980.
- Hidden Dissension: Some Effects of Culturally Conflicting Use of Terminology*, by Phyllis Morrow and Chase Hensel: Arctic Anthropology, no. 1, 1992.
- The Social Organization of Questions and Answers in Courtroom Discourse*, by S.U. Phillips: In *Power Through Discourse* (L. Kedar, Ed.). Ablex, Norwood, New Jersey, 1987.
- Narrative, Literacy and Face in Interethnic Communication*, by R. Scollon and S.B.K. Scollon: Ablex, Norwood, New Jersey, 1981.
- Linguistic Manipulation, Power and the Legal Setting*: A.G. Walker: In *Power Through Discourse* (L. Kedar, Ed.). Ablex, Norwood, New Jersey, 1987.
- Subsistence Economies in Alaska: Productivity, Geography and Developmental Impacts*, by R. Wolfe and R.J. Walker: Arctic Anthropology, vol. 24, no. 2, 1987.

Public History in the Aleutians

SANDRA M. FAULKNER

One role of the U.S. National Park Service is outreach to local communities and states to protect historic structures in the face of rapid population growth and development. A research and writing project on the Aleutian Islands was initiated in 1989.

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Public historians serve the research goals of multiple and diverse publics, such as Federal, state and local governments. The National Park Service (NPS) uses the results of historical research to make management decisions as part of its mission to preserve and protect resources. The NPS also administers the National Historic Landmarks (NHL) program and the National Register of Historic Places, which focus on historic and archeological resources of exceptional national value. The agency is concerned with the effects of rapid social change and economic development on the integrity of these resources.

Cultural resources, such as historic buildings, objects, archeological sites or landscapes, are the physical manifestations of historic events. The public historian uses research to discover the meaning of these resources and to place them in context within history, for public historical research is often resource-driven, rarely conducted

purely to add to the pool of knowledge. Recently the Alaska Regional Office, NPS, conducted several projects on Aleutian Island resources in response to the rapid and severe increase in development pressure on the island chain.

Aleutian History

The Aleutian Islands reach out from the Alaska Peninsula toward Japan in a long volcanic arc that stands between the Pacific Ocean and the Bering Sea. For thousands of years the rich natural resources of these windswept, fog-enshrouded islands have provided sustenance for the Aleut people. In recent centuries this marine bounty has lured the world's seafood industry.

In 1741 Vitus Bering set sail across the sea that would one day bear his name. Russian fur hunters, called promyshlenniki, followed. The Russian

*Church of the Holy Ascension
National Historic Landmark,
Unalaska, Alaska. Note
the bald eagle perched
on the dome.*





*Wood-frame mess hall and
quonsets at Eider Point,
Dutch Harbor National
Historic Landmark, Alaska.*

America Company, formalizing the Russian colonization effort, established a major post on Unalaska Island. In 1824 Reverend Ioann Veniaminov, canonized in 1977 as Saint Innocent, arrived in Unalaska to start an Alaskan career that contributed significantly to the enduring Russian heritage. The national significance of the Russian-American period has been recognized by designating the Sitka Spruce Plantation and the Holy Ascension Orthodox Church at Unalaska as National Historic Landmarks representing the Russian-American theme.

Nearly 200 years later, in 1941, American troops arrived at Fort Mears, Dutch Harbor, on Amaknak Island. On June 3 and 4, 1942, the Japanese bombed Ft. Mears and neighboring Unalaska. After the attack the U.S. Army and Navy evacuated hundreds of Aleut residents from Unalaska and other villages in the Aleutian and Pribilof islands. Later

of thousands of employees through Unalaska, which has a permanent population under 5000. This seasonal human influx supporting the fishing industry is accompanied by massive new physical structures. The demand for housing, mess halls, supplies, water and fish-processing facilities is met by barging in prefabricated apartment buildings and huge fish-processing and storage plants. Together, they create an instant "company town." The earth-moving and ground-disturbing activities, including some within the landmark boundaries, seriously jeopardize the integrity of the fragile structures and archeological sites. Incomplete data on the complex of nationally significant structures has exacerbated the problem by making it difficult to assess the development impacts.

Documenting Aleutian History

To better identify and protect the threatened cultural resources, the NPS initiated a multiyear research and writing project on the Aleutian sites. The first step determined that data in existing landmark narratives did not meet current information and resource protection standards. A data-collection effort was started in 1989 to revise the landmark narratives. A major task was to identify and analyze the available documentation, both secondary and primary, and to make site visits to determine which World War II resources had withstood both the Aleutian weather and the remediation efforts of the U.S. Army Corps of Engineers. The researcher, Rebecca Strand Johnson of Loyola University, met with the Ounalashka Native Corporation, the City of Unalaska and private citizens to solicit their views about the resources they valued as a reflection of their past.

By 1991 the NPS could list the features that contributed to the landmarks and redefine their boundaries to reflect this new information. Decisions about the development threats to the World War II landmark complex, occurring as part of the review process mandated by the National Historic Preservation Act, were made based on reasonable information. For example, numerous World War II "pill-boxes" (concrete structures used as gun emplacements) within a project area had to be assessed for significance and integrity of place in order to determine which were essential and which were marginal to the integrity of the site.

In 1991 the NPS initiated the project on World War II in Alaska to assist the State Historic Preservation Office. To assess properties nominated as National Historic Landmarks and for inclusion in the National Register of Historic Places, the "con-

*The public historian is concerned with applying
scholarly research to the management, interpretation
or preservation of resources.*

that month Japanese forces landed on Kiska and Attu and held these islands until 1943, when U.S. and Canadian forces regained the islands. There are now five Aleutian landmarks designated under the theme "World War II, the War in the Pacific 1941-1945": Dutch Harbor at Fort Mears, Cape Field at Fort Glenn, Adak Army and Naval Bases, Attu Battlefields and Airfields, and the Japanese Occupation Site on Kiska Island.

In the Aleutians, where it is common for the land to rise abruptly from the sea, people settled on the few gentle slopes and beaches. Today population and development continues in the same places as in centuries long past. As the only deep-water port in the Bering Sea, Unalaska is home to an international fishery. Each year the seafood industry brings hundreds of ships, tons of seafood and tens

text” offers a tool for measuring the importance of all World War II resources in Alaska. Using traditional historical methodology and much creativity in locating new historical sources, NPS is adding considerable information to what is known about World War II in Alaska. Data sources included the National Archives, the Naval Construction Battalion Center (Seabees Archives), the Operational Archives Branch and the Ships History Branch of the U.S. Naval Historical Center, and the U.S. Army Center of Military History. This research helped correct errors in past scholarly publications and assisted in the overall interpretation of the Pacific Campaign. In addition, the NPS Oral History project is gathering information from returning veterans during the commemoration ceremonies for the 50th anniversary of the bombing of Dutch Harbor. This will contribute to the social history of the war—the stories of both the GIs in the field and the families at home.

Meanwhile the NPS initiated a preservation plan to address historic resources with the City of Unalaska. The NPS and the Unalaska Aleut Development Corporation agreed to inventory buildings in the community to serve as a baseline for the preservation plan. Taking direction from the City of Unalaska Comprehensive Plan and working to “coordinate local growth with preservation of cultural and historic resources,” a plan was prepared, which, among other effects, helped certify the city and the Unalaska Historical Commission as qualified under the National Historic Preservation Act to review construction permits for their potential impacts on National Historic Landmarks and National Register properties.

The Unalaska Preservation Plan clearly defines places where development is encouraged and where it is not. The information is available to private investors at the onset of development planning, long before a public review, which usually comes when a project is ready to begin. This

should help prevent last-minute conflicts between investors and the public, and government agencies use this information to assess the effect of proposed actions on cultural resources identified in the plan.

The Role of Public History

The public historian is concerned with applying scholarly research to the management, interpretation or preservation of resources. The role of the public historian often precludes the dispassionate observation of the passing of time. The use of traditional historic research methodology reveals the secrets of the past, but, as the cancer researcher ardently wishes to eradicate a deadly disease, the public historian is often an advocate for historic resources. The role of public history is summed up in the following excerpt from the Unalaska Preservation Plan:

History in Unalaska is not restricted to scholars nor to the past—it is a unique commodity that people live with, every day. The Aleut people, the Russian family names, and the onion-shaped domes of the Holy Ascension Russian Orthodox Church preserve this history. History also exists in the flora and fauna of the island as well as the timeless traditions of beachcombing, hiking and time spent watching the horizon for the next ship to enter the harbor. By recognizing history as an ongoing link between the past, present and future, the community gains an irreplaceable identity and offers its residents and visitors a much richer place to live and to visit.

Publications

Readers may obtain further information on some of the activities described in this article from the following publications:

- The Plan: Historic Preservation for Unalaska, Alaska*, by Linda A. Cook: National Park Service, Alaska Regional Office, 1990.
- Historians' Fallacies: Toward a Logic of Historical Thought*, by David Hackett Fischer: Harper Colophon Books, New York, 1970.
- The Past Before Us*, by Michael Kammen: In *Contemporary Historical Writing in the United States*, Cornell University Press, Ithaca, NY, 1980.
- The Philosophy of History in Our Time: An Anthology*, edited by Hans Meyerhoff: Doubleday Anchor Books, New York, 1959.
- In Search of History: A Personal Adventure*, by Theodore H. White: Warner Books, Harper and Row, New York, 1978.

Fish processing plant and associated development at the site of the submarine base, Dutch Harbor National Historic Landmark, Alaska.



Documenting Alaska Native Cultural History

ANCSA and the Role of the Bureau of Indian Affairs

KENNETH L. PRATT

The Bureau of Indian Affairs has collected an extensive body of knowledge relating to the history, languages and land uses of Alaska Natives. In addition to prehistoric and historic site records, there is a collection of over 1400 taped interviews with Native elders. This information has not yet been put to much use by researchers, and ownership of the data is contentious.

