

FEDERAL ARCTIC RESEARCH INFORMATION WORKSHOP

Workshop Proceedings



JULY 1991

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PREFACE

This Federal Arctic Research Information Workshop was organized on behalf of the Interagency Arctic Research Policy Committee (IARPC) in order to facilitate the exchange of information on federal research to fulfill the intent of the Arctic Research and Policy Act of 1984. The Workshop was held on March 19-21, 1991 at the Anchorage Museum of History and Art. Representatives from federal agencies were invited to report on recent accomplishments of research and related activities and to exchange information on current and future projects and programs.

The Workshop Steering Committee included:

Minerals Management Service: Joy Geiselman, Jerry Imm, Cleve Cowles; Dept. of the Interior: Curt McVee; Ron McCoy; U.S. Fish and wildlife Service: Bill Palmisano, John G. Rogers; National Park Service: Allan Lovaas, Ted Birkedal, Jeanne Schaaf; Centers for Disease Control: Robert Wainwright; U.S. Geological Survey: Paul Brooks; National Oceanic and Atmospheric Administration: Jawed Hameedi, Michael Crane; National Marine Fisheries Service: Ron Morris; Cold Regions Research and Engineering Laboratory: Walt Olson.

Local arrangements were facilitated by the Steering Committee, Dr. Joy Geiselman, of the Minerals Management Service, Alaska OCS Region, served to facilitate the organization and logistics of the workshop. Proceedings of the Workshop were prepared by MBC Applied Environmental Sciences, Costa Mesa, California.

The Workshop was funded by the Minerals Management Service and the National Science Foundation.

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INTRODUCTION

**CURT MCVEE
SPECIAL ASSISTANT TO THE SECRETARY
DEPARTMENT OF THE INTERIOR**

Welcome to the Federal Arctic Research Information Workshop.

The purpose of this workshop is to report on recently accomplished, on-going, and planned federally-funded research in the Arctic. In addition, there will be the opportunity to comment of the Second Biennial Revision of the U.S. Arctic Research Plan.

This workshop started with an expression by the National Science Foundation (NSF) that based on individual contacts with several federal agencies that there was evidence that more work was being accomplished by federal agencies than was being recorded. Within the Department of the Interior it was agreed that this was true and that it would be worthwhile to catalog all of the work that was on-going, recently accomplished, or planned for the near future. This is considered to be the first step in making the specific information known and available to other organizations and individuals for their use.

NSF committed to providing some support if we in the federal establishment could initiate a workshop. A steering committee chaired by Dr. Joy Geiselman of the Minerals Management Service (MMS) with the support of Jerry Imm and other people have put this workshop together.

While it would be very interesting and beneficial to explore the findings and results of the work which will be reported here during the next three days, we do not have enough time and that is probably another meeting or series of discussions, What we do want to accomplish is to fully and accurately report and catalog the Arctic research activities of the various federal agencies. This is why many of the reports will not be presented by the principal investigators, but will be summarized or abstracted by an agency research manager.

We hope that these sessions will facilitate the exchange of information. I would like to thank the MMS for providing leadership and lots of staff support. Also I would like to thank the volunteers who made up the membership of the steering committee who designed the sessions and made many telephone calls to contact and identify participants.

DEPARTMENT OF AGRICULTURE
FOREST SERVICE
PACIFIC NORTHWEST RESEARCH STATION, PORTLAND, OREGON

Presented by: Leslie A, Viereck

Forest Service research in Arctic Alaska is carried out by the Pacific Northwest Research Station (PNW) at four locations: 1) the Institute of Northern Forestry (INF) in Fairbanks, 2) the Forestry Sciences Laboratory (AFSL) in Anchorage, 3) the Copper River Delta Institute (CRDI) in Cordova, and 4) the Forestry Sciences Laboratory (SFSL) in Seattle. Under the new reorganization of PNW, forest research in Alaska is conducted within four of the five newly established research programs and three of the six research and development programs.

INSTITUTE OF NORTHERN FORESTRY

Aquatic - Land Interactions Research Program

Research has been conducted primarily in the Caribou - Poker Creeks Research Watershed (CPCRW) and is focused on understanding subarctic hydrologic processes and the consequences for those processes of applying forest management practices in the discontinuous-permafrost taiga. Recent and current research addresses soil erosion in high-latitude settings, streamside vegetation management in headwater catchments, streamflow regimes and stream quality as affected by permafrost, and biological productivity of a stream/landscape continuum from headwaters to fifth-order streams.