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The 1971 Alaska Native Claims Settlement Act (ANCSA) granted Alaskan Natives fee-simple title to 40 million acres of land in Alaska and extinguished aboriginal title to any additional lands. One part of this legislation, Section 14(h)(1), allowed ANCSA-created Alaska Native regional corporations to receive a portion of their acreage entitlements in the form of historical places and cemetery sites. The Bureau of Indian Affairs (BIA) established the Anchorage-based ANCSA Office in 1978 to investigate these sites. These investigations have produced an extensive and diverse body of data of interest to archeologists, cultural anthropologists, linguists, historians and land planners, among others. However, these data have been little used by researchers, and access to the data set remains a controversial issue.

History of the Data

From 1978 to April 1983 the responsibility for implementing the 14(h)(1) program was shared between two organizations: the BIA ANCSA Office and a now-defunct division of the National Park Service (NPS), the Anthropology and Historic Preservation branch of the Cooperative Park Studies Unit (AHP-CPSU). During this period the

solely by the BIA ANCSA Office since that time, and the 14(h)(1) program has been one of the largest employers of anthropologists and archeologists in Alaska during the past decade.

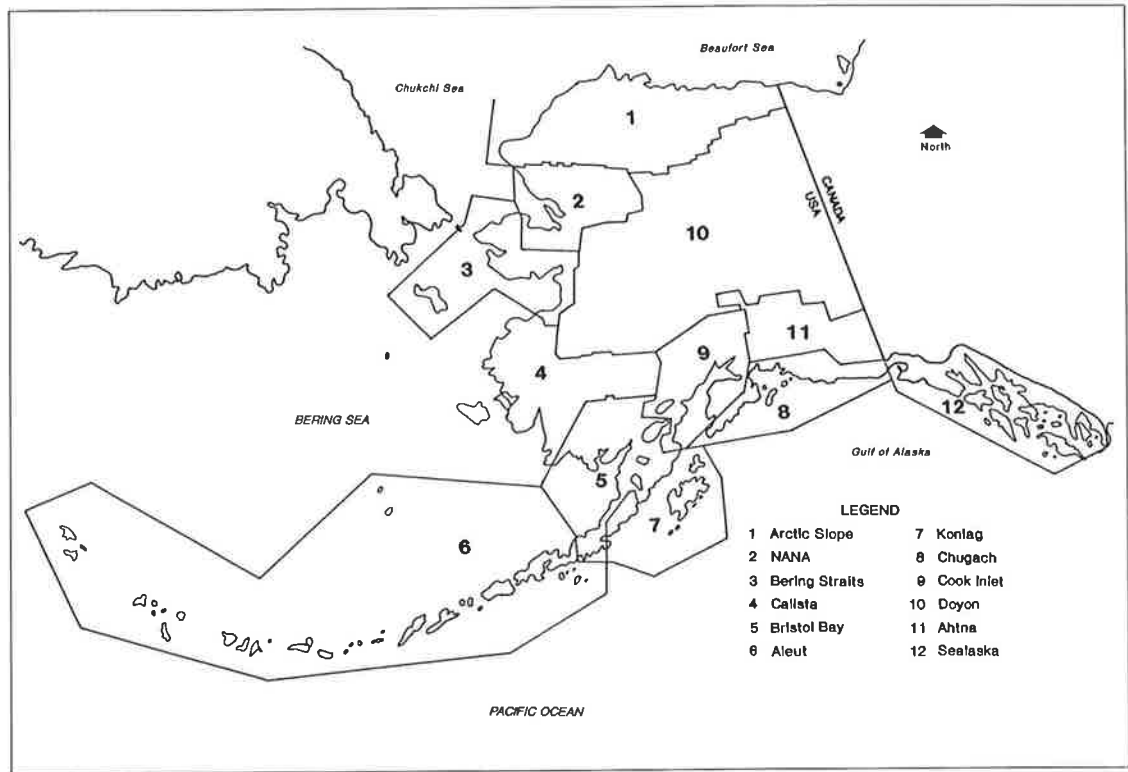
The BIA ANCSA Office was not created to conduct "pure" research. Rather, BIA ANCSA site investigations are conducted so that the BIA can determine if selected tracts of land are eligible for conveyance to Native regional corporations. The 14(h)(1) site eligibility criteria contained in the ANCSA regulations are modeled after those established for the National Register of Historic Places, but they differ in significant ways. For example, the 14(h)(1) criteria specifically exclude subsistence sites, in and of themselves, from eligibility. Thus, 14(h)(1) eligibility determinations do not indicate the sites' potential eligibility for inclusion on the National Register.

The sites to be investigated were chosen by the regional corporations before the BIA ANCSA Office was formed, so that office has no control over the sites it examines. The Sealaska Corporation hired a consulting firm to make its selections, but information in support of selections made by all the other regional corporations was gathered either by BIA Realty personnel or by anthropological researchers affiliated with the NPS Alaska Regional Office in Anchorage. The majority of the selections were based on site descriptions contained in published historical and anthropological accounts or on consultations with village elders. The use of village elders in this process biased the selections toward late prehistoric and historic sites. This has the dual benefit of focusing attention on an archeological resource that is much neglected in Alaska and of encouraging the collection of oral accounts about historic land and resource use. The disadvantage of this approach is that older sites are poorly represented in the selections.

Site investigations have been performed annually since 1978. To date, more than 2200 investigations have been completed, and only a few sites

The ANCSA 14(h)(1) program has been documenting Alaska Native cultural history since 1978, and the resulting data have wide applicability for archeological and anthropological research.

AHP-CPSU provided the BIA with a professional staff who directed the anthropological and archeological aspects of the research. The AHP-CPSU was disbanded in 1983 following the NPS's voluntary transfer of its ANCSA 14(h)(1) responsibilities to the BIA. The program has been implemented



Alaska Native regional corporations.

have yet to be investigated. [Several hundred non-14(h)(1) sites have also been minimally recorded.] The methods used in the investigations are tailored to help determine the site eligibility under the 14(h)(1) criteria. They include a reconnaissance-level archeological survey at each site. Since the emphasis is on surface indications of cultural activity, detailed site maps are prepared. These maps typically include scale drawings of all identified surface cultural features (such as house remains) and their distribution. No excavations are performed, and subsurface tests are conducted only on a very limited scale. This reflects the time constraints imposed on BIA ANCSA researchers due to the number of investigations annually performed—an average of about 170 per year over the course of the program. A literature search is made for data pertinent to the site or the general area. Also, because many of the sites are relatively recent and poorly represented in the literature, there has been an emphasis on gathering oral history data.

The oral history collection, which contains over 1400 taped interviews with Alaska Native elders, is the largest and most valuable body of the 14(h)(1) data. Roughly a third of these taped interviews have been professionally transcribed and translated by linguists at the Alaska Native Language Center of the University of Alaska-Fairbanks. While the major reason for conducting these interviews is to collect site-specific data, they have yielded data on a wide range of related subjects, including subsistence and land use patterns, technology, social or-

ganization, religious and ceremonial life, culture change, language and ethnogeography. Since the published literature contains meager information about many of these subjects, the value of the oral history collection for preserving Alaska Native traditional knowledge is unparalleled.

Except for several "overview" reports (based on multiple site investigations), each completed site investigation leads to the production of an individual report, typically 30–50 pages long. Copies of all final reports are maintained in the files of the BIA ANCSA Office and at the Alaska State Office of the Bureau of Land Management (BLM) in Anchorage. Also, one report copy is submitted to the applicant regional Native corporation, and one is sent to the Alaska office of the Federal agency having jurisdiction over the lands on which the site is located. Besides the BLM and NPS, Alaska-based agencies that receive 14(h)(1) site reports include the Fish and Wildlife Service (Anchorage) and the Forest Service (Juneau). The Alaska State Historic Preservation Officer (Anchorage) receives abbreviated, computerized site records. Otherwise, these reports are not distributed further.

Data Ownership and Access Problems

The question of who properly controls access to and use of the ANCSA 14(h)(1) data has been and remains a complex and contentious issue, the result

**Status of ANCSA 14(h)(1) site investigations,
August 1992.**

<i>Corporate region</i>	<i>Number completed</i>	<i>Number remaining*</i>
Arctic Slope†	0	0
Ahtna	51	3
Aleut	384	0
Bering Straits	167	0
Bristol Bay	33	0
Calista	953	0
Chugach	270	0
Cook Inlet	27	0
Doyon	178	0
Koniag	31	0
NANA	67	0
Sealaska	96	0
Total	2257	3

* Corporation appeals of Bureau of Land Management adjudication decisions or BIA eligibility determinations could result in additional site investigations.

† This corporation chose not to make any ANCSA 14(h)(1) site selections.

Note: Alaska Natives living outside the state comprise what is known as the "13th Corporation." Since this corporation has no land base in Alaska, it was not eligible to make ANCSA 14(h)(1) selections.

being that these data have been relatively inaccessible to researchers and the general public. This situation developed through a combination of several factors.

First, the BIA has relied almost exclusively on the regulations contained in ANCSA to craft 14(h)(1) program policies, but those regulations do not contain specific guidelines for data management. The ANCSA legislation, by itself, does not require the BIA to use data generated by the 14(h)(1) program for anything other than preparing reports on the sites investigated. It also does not require the completed site reports to be published or widely disseminated, nor does it stipulate actions that must be taken to provide for the long-term curation and preservation of the data. Until its 1983

ment of cultural resource materials to the 14(h)(1) data. While other factors were certainly involved, the agency's failure to address these laws earlier is primarily related to its historical perception of the 14(h)(1) program as simply one part of a massive land transfer process (that is, a real estate exercise).

Second, the continued neglect of these data by social scientists and others (both inside and outside of Alaska) familiar with the 14(h)(1) program has helped keep the program's obscurity intact. This situation prevails despite repeated efforts by BIA ANCSA staff to report the results of annual 14(h)(1) field projects or to otherwise describe the scope of the program's data collection to presumably "interested" audiences. Since 1987 this has included over 35 presentations at professional conferences and numerous talks at community and museum events. During the same period, at least 10 publications were produced that either describe the program or rely heavily on ANCSA 14(h)(1) data. As of August 1992, however, the BIA ANCSA Office has received no more than five requests for access to 14(h)(1) data during FY 92, and this is not an abnormally low figure. Acknowledging the limitations of prior efforts to publicize the office's holdings, it is nevertheless difficult to explain the extreme lack of interest exhibited in these data. But it suggests that contemporary researchers concerned with Alaska Natives are less than exhaustive in their search for data. It is also true that some anthropologists—particularly those occupying academic positions—belittle anthropological research performed by Federal programs.

Finally, and most important, the BIA has major trust responsibilities to its Native clients. These responsibilities apparently do not extend to the regional Native corporations, yet this "trust" consideration ultimately led to the development of a policy whereby the release of ANCSA 14(h)(1) data to a requesting party was forbidden without the written consent of the applicant corporation. The responses of regional corporations to requests for data have ranged from complete refusal to wholehearted approval. But whatever the corporate stance, the upshot of this policy was that it fostered a belief among the regional corporations that they own and control all of the data generated by the 14(h)(1) program.

The feeling among BIA ANCSA anthropologists is that 14(h)(1) data should be treated no differently from data collected by other Federal agencies working on public lands with public funds. In September 1990 the BIA ANCSA Office obtained a legal opinion that adopts this same position and was expected to significantly increase the rights to access and use of the data by professional researchers. The ANCSA Office sent copies of this opinion to

The value of the oral history collection for preserving Alaska Native traditional knowledge is unparalleled.

withdrawal from the program, the nature of NPS's "consultant" role implicitly gave it responsibility for managing anthropological data collected in connection with the site investigations; thereafter that responsibility clearly passed to the BIA. Unfortunately the terms of agreement for the transfer of NPS's 14(h)(1) duties to the BIA ANCSA Office did not address the data management issues. Until late 1990 the BIA did not officially recognize the need to apply Federal laws concerning the manage-

each regional Native corporation along with a request for written responses that could be used to establish a new policy for handling 14(h)(1) data access requests. The responses were overwhelmingly negative and strongly reasserted the corporations' convictions that they, not the Federal government, own the 14(h)(1) data. This position is closely tied to a land status argument explicitly stated in several corporate responses, that is, that all lands applied for as 14(h)(1) sites were removed from the public domain (and officially became "Indian lands") as of the date of their application. In fact, ANCSA Section 14(h)(1) provides the means by which selected sites can legally become "Indian lands," but title conveyances do not automatically flow from the submission of 14(h)(1) applications. Title conveyance can only occur after a site's physical existence has been verified, its location is determined to be on unappropriated public land, and the BIA has certified that it is eligible according to 14(h)(1) criteria. The ANCSA Office intends to follow its legal opinion, but since it also does not wish to alienate the regional Native corporations or the larger Alaska Native community, it will continue to try to satisfy their concerns about 14(h)(1) data access and use whenever possible.

While this discussion should not discourage attempts to access and use the 14(h)(1) data, it should make it clear that obtaining access to those data may remain somewhat tedious.

Research Applications

The ANCSA 14(h)(1) program has been documenting Alaska Native cultural history since 1978, and the resulting data have wide applicability for archeological and anthropological research. For example, since the program has collected information on several thousand sites throughout Alaska, if an archeologist had a specific research question in mind, wanted to work in a particular local area or was searching for a promising site to excavate, the ANCSA Office would be an excellent starting point. For archeologists interested in the historic or late prehistoric eras, the 14(h)(1) data are especially valuable because of the detailed oral history accounts compiled for most of the investigated sites; many of these accounts can be used to develop more sophisticated approaches to site excavation. Dates of construction and occupation for specific houses on a site have frequently been collected, for instance, and this information could prove valuable in deciding which house or what area to excavate to address particular research questions.

With respect to Alaska Native ethnohistory, the value of the 14(h)(1) data base can be illustrated by considering the Yukon-Kuskokwim (or Central Yup'ik Eskimo) region of southwest Alaska. The Yukon-Kuskokwim (contained within the geographic boundaries of the Calista Corporation) was arguably the last region in Alaska to experience sustained Euro-American contact with its Native inhabitants. Consequently the historical literature on this region is limited. Similarly the Yukon-Kuskokwim is essentially a void archeologically; the number of excavations conducted there can almost be counted on one hand. Of the total 14(h)(1) investigations completed to date, however, about 950 (or 42%) were in the Yukon-Kuskokwim region. Also, roughly 1100 (or 80%) of the oral history tapes compiled during the program were recorded with Yup'ik Eskimo elders of that region. It is not unreasonable, therefore, to state that the ANCSA 14(h)(1) program has made the cultural history of the Yukon-Kuskokwim among the most thoroughly documented of all regions in Alaska. In the Yukon-Kuskokwim case a very strong argument can be made that the 14(h)(1) data could benefit virtually any ethnohistorical research based in this region.

Conclusion

It is uncertain what the BIA ANCSA Office's status will be once all of the required 14(h)(1) site investigations are completed, which could be as early as the end of FY 93. But the tremendous body of data produced by the 14(h)(1) program will be preserved in the Anchorage branch of the National Archives. These data should prove extremely valuable in the development of local cultural heritage programs, the implementation of state and Federal subsistence management programs, academic research, and the management and protection of Alaska's cultural resources.

Publications

Readers may obtain further information on some of the issues described in this article from the following publications:

Alaska Native Land Claims, by Robert D. Arnold:
The Alaska Native Foundation, Anchorage,
1978.

A Summary of Archeological Research on the ANCSA 14(h)(1) Project, by Kenneth L. Pratt and Dale C. Slaughter: Federal Archeology Report, vol. 2, no. 3, pp. 5-7, 1989.

Principles for the Conduct of Research in the Arctic

Introduction

All researchers working in the North have an ethical responsibility toward the people of the North, their cultures, and the environment. The following principles have been formulated to provide guidance for researchers in the physical, biological, behavioral, health, economic, political, and social sciences and in the humanities. These principles are to be observed when carrying out or sponsoring research in Arctic and northern regions or when applying the results of this research.

This statement addresses the need to promote mutual respect and communication between scientists and northern residents. Cooperation is needed at all stages of research planning and implementation in projects that directly affect northern people. Cooperation will contribute to a better understanding of the potential benefits of Arctic research for northern residents and will contribute to the development of northern science through traditional knowledge and experience.

These "Principles for the Conduct of Research in the Arctic" were prepared by the Interagency Social Science Task Force in response to a recommendation by the Polar Research Board of the National Academy of Sciences and at the direction of the Interagency Arctic Research Policy Committee. This statement is not intended to replace other existing Federal, State, or professional guidelines, but rather to emphasize their relevance for the whole scientific community. Examples of similar guidelines used by professional organizations and agencies in the United States and in other countries are listed in the publications.

These principles are to be observed when carrying out or sponsoring research in Arctic and northern regions or when applying the results of this research.

Implementation

All scientific investigations in the Arctic should be assessed in terms of potential human impact and interest. Social science research, particularly studies of human subjects, requires special consideration, as do studies of resources of economic, cultural, and social value to Native people. In all instances, it is the responsibility of the principal

investigator on each project to implement the following recommendations.

1. The researcher should inform appropriate community authorities of planned research on lands, waters, or territories used or occupied by them. Research directly involving northern people or communities should not proceed without their clear and informed consent. When informing the community and/or obtaining informed consent, the researcher should identify—

- a. all sponsors and sources of financial support;
- b. the person in charge and all investigators involved in the research, as well as any anticipated need for consultants, guides, or interpreters;
- c. the purposes, goals, and time frame of the research;
- d. data-gathering techniques (tape and video recordings, photographs, physiological measurements, and so on) and the uses to which they will be put; and
- e. foreseeable positive and negative implications and impacts of the research.

2. The duty of researchers to inform communities continues after approval has been obtained. Ongoing projects should be explained in terms understandable to the local community.

3. Researchers should consult with and, where applicable, include northern communities in project planning and implementation. Reasonable opportunities should be provided for the communities to express their interests and to participate in the research.

4. Research results should be explained in non-technical terms and, where feasible, should be communicated by means of study materials that can be used by local teachers or displays that can be shown in local community centers or museums.

5. Copies of research reports, data descriptions, and other relevant materials should be provided to the local community. Special efforts must be made to communicate results that are responsive to local concerns.

6. Subject to the requirements for anonymity, publications should always refer to the informed consent of participants and give credit to those contributing to the research project.

7. The researcher must respect local cultural traditions, languages, and values. The researcher should, where practicable, incorporate the following elements in the research design:

- a. Use of local and traditional knowledge and experience.

- b. Use of the languages of the local people.
 - c. Translation of research results, particularly those of local concern, into the languages of the people affected by the research.
 - 8. When possible, research projects should anticipate and provide meaningful experience and training for young people.
 - 9. In cases where individuals or groups provide information of a confidential nature, their anonymity must be guaranteed in both the original use of data and in its deposition for future use.
 - 10. Research on humans should only be undertaken in a manner that respects their privacy and dignity:
 - a. Research subjects must remain anonymous unless they have agreed to be identified. If anonymity cannot be guaranteed, the subjects must be informed of the possible consequences of becoming involved in the research.
 - b. In cases where individuals or groups provide information of a confidential or personal nature, this confidentiality must be guaranteed in both the original use of data and in its deposition for future use.
 - c. The rights of children must be respected. All research involving children must be fully justified in terms of goals and objectives and never undertaken without the consent of the children and their parents or legal guardians.
 - d. Participation of subjects, including the use of photography in research, should always be based on informed consent.
 - e. The use and disposition of human tissue samples should always be based on the informed consent of the subjects or next of kin.
 - 11. The researcher is accountable for all project decisions that affect the community, including decisions made by subordinates.
 - 12. All relevant Federal, State, and local regulations and policies pertaining to cultural, environmental, and health protection must be strictly observed.
 - 13. Sacred sites, cultural materials, and cultural property cannot be disturbed or removed without community and/or individual consent and in accordance with Federal and State laws and regulations.
- In implementing these principles, researchers

may find additional guidance in the publications listed below. In addition, a number of Alaska Native and municipal organizations can be contacted for general information, obtaining informed consent, and matters relating to research proposals and coordination with Native and local interests. A separate list is available from NSF's Division of Polar Programs.