Ecosystem Processes Research Program

Long-term monitoring of vegetation and environment is carried out in the Bonanza Creek Experimental Forest (BCEF) under the National Science Foundation (NSF) -funded Long-Term Ecological Research (LTER) Program. Effects of competition and facilitation of alder and competition of *Calamagrostis* on white spruce regeneration and growth will be studied in a series of plantations, artificial communities, and on clear-cuts in BCEF. A project funded by National Aeronautics and Space Administration (NASA) through the Jet Propulsion Laboratory is providing ground truth of ecosystem characteristics and temporal ecosystem conditions as part of an effort to determine the capabilities of Synthetic Aperture Radar (SAR) to predict ecosystem structure, condition, and phenology. These observations will be expanded after the launch of the ERS-1 satellite scheduled for May 1991. Fire effects research is limited to the monitoring of a number of permanent plots established in wildfires that date back as far as the 1950 Porcupine River Fire. Through cooperation with U.S. Fish and Wildlife Service (USFWS) a number of vegetation plots have been established in wildlife refuges to document changes that result from a program of prescribed fire to improve wildlife habitat. Research on the Denali National Park moose, which began in 1980, is continuing. Data gathered in the 1989-1990 field season included continuing survival and mortality data on adults and juveniles and annual population surveys to determine population composition and trend. Studies of moose winter habitat ecology were also conducted on the Copper River Delta.

Resource Management and Productivity Research Program

Under the forest genetics research program a major study of the variability in coastal Sitka spruce was initiated. In cooperation with the U.S. Navy, a program to determine the best seed sources of plantations of Sitka spruce on Adak Island was continued. A seed zone map for all of Alaska is nearing completion. Silvicultural research was directed toward promoting successful regeneration of floodplain forests of white spruce and in determining the potential for using alternate harvest methods for white spruce. Current research emphasizes the analysis of structure and dynamics in mixed forest stands which in interior Alaska occur on a majority of the productive sites due to past fire history. These stands contain white spruce, quaking aspen, paper birch, and balsam poplar. Research planned for the next several years emphasizes consideration of plant interactions during the regeneration and stem exclusion period and will concentrate on the response of white spruce to competition.

Environmental Health and Protection Research Program

In studies to predict the risk of spruce beetle outbreaks on the Kenai Peninsula, it was determined that vegetation association was the most important variable determining the risk of spruce beetle outbreaks. Low elevation mixed spruce-paper birch communities with white or Lutz spruce exhibited the greatest overall risk of spruce beetle outbreak. In spite of host suitability differences, outbreaks of spruce beetle have been more frequent and severe in stands of Lutz spruce than in white or Sitka spruce. Integrated pest management strategies have been developed to reduce the impact of *Ips* engraver beetles in stands of white spruce in interior Alaska using pheromones and protective chemicals. Research is underway to: 1) develop different forest management prescriptions for managing spruce stands to protect them from attack by spruce beetles in south central and interior Alaska, and 2) to develop strategies for managing populations of spruce beetles.

Global Environmental Protection Research and Development Program

Fire research in Alaska is conducted under this program and is discussed under the work of the Seattle Forestry Sciences Laboratory.

Planned global climate change research is also included under this program. At INF the following climate change projects are planned when funding becomes available: reproductive biology and vegetation dynamics at treeline, permafrost studies, GIS-based landscape models, local and regional transects, and increased long-term monitoring in BCEF and CPCRW.

Production of Goods and Services Research and Development Program

Studies are underway to determine the best methods of preservative treatment of white spruce. Good results have been obtained by treating fence posts by soaking in pentachlorophenol as well as double-diffusion using chemicals such as sodium chloride and copper sulfate. Spiral grain has been measured in 500 white spruce trees in interior Alaska and correlated with site and tree characteristics. Future research will examine the moisture content in bole wood of interior Alaska tree species and the mechanical properties on interior white spruce.

SEATTLE FORESTRY SCIENCES LABORATORY

Global Environmental Protection Research and Development Program

Fire Research in Alaska - The response of taiga and tundra ecosystems to fire is directly related to the amount of woody fuel, duff, and lichen/moss layer that is consumed. Characterization of fuel consumed and modeling of biomass consumption is critical in any ecological response to fire. During the summer of 1990 the following was initiated: 1) a wildfire consumption study on three active wildfires and two stand replacement prescribed fires, 2) moss/fuel consumption validation in a broadcast burn unit in Bonanza Creek Experimental Forest, and 3) an analysis of lake sediment cores for fire occurrence and frequency. In 1991, wildfire severity and fuel consumption studies will be continued and fuel moisture studies of moss types will be initiated.