Publications

- Arctic Social Science: An Agenda for Action.* National Academy of Sciences, Washington, D.C., 1989.
- Draft Principles for an Arctic Policy.* Inuit Circumpolar Conference, Kotzebue, 1986.
- Ethics.* Social Sciences and Humanities Research Council of Canada, Ottawa, 1977.
- Nordic Statement of Principles and Priorities in Arctic Research.* Center for Arctic Cultural Research, Umea, Sweden, 1989.
- Policy on Research Ethics.* Alaska Department of Fish and Game, Juneau, 1984.
- Principles of Professional Responsibility.* Council of the American Anthropological Association, Washington, D.C., 1971, rev. 1989.
- The Ethical Principles for the Conduct of Research in the North.* The Canadian Universities for Northern Studies, Ottawa, 1982.
- The National Arctic Health Science Policy.* American Public Health Association, Washington, D.C., 1984.
- Protocol for Centers for Disease Control/Indian Health Service Serum Bank.* Prepared by Arctic Investigations Program (CDC) and Alaska Area Native Health Service, 1990. (Available through Alaska Area Native Health Service, 255 Gambell Street, Anchorage, AK 99501.)
- Indian Health Manual.* Indian Health Service, U.S. Public Health Service, Rockville, Maryland, 1987.
- Human Experimentation. Code of Ethics of the World Medical Association (Declaration of Helsinki).* Published in *British Medical Journal*, 2:177, 1964.
- Protection of Human Subjects.* Code of Federal Regulations 45 CFR 46, 1974, rev. 1983.

Interagency Arctic Research Policy Committee

*Tenth Meeting:
August 27, 1992*

Committee Members or Agency Representatives Present: Ari Patrinos, Department of Energy; Tom Crow, Department of Health and Human Services; Eldon Ross, USDA Forest Service; John Sayre, Department of the Interior; Walter E. Massey, National Science Foundation; Courtney Riordan, Environmental Protection Agency; William J. Ecker, Department of Transportation; William Townsend, National Aeronautics and Space Administration; Grant Aufderhaar, Department of Defense; E.U. Curtis Bohlen, Department of State; Ned A. Ostenson, National Oceanic and Atmospheric Administration.

Guests: David Garman, Senate Select Committee on Intelligence; Philip Johnson, Arctic Research Commission; Luis Proenza, Arctic Research Commission.

Chairman Walter E. Massey convened the meeting at the National Science Foundation, Washington, D.C. Dr. Massey stated that the purpose of the meeting was to determine the appropriate Federal agency research response to the growing reports of widespread radioactive and hazardous waste pollution in the Arctic regions of the former Soviet Union. He noted the strong Congressional interest in the issue of Arctic contamination. Senator Frank Murkowski (Alaska) has written to several agencies requesting a review of these issues, and he also chaired a field hearing of the Senate Select Committee on Intelligence on August 15th in Fairbanks, Alaska.

Dr. Massey stated that the Arctic Research Commission (ARC) feels that the issue of Arctic contamination is an important scientific question for which the Commission and also the IARPC should have an interest and act as a coordinating body. The ARC unanimously adopted a resolution that urges the IARPC to take the lead in compiling data and developing and coordinating research programs.

Dr. Massey then called on David Garman, Professional Staff Member, Senate Select Committee on Intelligence, to report on the Senate Select Committee on Intelligence field hearing that addressed Arctic pollution issues. Mr. Garman stated the consensus among participants in the August 15th hearing was that there is serious, widespread and potentially catastrophic radiation and other pollution problems in the Arctic. The Director of Central Intelligence, Robert Gates, provided confirmation of various reports that have been circulated worldwide. Several points were raised by Mr. Garman:

- There is a lack of specific information concerning Arctic contamination; however, there are activities underway to assess the long-term impacts on Arctic ecosystems of radiation from nuclear testing and waste disposal. There is concern about the Russian naval reactors located in or near Arctic waters. Many are awaiting decommissioning, most of them in submarines, yet the Russians probably lack the capacity to

solve the immediate problem given their current economic situation.

- Indigenous peoples are concerned because of the risk of contamination of food sources. Walrus are already showing higher levels of mercury, cadmium and other metals that may be coming from industrial pollutants in the Ob River.
- The Russian Academy of Medical Science presented medical information on the serious medical impacts they have noted that are possibly associated with the radiation or other pollutants. Mr. Garman cautioned that more information is needed to prove a relationship.
- A consensus that emerged from the hearings was that there is a need for interdisciplinary, international efforts to verify reports and a need for research on actual and potential impacts, transport pathways and, if necessary, remediation strategies.
- Funding will be difficult. Several Congressional bills have funding proposed for Arctic contamination studies.

Mr. Garman added that it is rare to have such broad public recognition of the need for research in the Arctic. The public is waiting to see what the Federal agencies and IARPC will do. It is an opportunity for the U.S. to take a leadership position in the Arctic, as well as an opportunity for cooperation with Russian scientists.

Discussion of the Policy Statement on Arctic Contamination

Dr. Massey reviewed the contents of a proposed draft Policy Statement on Arctic Contamination. The Policy Statement would put the Committee on record as recognizing the importance of the Arctic contamination issue. After much discussion the Policy Statement was approved by the IARPC. All agencies agreed that there would be little new money for most of them this year; funding would have to be the result of redirecting funds.

Discussion of the Agenda for Action

Dr. Massey commented that a proposed Agenda for Action, drafted by the IARPC staff, would commit the IARPC to implement the Policy Statement

on Arctic Contamination and take action to address the reports of radioactive and hazardous waste pollution in the Arctic.
After much discussion the Committee directed

the staff group to further develop the Agenda for Action for approval by the Committee. (The Agenda for Action was approved by the Committee on November 25, 1992.)

INTERAGENCY ARCTIC RESEARCH POLICY COMMITTEE POLICY STATEMENT ON ARCTIC CONTAMINATION

(adopted August 27, 1992)

The U.S. and other countries are becoming aware of a potential problem that requires international cooperation: the extent of contamination of the Arctic area and the bordering seas by radioactive materials and a variety of other hazardous substances.

For example, there are many reported instances of Former Soviet Union disposal of radioactive and other toxic wastes directly into the Arctic Ocean and into aquatic and terrestrial Arctic and Subarctic sites. The contamination reported in the Former Soviet Union is of concern to eight Arctic nations and other countries because of the potential for redistribution and:

- 1) the level and distribution of radioactive and toxic contamination in terrestrial, aquatic, and marine Arctic environments,
- 2) the ecological risk of surface contamination to terrestrial, aquatic, and marine Arctic ecosystems,
- 3) the health risk to human populations, and
- 4) the economic impacts associated with contaminant transport throughout the Arctic and adjacent seas, and affecting fisheries, foodstuffs and other resources.

At present there is limited information regarding such contamination. Scientifically based quantitative data are essential for sound risk assessment activities.

IARPC agencies support a coordinated U. S. program to evaluate the ecological and health risks of Arctic contamination and a coordinated international effort under the umbrella of appropriate international organizations to:

- 1) evaluate the scope of this problem,
- 2) rescue data from world archives, and
- 3) promote international scientific cooperation.

The international organizations include, for example, the Arctic Environmental Protection Strategy, with its focused efforts under the Arctic Monitoring and Assessment Program (AMAP), the International Atomic Energy Agency (IAEA), the International Maritime Organization (IMO), and the International Arctic Science Committee (IASC).

INTERAGENCY ARCTIC RESEARCH POLICY COMMITTEE AGENDA FOR ACTION

to implement

POLICY STATEMENT ON ARCTIC CONTAMINATION

IARPC intends to pursue an incremental plan to implement the Policy Statement on Arctic Contamination (adopted on August 27, 1992).

IARPC will implement appropriate steps as warranted by successive analyses and available funds. These steps are:

- 1) Identify, compile and evaluate existing data on Arctic contamination resulting from the practices of the Former Soviet Union, in cooperation with scientists in other countries. Include results of 1992 *Polar Star* and Office of Naval Research cruises.
- 2) Assess the rates of movement of toxic materials and contaminated organisms into and out of Russian territorial waters. Assess the probable long-term effect on food webs and peoples of the North, and through export of fishery products, on peoples of lower latitudes. Where warranted, define the additional data necessary to assess the scope of the problem.
- 3) Depending on the outcome of the assessment activities, define policy issues, additional risk assessment activities, and risk management options for mitigative actions or other steps commensurate with the scientific risk or exposure assessments.
- 4) Define the potential for advancing Arctic science by measurements of labeled isotopes.

International collaboration will be conducted through the International Arctic Environmental Protection Strategy and its focused efforts under the Arctic Monitoring and Assessment Program (AMAP), and through bilateral cooperation and agreements with Russia. Data and information will be broadly shared.

The actions endorsed at this time are:

- I. IARPC will sponsor one or more workshops to evaluate and assess the compilation of existing data and analyses and to recommend future actions toward an integrated assessment of Arctic contamination.
- II. IARPC, working through the U.S. Coast Guard and the U.S. Geological Survey, will design a series of monitoring activities to be conducted on the 1993 cruise of the *Polar Star*. These experiments will expand the compilation of biological, hydrological, and geological baselines in the western Arctic Basin and Margin, begun on the 1992 cruise of *Polar Star*.
- III. Depending on the results of I and the availability of funds, IARPC agencies will issue an interagency announcement to solicit proposals from the scientific community to implement the recommendations from I.
- IV. IARPC directs its Arctic Environmental Monitoring and Assessment Task Force to plan and implement these activities and to coordinate IARPC's actions with the International Arctic Environmental Protection Strategy and its focused efforts under the Arctic Monitoring and Assessment Program (AMAP).
- V. IARPC will integrate specific research and assessment plans of U.S. Federal agencies into the Third Biennial Revision to the U.S. Arctic Research Plan that will be submitted to the President by July 31, 1993.

United States Arctic Research Commission

Twenty-Sixth Meeting March 25, 1992

Commission Members

Present: Donald D. O'Dowd, Chairperson; Ben C. Gerwick, Jr.; Clifford J. Groh, Sr.; Charles H. Johnson; George B. Newton, Jr.; and Frederick Bernthal representing the Ex-Officio Member.

Staff: Philip L. Johnson, Executive Director; and Lyle D. Perrigo, Head, Alaska Office.

Advisors: Thomas F. Albert, Vera Alexander, Jerry Brown and Luis Proenza.

Visitors: Maggie Ahmaogak, Executive Director, Alaska Eskimo Commission, Anchorage, Alaska; Raymond Arnaudo, OES, Department of State, Washington, D.C.; Cynthia E. Bailey, BP Exploration, Anchorage, Alaska; Robert Dewey, Defenders of Wildlife, Washington, D.C.; Whit Fraser, Chairman, Canadian Polar Commission, Ottawa, Canada; Samuel L. Fry, Olympia, Washington; Dave Garman, Office of Senator Murkowski, Washington, D.C.; Robert J. Hofman, Marine Mammal Commission, Washington, D.C.; Robert S. Hoffmann, Smithsonian Institution, Washington, D.C.; Leslie Kaleak, Sr., Mayor, North Slope Borough, Barrow, Alaska; John Kelley, University of Alaska-Fairbanks; Jessica Lefevre, Alaska Eskimo Whaling Commission, Alexandria, Virginia; Elizabeth Leighton, University of Alaska-Fairbanks; Craig Leisy, U.S. Coast Guard, Washington, D.C.; Peter Lunn, Department of Energy, Washington, D.C.; Bruce McKenzie, Alaska Clean Seas, Anchorage, Alaska; Charles E. Myers, Gerson Sher and Jack Talmadge, National Science Foundation, Washington, D.C.; O.E. Osborn, Science Environmental Foundation, Fairfax, Virginia;

The Arctic Research Commission held its meeting in the Old Post Office Building, Washington, D.C., on March 25, 1992. Chairperson Donald O'Dowd congratulated Charlie Johnson, Nome, AK, and George Newton, Arlington, VA, on their recent appointments by the President, and he expressed appreciation on behalf of the Commission for the excellent *Assembly on the Arctic* held at the National Academy of Sciences cosponsored by the Commission, the Arctic Research Consortium of the U.S. and the Polar Research Board of the National Academy of Sciences.

Since the last meeting the Chairman issued a number of letters conveying recommendations on:

- NSF reorganization to support Arctic research;
- Selection criteria and program themes for the International Arctic Science Committee;
- Encouraging Navy cooperation in civilian Arctic science; and
- Encouraging Alaska Clean Seas to plan for an in-situ burning of an experimental marine oil spill.

Alaska Congressional Delegation

Dave Garman of Senator Murkowski's staff reported that the Senator, as Vice Chair of the Senate Select Committee on Intelligence, was concerned about mechanisms and priorities to encourage U.S. work with Russian scientists. He is particularly concerned about apparent high levels of radioactive materials discharged in the Russian Arctic, and he welcomes ideas to address these concerns.

State of Alaska

Luis Proenza, Science Policy Advisor to Governor Hickel, conveyed greetings from the Governor. He reported that Alaska has a budget shortage due to the decline in oil industry activity in the state, and the Alaska Science and Technology Foundation (ASTF) will apparently weather the legislative quest for funds this year. Dr. Proenza observed that Anchorage is the largest air cargo transshipment location in the world. It might therefore be feasible to sample this segment of world commerce as a step toward identifying economic development targets.

Dr. Proenza reported that Elizabeth Leighton is serving a two-year fellowship at the University of Alaska-Fairbanks and will then return to the Department of State. She is organizing a conference

in Fairbanks on August 12-14, 1992, entitled *The Changing Role of the United States in the Circumpolar North*.

Mead Treadwell, Deputy Commissioner, Alaska Department of Environmental Conservation, reported that his agency is signing a number of "partnership" agreements with over 50 communities in Alaska and with Russian counterparts in Magadan and Vladivostok. The EPA is a financial partner, providing a third of the ADEC operating budget. These partnerships are intended to better address environmental problems in Alaska.

Mr. Treadwell reported that ADEC is assisting research and development in the following areas:

- Developing new hazardous waste remediation technology (in collaboration with ASTF), improving bioremediation, testing oil spill burning and encouraging the Prince William Sound Oil Spill Recovery Institute in Cordova;
- Improving rural substandard water and sewer systems;
- Examining and testing applications of remote sensing and geographic information systems (GIS) using the capabilities available at Fairbanks; these applications would provide improvements in utilizing the resources available, tracking environmental conditions and supporting resource management efforts.

Mr. Treadwell concluded by identifying two environmental research concerns. The first is for the effects of a depleted stratospheric ozone layer and associated remediation consequences; the second is for the potential legacy of the former Soviet Union in the form of toxins in Arctic ecosystems through air, water and radioactive contamination. He urged joint efforts and exchange of information with Russian experts quickly.

Interagency Arctic Research Policy Committee (IARPC)

Fred Bernthal, Deputy Director of NSF, representing the Chairman of the IARPC, reported that the biennial report mandated by legislation was submitted to the President in January 1992, and it contained a listing of agency responses to Commission recommendations. Primarily the report cross-referenced sections of the *U.S. Arctic Research Plan, Second Biennial Revision* with Commission recommendations. Mr. Gerwick observed that he was pleased to see the responses but asked that a glossary of abbreviations be added for better public understanding. Dr. Bernthal agreed that a glossary would be added to future reports. Mr. Groh observed that it

John Parkinson, SRI International, Washington, D.C.; Burton Rexford, Chairman, Alaska Eskimo Whaling Commission, Barrow, Alaska; Paul Ringold, U.S. Environmental Protection Agency, Washington, D.C.; Marianne Stenbaek, President, Association of Canadian Universities for Northern Studies, Ottawa, Canada; Mead Treadwell, Alaska Department of Environmental Conservation, Juneau, Alaska; David Witt, Institute of Arctic Biology, University of Alaska-Fairbanks; Bernard Zak, Sandia National Labs, Albuquerque, New Mexico.

would be helpful to have suggestions to better fulfill the intent of the Arctic Research and Policy Act.

Dr. O'Dowd indicated that he did not agree with the IARPC responses to the EIS recommendations. They appear defensive, and to his knowledge the steps recommended to assist the agencies are not in fact carried out as claimed in the IARPC report. Dr. Bernthal responded that this issue could be examined further by asking the Council on Environmental Quality to host an interagency meeting and that IARPC would explore such an initiative. Thomas Albert concurred that the recommended steps for strengthening the science and the environmental assessments are not now carried out in Alaska but are very much needed.

Regarding an Arctic research vessel, Dr. Bernthal reported that a letter required by Congress comparing lease versus purchase procurement options in accord with OMB guidance was forwarded in March 1992; the analysis appears to favor direct purchase, but both options remain open. Funds are requested for FY 93 to complete the design and bid package. A construction award is planned for late 1993 and a launch in late 1995. The Commission is pleased that this long-standing recommendation for an ice-capable Arctic research vessel is finally being implemented.

Interagency Arctic Policy Working Group (IAPWG)

Ray Arnaudo, Director, Division of Polar Affairs, reported that IAPWG is chartered by the National Security Council and chaired by the Department of State. It consists of Federal officials representing about 17 agencies. The Commission and the Polar Research Board have observer status.

Mr. Arnaudo said that IAPWG had worked to negotiate the terms of the nongovernmental International Arctic Science Committee (IASC) and the terms of the intergovernmental agreement on an Arctic Environmental Protection Strategy. It is currently coordinating U.S. participation on various international working groups of the Strategy. The next ministerial meeting for the Strategy will be held in 1993.

Arctic Research Consortium of the U.S. (ARCUS)

Laura Lee McCauley, Executive Director, provided copies of a new brochure. ARCUS now consists of 21 member institutions located in 17 states. It is pursuing funding for core support, service tasks to NSF for the Arctic System Science program, and an education program, all pending at NSF. It has provided significant testimony to Con-

gress and helped organize the *Assembly on the Arctic* held March 25, 1992, jointly with the Commission and the Polar Research Board. Meanwhile ARCUS has incorporated as a not-for-profit organization recognized by IRS under section 501(c)(3) of the tax code. It has strengthened its business plans and clarified the services it can provide. Mr. Talmadge commented on behalf of the ex-officio member that NSF was pleased with the progress by ARCUS.

Resolution of Appreciation

Upon discussion, Mr. Groh moved consensus for Resolutions of Appreciation in recognition of the service of Elmer Rasmuson and John Steele as Members of the Commission. Terms for both were completed in February 1992. Recognizing that the ex-officio member may not vote, nevertheless he wishes the record to reflect his support for these resolutions.

Interagency Oil Pollution Research and Development Plan

CDR Craig Leisy, USCG, Executive Director, Interagency Coordinating Committee on Oil Spill Research, reviewed the terms of the Oil Pollution Act of 1990 (P.L. 101-380) whereby under Section VII the U.S. Coast Guard is mandated to establish an interagency committee and to prepare an Oil Pollution Research and Technology Plan. Both tasks have been undertaken and will soon be approved and released to the public. Funding to implement the Plan consists of about \$11 million in ongoing activities in 13 Federal agencies plus up to \$19 million authorized but not yet appropriated. If funds are appropriated from a trust fund, a regional grants program is anticipated. An international oil pollution research and development abstract database is also planned to be accessible by computer.

CDR Leisy pointed out that the USCG and the International Maritime Organization are organizing an International Oil Spill R&D Forum in Washington, D.C., on June 1-4, 1992.

Arctic Marine Mammal Research

Robert Hofman, Scientific Program Director of the Marine Mammal Commission, provided copies of the MMC Annual Report to the Congress for FY 91 as well as various workshop reports and letters regarding selected Arctic marine mammals. There are about 20 such species in and around Alaska, and these populations are shared with Canada and Russia. He summarized the status of research on the major species, including the potential impact of offshore oil and gas activities on important subsistence species such as the bowhead whale. The decline in population of certain seal populations in

the Bering Sea remains unexplained. Various reasons may contribute, including environmental pollution, overfishing of prey species and possibly global warming. A new viral infection in harbor seals similar to distemper in dogs could spread across the Arctic. A substantial number of sea otters died in Prince William Sound following the major oil spill, but the exact number may never be known, and much of the data is sequestered for ongoing litigation.

Atmospheric Radiation Measurement (ARM)

Peter Lunn, ARM Program, Department of Energy, reported on a new study in solar radiation forcing and feedbacks that is part of the DOE's efforts to resolve scientific uncertainties about global climate change. The purpose is to obtain data to improve models and predictions of climate change.

Five sites, including one on the Alaskan North Slope, will be selected. An instrument array at a primary station of 160 acres and smaller stations spread over 25,000 square miles will operate for up to 10 years. The first site (in Oklahoma) will start in 1992. The site in Alaska is planned to start in three years. Each site will represent a total investment of \$5–10 million. The data will allow analyses of the effects and interactions of sunlight and clouds on temperature, weather and climate. The program seeks synergism with other agency programs and acceptance by local residents. One issue may be a radar generator on site that produces a periodic loud noise and therefore must be at least two miles from any residence. Initial evaluations in Alaska began in 1992.

Update on the State of Russian Science

Gerson Sher, Division of International Programs, NSF, summarized his current views of Russian science, based in part on his visit to Moscow in March 1992. The status in a word is terrible. There is no budget for science. Institutes receive funds monthly or quarterly; often there are no funds to meet payrolls. Clearly the scientific population must shrink; jobs will be lost and clever people will leave research and create businesses. However, the distribution of change varies; in some institutes it is very wrenching, while in others there is little impact.

The Russian Academy of Science is responsible for all science and technology institutes in the republic. The Ministry for Science, Education and Technology Policy is in transition, and the former Science and Technology Commission has disappeared. The retained influence of individuals now

in different roles is not always clear and may be overstated. Universities are in worse condition and are not viewed traditionally as research institutions. The Far Eastern Branch of the Academy of Science appears to be more autonomous.

In the U.S., Congress appropriated \$400 million to the Department of Defense to assist demilitarization and \$650 million to the Department of State for aid and assistance in the former Soviet Union (FSU). (President Bush announced a \$24 billion plan of international assistance on April 1, 1992.) The President's Science Advisor, Dr. Bromley, requested recommendations from the National Academy of Sciences on preferred means to preserve the basic science capability of the FSU. A workshop was convened on March 3 and a report provided by mid-March 1992. The Academy's report urges rapid U.S. response, particularly by using existing mechanisms for funding "cooperative projects with U.S. scientists and engineers to encourage FSU specialists to remain in place and to help in building a civilian market-oriented economy." Also in March the National Science Board adopted a resolution such that NSF grantees can apply for supplemental funding to support cooperative research with FSU colleagues.

There remain some barriers to using U.S. dollars in the FSU. There is a high FSU tax on funds for salaries (40%), but there may be ways around this. The U.S. export controls on technology are still in place, although sentiment is growing to modify them. Communication with Russian colleagues via phone and fax remains uncertain. Russian scientists cannot buy (or afford) international airline tickets in Russia. Dr. Sher is skeptical that new dollars will materialize to address these problems.

Discussion of Oil Spill Research

Lyle Perrigo, Head, ARC Alaska Office, presented a final draft of Findings and Recommendations No. 8, *Research Needed to Respond to Oil Spills in Ice-Infested Waters*. He described the process that had produced this report, including the incorporation of comments from 15 experts in this field.

Mr. Gerwick observed that the current draft was well prepared and met his expectations. Mr. Kaleak, Mayor of the North Slope Borough, expressed appreciation for the Commission's consideration of Native views. He stated that the Borough welcomes in principle the proposed in-situ oil burn in Prudhoe Bay this summer by Alaska Clean Seas (ACS) but is not willing to grant approval until satisfied with the scientific plan.

The Commission upon discussion adopted the draft report as presented subject to review by the Group of Advisors and minor editorial changes.

Canadian Polar Commission (CPC)

Whit Fraser, Chairperson of the CPC, commented on his Commission's status. CPC was established by an Act of Parliament, and Mr. Fraser and 11 other Canadians were appointed to the Commission in September 1992. Its mandate is:

- To monitor the state of knowledge, in Canada and elsewhere, of the polar regions;
- To enhance Canada's international polar profile by fostering and facilitating international and domestic liaison and cooperation in circumpolar research;
- To promote and encourage national institutions and organizations to support the development and dissemination of northern knowledge;
- To provide information about research concerning the polar regions to Canadians and Canadian organizations, institutions and associations; and
- To advise the Minister of Indian Affairs and Northern Development on matters relating to the polar regions.

CPC is organizing its priorities, which will first focus on northern Canada, then Canada as a whole and then international concerns. Mr. Fraser, who comes from a career in electronic journalism, feels that good communication is as important as good science. In response to a question about the CPC role in a Canadian proposal for an international Arctic Council, Mr. Fraser stated that CPC expects to be a Canadian science arm of any such future Arctic Council. Chairperson O'Dowd thanked Mr. Fraser for his attendance and comments on the occasion of his first trip to the U.S. as Chairperson of CPC, and he also expressed the desire of the U.S. Commission for continuing liaison between the two Commissions.

Upon adjournment the Commission visited the Navy-NOAA Joint Ice Center in Suitland, MD.

Twenty-Seventh Meeting July 6, 1992

The Arctic Research Commission held a one-day meeting at the University of Alaska-Anchorage on July 6, 1992. Chairperson Donald O'Dowd congratulated James Campbell, Anchorage, and Luis Proenza, Fairbanks, on their appointments to four-year terms by the President, which now brings the Commission to a full seven voting members.

Alaska Congressional Delegation

Dave Garman of Senator Murkowski's staff reported that the Senator had explored the potential use of the nation's intelligence assets for critical

science problems. To determine their utility, a 12-person committee of scientists with security clearances has been selected to assess, over a one-year period, classified systems for nonclassified use.

Mr. Garman announced that an open hearing will be held by the Senate Select Committee on Intelligence in Fairbanks on August 15, 1992, on "Radioactive and Other Environmental Threats to the United States and the Arctic resulting from past Soviet Activities." Chairperson O'Dowd has been asked to testify on opportunities for collaborative scientific research with the Russians.

Mr. Garman also reported that a Russian aid bill passed the Senate on July 2, 1992, which, among other items, authorized cooperative environmental monitoring in the Arctic. The Senator expects at least \$5 million will be available for this purpose in FY 93.

State of Alaska

Mead Treadwell, Deputy Commissioner, Alaska Department of Environmental Conservation, reported on a series of state activities.

The Department of Environmental Conservation has bilateral agreements with its counterparts in Magadan, Kamchatka and Vladivostok concerning common interests in mining regulation, clean drinking water, wastewater disposal, clean air and clean-up of contaminated sites. Alaska would welcome publication of a radiation disposal map for the Russian Far East similar to one published by Norway for Arctic European Russia.

Alfred Wong, UCLA, has been funded by the Alaska Science and Technology Foundation to develop a plasma torch at the Alaska HIPAS facility. In addition to studies of aurora phenomena, such a development could have applications for waste remediation.

A pilot project to beam power from the Bradley Lake hydroelectric plant to Dolina, a small village, may help demonstrate an alternative mode for transmission of energy within the Arctic. The Alaska Energy Authority, Texas A&M, Arthur D. Little Co. and Raytheon Corp. are seeking funding for this project.

The Northern Forum of 14 regional governments will meet in Whitehorse, Yukon, in September. It has hired Steve Shropshire (907-561-3280) as its Executive Director to be based in Anchorage, Alaska. Current initiatives include analysis of the Northern Sea Route, international environmental monitoring and promotion of northern east-west air routes.

The Earth Summit in Brazil (UNCED) produced a comprehensive statement to guide actions affecting the environment, called Agenda 21. For example, language regarding oceans calls for more bio-

*Commission Members
Present: Donald D. O'Dowd,
Chairperson; James O.
Campbell; Clifford J. Groh
Sr.; Charles H. Johnson;
George B. Newton Jr.; Luis
M. Proenza; and Charles
Myers representing the Ex-
Officio Member.
Staff: Philip L. Johnson,
Executive Director, and Lyle
Perrigo, Head, Alaska Office,
Advisors: Thomas Albert,
Vera Alexander, William*

Nelson and Howard Thomas,
Visitors; Dave Garman,
Office of Senator Murkowski,
Washington, D.C.; Laura Lee
McCauley, ARCUS; Mead
Treadwell, Alaska Dept. of
Environmental Conservation;
and Alan Walker, U.S.
Coast Guard.

logical research and reduction of wasteful bycatch. Mr. Treadwell also stated that the United Nations University might consider a regional center in Alaska.

EPA's de facto denial of a permit for an experimental in-situ burn of spilled oil this summer was especially disappointing to Alaska organizations. The Prince William Sound Oil Spill Recovery Institute at Cordova has \$500,000 this year from Congress and may receive funds from Exxon settlement disbursements. The Commission's recent recommendations on oil spill research in Arctic waters will be considered in formulating the plans of the Cordova Institute.

Interagency Arctic Research Policy Committee (IARPC)

Charles Myers reported that considerable IARPC staff discussion had occurred on Russian radiation waste on land and at sea. The Arctic Environmental Monitoring and Assessment Task Force has received proposals for assessment efforts, and several agencies expect to gather limited data this year. In response to a letter from Senator Murkowski, Chairperson Massey has written to IARPC representatives asking that they consider the validity of existing data, identify needed data and develop a science plan for this issue.

Regarding a schedule to develop the *Third Biennial Revision of the U.S. Arctic Research Plan*, Mr. Myers indicated that a draft would be completed by the end of December, agency consultation and public reviews would take place from January to March 1993, final approval by IARPC and the agencies would occur by late May, and it will be forwarded to the President by July 31, 1992.

Mr. Myers stated that a report required by Congress concluded that it was cheaper to build, own and operate an ice-capable Arctic research vessel than to lease one. The science requirements for such a vessel are being updated this month. Construction is projected for 1994-95 at \$45-50 million. Vera Alexander confirmed that the final science requirements are evolving from seasonal ice toward some central Arctic Basin capabilities.

Luis Proenza asked for information on future agency Arctic budgets and the range recommended by staff. Mr. Myers responded that each agency had its distinctive long-range plans and that future budget levels for FY 94 would not likely be known until early March. Dr. Proenza asked how NSF allocated the additional \$6.3 million received in FY 92. Mr. Myers responded that \$4.3 million was assigned to the ARCSS program within the Division of Polar Programs and that \$2.0 million was assigned to core science programs for joint funding with programs in ocean, atmospheric and biological

sciences. Dr. Proenza asked about the status of Arctic reorganization at NSF. Mr. Myers reported that an Arctic science section was being implemented. The plan has been accepted and personnel actions and budget allocations assigned. Full implementation is intended by August.

Resolution of Appreciation

In recognition of Oliver Leavitt's (Barrow, Alaska) appointment and service as a Commissioner from February 1985 to 1992, the Commission adopted a Resolution of Appreciation by unanimous consent.

Commission Review and Planning Discussion

The Commission conducted an extended review and discussion of Arctic policy, the duties and accomplishments of the Commission and the Interagency Arctic Research Policy Committee, the unfilled needs and expectations in basic and applied research as well as management of research, and the priorities for Commission activities. This long-range planning discussion among the members was particularly useful for the new members and provided a common basis for selecting future tasks.

Three future tasks are required by law:

- Preparation of a biennial statement of goals and objectives with respect to Arctic research;
- Preparation of an annual report to the President and to the Congress; and
- Review and comment on the *Third Biennial Revision of the Arctic Research Plan*. The first two tasks require publication by January 31, 1993. The third task will occur in the first quarter of 1993.

Two categories of future work of the Commission entail careful review and development of recommendations on priority scientific and engineering research and on improvements to coordination and management of research. A number of candidate topics were considered, and further discussion and selection is scheduled for the next meeting.

Other Business

George Newton reported on activities underway to determine the availability of submarines for science deployments in the Arctic. Only nuclear subs have the capability for extended missions under sea ice. Mr. Newton has submitted an article to the U.S. Naval Institute on this subject, which was approved in principle by the Navy. A similar article was published in *EOS*, and the UNOLS Fleet Improvement Committee published a report in January 1992, *Scientific Opportunities Offered by a Nuclear Submarine*.

The House Armed Services Committee has des-

ignated \$3 million in FY 93 for the operating costs of a U.S. sub, equivalent to a 60-day science deployment. Research projects would separately support the costs of the science. Alan Walker commented on the desirability of a science plan for the sub deployment that would also coordinate observations from surface and air-borne platforms. He pointed out that active cooperation between the U.S. and Canadian Coast Guards was freeing ice-breaker time for science missions. A Polar-class research deployment is scheduled off Greenland in the summer of 1992 and in the western Arctic in the summer of 1993. Vera Alexander expressed enthusiasm for the scientific opportunities from submarine platforms but cautioned that collaboration on Russian vessels should be approached and planned carefully. She also anticipates the need for new instrument development to obtain more than standard oceanographic data.

In response to Dr. O'Dowd's questions about the size of the Arctic research community, Laura Lee McCauley stated that the Arctic Research Consortium of the U.S. (ARCUS) has proposed to inventory and create a directory of Arctic researchers. One indication of investigator interests in the Arctic is the \$56 million of proposals sent to the NSF ARCSS program, for which only \$12 million is available. Ms. McCauley pointed out that a major upgrade of the Toolik Lake Research Station, which the Commission visited in August 1991, is being planned and budgeted.

Meeting Schedule

The Commission adopted a meeting schedule for 1993 as follows: 30th Meeting: March 24–25, Boulder, CO; 31st Meeting: May 26–27, Anchorage Alaska; 32nd Meeting: September 8–9; Fairbanks or Kotzebue, Alaska; 33rd Meeting: Dec. 7–8, Washington, DC. The next meeting is in Seattle, Washington, on December 3–4, 1992.

Discussion of Visit to Russian Far East

The Members were provided with visas and extensive background information on the Russian Far East and its scientific institutes. The Commission is to meet July 8–13 with its counterpart, the Arctic Research Commission of the Presidium of the Russian Academy of Sciences. The International Scientific Center "Artika," Magadan, will host the meeting and arrange for visits to the Russian Arctic. A trip report will be prepared for the next Commission meeting to be held in Nome on August 10–11.

Executive Session

Luis Proenza was nominated and elected by unanimous consent as Vice Chairperson of the Commission.

Twenty-Eighth Meeting August 10–11, 1992

Report of the Chair

Chairperson O'Dowd stated that the Commission report *Research Needed to Respond to Oil Spills in Ice-Infested Waters* was published in May and provided to the International Forum on Oil Spill Research convened in Washington on June 1–4, 1992. Notice of this report in the *Oil Intelligence Newsletter* has triggered more requests from industry and agencies than any previous Commission report.

Since the July meeting the most significant activity for the ARC was a joint meeting of the Arctic Research Commission and the Russian Academy of Sciences in Magadan on July 8–13, 1992. A trip report has been prepared and can be provided to those who provide mailing addresses to staff. In the period July 7–13, 1992, the Arctic Research Commission went to northeastern Russia, met with various officials and scientists, and visited a number of sites of scientific and technical interest. The objectives of the trip were to:

- Acquire information about the operation of the Russian Academy;
- Develop more extensive contacts with the Russian Academy of Sciences, regional branches and individual scientists;
- Identify areas of mutual interest and potential cooperation; and
- Observe relevant field conditions that affect scientific research in northeastern Russia.

During two days of discussion the two groups exchanged views on the research priorities of their respective countries and were pleased to note that there is great similarity in these priorities. At the conclusion of the meeting a joint memorandum was signed to conduct further joint meetings to evaluate progress and coordination of activities of mutual interest. Near the end of the meetings, U.S. Interior Secretary Manuel Lujan joined the meeting and briefly addressed the two delegations.

On July 11–13 the U.S. Commission and representatives of the Russian Academy (nine from the U.S. and seven from Russia) traveled by plane and helicopter to various sites in northeast Russia and as far as Wrangel Island, a total of 2700 miles. The experience in visiting different Arctic environments and settlements, as well as informal discussions enroute, added to understanding of the potential as well as the limitations of joint research activities.

Luis Proenza reported that the Inuit Circumpolar Conference recently convened in Canada had adopted *Principles and Elements for a Compre-*

Commissioner Members and Staff Present: Donald D. O'Dowd, Chairperson; Luis M. Proenza, Vice Chair; James O. Campbell; Ben C. Gerwick; Charles H. Johnson; George B. Newton; and Charles Myers representing the Ex-Officio Member Walter E. Massey. Staff: Philip L. Johnson, Executive Director, and Lyle Perrigo, Head, Alaska Office. Advisor: Thomas Albert. Visitors: Ken Adkisson, Ted Birkedal, Paul F. Haertel, Leonard Z. Hanson, Ernest Suazo and Fredrick Tocktoo, National Park Service; Anne Marie Anarok and Rose Atuk Fosdick, Reindeer Herders Association; Irene Anderson, Sitnasuak Native Corporation; Buff Bohlen and John G. VanDerwalker, Dept. of State; Fred Bue, Larry Buklis, Charles Lean and Randy Romanesko, Alaska Dept. of Fish and Game; Cherie Collins, KNOM Radio, Nome; Paul Day, City Manager, Nome; Dave Garman, Office of Senator Murkowski and Senate Intelligence Committee Staff; Dwight Hoyland, U.S. Bureau of Land Management; Jerry Irm, U.S. Minerals Management Service; Matthew Iya, Eskimo Walrus Commission; Judy Johnson, Arlington, Virginia; Peter Larsen, Jr., and Darryl Trigg, NEC, Nome; Marcia Levenson, Berkeley, California; Robert Mattock, Branch Manager, Nome; Larry Merculieff, Bering Sea Coalition; Charles Myers, National Science Foundation; Eileen Norbert, Kawerak, Inc.; Lyle Rennecker, Reindeer Research Program, University of Alaska-Fairbanks; Tim Smith, Nome; and Mead Treadwell, Alaska Dept. of Environmental Conservation.

hensive Arctic Policy and recommended this report as a thoughtful statement.

Alaska Congressional Delegation

Dave Garman of U.S. Senator Murkowski's staff indicated that concern for heavy metal pollution and radioactive contaminants in Russia was a major focus of the Senate Select Committee on Intelligence. Empirical data are especially needed for heavy metals in marine mammals and for evidence of movement in the ocean. It is also viewed as an excellent opportunity for cooperation in science with Russia. The Senate Committee hearing in Fairbanks on August 15 will provide expert testimony from the CIA Director and other experts. Dr. O'Dowd indicated that his sources reported probable radiation exposure to people in the Russian Arctic coastal regions, and he emphasized the need to include the Russian Academy of Medical Sciences in the joint analysis.

State of Alaska

Mead Treadwell, Deputy Commissioner, Alaska Department of Environmental Conservation, reported on an agreement with the U.S. EPA for environmental monitoring within Alaska. The State will monitor the U.S.-Russian aid package to seek ways to involve Alaska and assist the Russian Far East. He also raised the question of using funds collected from environmental fines for research rather than having it revert to general operating accounts, and he asked if the Commission could help explore this possibility. James Campbell pointed out the importance of improving communications within Russia to facilitate meaningful economic development.

Interagency Arctic Research Policy Committee (IARPC)

Charles Myers, NSF, representing Walter Massey, reported that the Congressional FY 93 appropriation for NSF is essentially the same as in FY 92. For planning and designing an Arctic research vessel, \$1.5 million is specified by the House Committee. The science requirements for this vessel are being confirmed by September and may lead to specification of an A-3 ice classification.

Regarding Russian pollution, especially radioactive contaminants, IARPC Chair Walter Massey has scheduled a meeting on August 27, 1992, for agencies to discuss the need for analysis and a plan that could be incorporated into the third revision of the U.S. Arctic Research Plan. This Plan will be prepared this fall and winter for review and for completion by July 1993.

Dr. Proenza asked about implementation by NSF of the recommendations of the National Sci-

ence Board (NSB) Committee on Polar Science. Mr. Myers replied that a doubling of program funds for the Arctic had been achieved but not as yet for the Antarctic. Dr. Proenza suggested that the Commission request an update of the status of these NSB recommendations and possible time on the NSB agenda to discuss this progress.

Department of State

Buff Bohlen, Assistant Secretary for Oceans, Environmental and Scientific Affairs, discussed progress under the Arctic Environmental Protection Strategy, particularly the several working groups in the Arctic Monitoring and Assessment Program. He indicated that DOS intended to increase its role in Arctic affairs and would soon appoint an advisory panel from environmental and Native organizations.

He expressed concern for a decline in pollack size caught in the Bering Sea and suggested a moratorium on catch in the "donut hole." DOS has funded the Polar Research Board for a two-year analysis of all available data in the Bering Sea marine ecosystem to better pinpoint the problems causing declining populations. The June communique by Presidents Bush and Yeltsin again cited the need for a Beringian Heritage International Park.

At the June United Nations Conference on Environmental and Development in Brazil, the Arctic was not explicitly on the agenda; however, President Bush committed the U.S. to principles of sustainable development along with 150 other countries. Mr. Bohlen pointed out that the environmental guidelines adopted by the participating countries, known as Agenda 21, is relevant to northern latitudes, particularly the chapter on oceans.

Consideration of Submarines as Research Platforms

Commissioner Newton reported that \$3 million for operation of a U.S. Navy nuclear submarine as a science platform (about 60 days) was included in the House Defense Appropriations bill for FY 93. Upon passage of House and Senate appropriations, the time frame for a detailed research plan will be very short. He will monitor progress for the Commission.

Mr. Newton participated in a small delegation to St. Petersburg, Russia, in July to discuss the offer of a Russian Delta-class nuclear submarine as a science platform. This offer was made by the Russian submarine design bureau, but the Russian Navy does not wish to operate the vessel. The design bureau seeks \$70-100 million to retrofit their sub for ten or more years' availability. Richard Pittenger, Woods Hole Oceanographic Institution, signed an agreement to convene a conference for further discussion.

Proposed Marine Research Coordination and Funding

State Senator Arliss Sturgulewski reminded the Commission of a proposal that she and Paul Fuhs presented at its meeting in Unalaska, Alaska, in August 1988. That presentation emphasized the need to "enumerate research needs, funding sources, and resultant management systems for national and international waters of the Bering Sea" in an integrated and comprehensive way. It is now time to pull North Pacific/Arctic Ocean research programs together under a coherent, rational plan. Absent such a plan, the U.S. may squander precious resources without answering fundamental questions about ocean ecosystems essential to sound resources management.

Ms. Sturgulewski made two proposals:

- **Coordination**—That the Arctic Research Commission convene representatives of PICES, the North Pacific Universities Fisheries Research Consortium, the Pacific States Marine Fisheries Commission, and other relevant groups to discuss goals, benefits and mechanics of a comprehensive long-term North Pacific/Arctic Ocean marine research plan.
- **Funding**—A Marine Sciences Endowment be established of up to \$100 million from a balance of some \$700 million of the *Exxon Valdez* civil settlement due the State of Alaska and the United States. The purpose would be to provide long-term baseline marine research and to be a coordinating mechanism for various research organizations active in Alaskan marine waters. Funding would provide monitoring and assessment of resources and ecosystems affected by spilled oil; determine effective resource recovery; and define opportunities to enhance natural resources. Such funds could be managed as an endowment or as a sinking fund for a specified period.

The Commission found both proposals interesting and challenging and agreed to consider and pursue both of them. The discussion acknowledged possible geographic constraints and scope of work, possibly bounded by the wording of the *Exxon Valdez* legal settlement, but the public need argues for a broad scope of research funded from such an endowment.

Discussion of Follow-Up to Russian Trip

The Commission discussed the serious environmental pollution in Russia from misuse and disposal of radioactive materials and from industrial wastes such as heavy metals. The Chairperson's

testimony to the Senate Select Committee on Intelligence in Fairbanks on August 15, 1992, was distributed. Because of the Commission's concern for the scientific uncertainties and potential risks to Arctic ecosystems and peoples, a resolution was prepared urging IARPC to organize and implement a multiagency assessment. It was also noted that hazardous wastes from past activities and installations of the U.S. military in Alaska may be a future issue. Mr. Treadwell recommended that the assessment include publication of a map of disposal sites for the Russian Far East similar to one for the Barents Sea published by Norway.

Other Business

Mr. Myers, in response to a question, stated that the planned Arctic Section (202-357-7818) in the Division of Polar Programs, NSF, would be implemented in August. Eight full-time staff are planned, several of whom are to be recruited. Dr. Peter Wilkniss will serve as acting Section Head.

Commissioners O'Dowd, Johnson and Proenza and the Executive Director participated in a conference titled *The Changing Role of the United States in the Circumpolar North*, in Fairbanks, August 12-14; and Chairperson O'Dowd testified on August 15, 1992, at a public field hearing of the Senate Select Committee on Intelligence on "Radioactive and Other Environmental Threats to the United States and the Arctic Resulting from Past Soviet Activities." The Chairperson's testimony concerned the potential for collaborative research on this important subject.

Public Meeting

A public meeting was convened to discuss research needs in the Arctic in the Conference Room over the Board of Trade, Nome, Alaska.

Presentations included:

- Status of the Beringian Heritage International Park, by Paul Haertel and Ted Birkedal, National Park Service; and
- Bering Sea Wildlife and Fisheries Research, by Larry Merculieff, Bering Sea Coalition, and Larry Buklis and Charles Lean, Alaska Fish and Game Department.

Comments were also received from Matthew Iya, Eskimo Walrus Commission; Rexford Burton, Eskimo Whaling Commission; Rose Atuk Fosdick, Reindeer Herders Association; Lyle Renecker, Reindeer Research Program, U.S.A.; Tom Albert, Dept. of Wildlife Management, North Slope Borough; Irene Anderson, Sitnasuak Native Corporation; and Eileen Norbert, Kawerak, Inc.

Forthcoming Meetings

Listed here is a compilation of recent and forthcoming meetings, workshops and conferences on Arctic or northern topics and activities. Readers are invited to submit information on upcoming meetings, as well as reports on national or international meetings attended, to Editor, Arctic Research, National Science Foundation, Room 620, 1800 G St., NW, Washington, D.C., 20550.

1992

Third International Conference: The Role of Circumpolar Universities in Northern Development

30 November–3 December 1992, Rovaniemi, Finland

Contact: Ms. Outi Snellman, University of Lapland, P.O. Box 122, 96101 Rovaniemi, Finland
Phone: 60-324 208
Fax: 60-324-207

1993

Remote Sensing and Global Environmental Change 25th International Symposium

4–8 April 1993, Graz, Austria

Contact: Nancy J. Wallman, ERIM/International Symposium, P.O. Box 134001, Ann Arbor, Michigan 48113-4001

Phone: (313) 994-1200, ext. 3234
Fax: (313) 994-5123

CIRCUM-Pacific Council for Energy and Mineral Resources

Symposium on Arctic Resources: The Challenge of Development

24–26 May 1993, Anchorage, Alaska

Contact: Donald P. Blasko, U.S. Bureau of Mines, 3301 "C" Street, Suite 525, Anchorage, Alaska 99503-3935
Phone: (907) 271-2455
Fax: (907) 271-3933

Fourth Canadian Marine Geotechnical Conference 27–30 June 1993, St. John's, Newfoundland, Canada

Contact: Farrokh Poorooshasb, Technical Chairman, Fourth Canadian Marine Technical Conference, C-CORE, Memorial University of Newfoundland, St. John's, Newfoundland A1B 3X5, Canada

VI International Conference on Permafrost 5–9 July 1993, Beijing, China

Contact: G.D. Cheng, Lanzhou Institute of Glaciology and Geocryology, Academia Sinica, Lanzhou, China
Phone: 26726-385
Fax: 86 931 485 241
Telex: 72008 IGGAS CN

International Cryosols Tour: Classification, Correlation, and Management of Permafrost Soils

18–30 July 1993, Northwest Canada and Alaska

Contact: John Kimble, USDA-SCS, Federal Building, Room 152, 100 Centennial Mall North, Lincoln, Nebraska 68508-3866
Phone: (402) 437-5363
Fax: (402) 437-5336

Pre-Conference Field Trip, Geomorphology and Permafrost,

11–22 August 1993, Yukon and Western Canadian Arctic

Contact: C.R. Burn, Department of Geography, University of British Columbia, Vancouver, B.C., Canada V6T 1W5

Third International Conference on Geomorphology 23–29 August 1993, Hamilton, Canada

(including the Binghamton Symposium on Geomorphology, 25 August 1993)

Contact: McMaster University, Hamilton, Ontario, Canada L8S 4K1
Phone: (416) 546-9140 ext. 4535
Fax: (416) 546-0463
Telex: 061-8347

International Symposium on the Ecological Effects of Arctic Airborne Contaminants

4–8 October 1993, Reykjavik, Iceland

Contact: Debra Steward, Technical Resources, Inc., 3202 Tower Oaks Boulevard, Rockville, Maryland 20852
Phone: (301) 770-3513
Fax: (301) 468-2245

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Back Cover

Blanket toss in Wainwright, Alaska, a part of Nalukataq, the annual festival celebrating the successful landing of a bowhead whale. (Photo by David Burnham.)

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