COPPER RIVER DELTA INSTITUTE

The mission of CRDI is to improve understanding, use, and management of natural resources of the Copper River ecosystems. Research will be concentrated on the study of the wetlands of the Copper River Delta and will include studies of the structure and function of wetlands, waterfowl and other wildlife habitat requirements, and the effects of catastrophic events such as the uplift from the 1964 earthquake and the 1989 oil spill. Economic and social values will also be included in the research program,

ANCHORAGE FORESTRY SCIENCES LABORATORY

Presented by: Frederic R. Larson

inventorying and Monitoring Natural Resources

The Inventory and Analysis Project at the Anchorage Forestry Sciences Lab is one of seven within the U.S. Forest Service with responsibilities for inventorying renewable resources in the United States. Several federal laws passed in the late 1970s mandate that all renewable resources on all lands, regardless of ownership, be periodically inventoried and reported to Congress. While these laws are directed at all federal agencies, the assignment was given to the Secretary of Agriculture with instructions to cooperate with other agencies as necessary, and not to duplicate efforts.

Since 1981, a state-wide multi-agency, multi-resource soils and vegetation inventory has been progressing. The initial effort used a four phase sample design with co-located plots on Landsat imagery, small scale (1:60,000) photography, large scale (1:5,000) photography, and the ground. The Tanana and Copper River Basins, and southeast Alaska have been inventoried using this system, covering nearly 120 million acres.

We are moving ahead with the state-wide renewable resource inventory in cooperation with the Soil Conservation Service, but have changed the sample design. The new design will use Landsat imagery to sort forest, woodland, shrubland, herbaceous land, barren land, and water into subpopulations. Each subpopulation will be sampled separately, and at different intensities, in two phases small scale (1:60,000) photography and ground plots. We will inventory the Kuskokwim and Bristol Bay watersheds in 1991 and 1992, the Yukon drainage in 1993 to 1994,

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and the Kobuk drainage in 1995. If cooperators desire and funding can be obtained, the effort will be extended to include the North Slope.

We are also cooperating with the Environmental Protection Agency in designing and implementing an Environmental Monitoring and Assessment Program (EMAP). The goal of this program is to inventory forest ecosystems in matters that relate to atmospheric pollution and conduct such surveys as are necessary to monitor long-term trends in the health and productivity of our domestic forest ecosystems. We are also interfacing with the plan developed by the Anchorage Field Office of the U.S. Geological Survey's Earth Resources Observation System (EROS) in their baseline studies for monitoring global climate change in the Arctic environment. This effort will utilize established inventory plots and data gathered on the Long Term Ecological Research (LTER) sites. The goal of this study is to monitor the condition of ecological resources in an attempt to show significant changes in vegetation health and vigor through repeated observations of key indicator plant species or ecosystems.

DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

Presented by: Rick McClure and J. David Swanson

The Soil Conservation Service (SCS) assists and coordinates with private land owners, village, regional as well as state and federal land owners. SCS field office personnel in Northwest, Interior and Southcentral Alaska provide technical resource planning and application assistance to these various land owners and users. Conservation plans and coordinated resource management plans, or interim plans are developed at the individual's request to assist them with their conservation program.

Currently the SCS is in the process of completing wetlands maps of all agriculture lands, and lands identified as potential agricultural areas in Alaska. The principal purpose of the mapping effort is implementation of the Swampbuster¹ provisions of the 1985 Food Security Act. Approximately 300,000 acres were mapped in the interior near Fairbanks and Delta Junction during 1990. An additional approximate 200,000 acres is scheduled for mapping in southcentral Alaska and the Kenai Peninsula during the 1991 field season. Wetland delineations are consistent with the Federal Manual for Identifying and Delineating Jurisdictional Wetlands (1989) and the SCS National Food Security Act Manual.

A major part of the range program involves areas grazed by 36,500 reindeer. The present tundra monitoring program involves utilization checks in selected reindeer grazing permit areas. Exclosure monitoring has involved evaluating plant treatment response and plant succession. Enclosures are located on Adak, Hagemeister, Nunivak Islands and on the Seward Peninsula. Exclosure data organization, standardization and enclosure maintenance is needed. A cooperative study with University of Alaska Anchorage (UAA) and USFWS has resulted in the establishment of ten long-term vegetation trend monitoring plots on Nunivak Island in 1990. Data from the Nunivak study is automated and will be available April 1991. In June 1991, an interagency team will determine procedures, cost and test mapping ecological range condition on the Seward Peninsula. If funded a lichen growth rate study by UAA/SCS starting in June 1991 to 1994 will evaluate lichen growth rates relative to grazing, fire and other treatments and make other ecological and physiological assessments as they pertain to reindeer and caribou ecosystems,

Final reports for the Tanana and Copper River Basin Studies will be issued in 1991. Portions of the soils and land cover mapping have been digitized. Field work on the Kenai River Basin Study will be completed in 1991 which includes streambank inventory and designs for erosion control structures. Soils and land cover maps will be digitized and the final report for the Kenai Study should be produced by 1993. Field work for the Kuskokwim River Basin Study is expected to begin in 1992.

Soil survey data is available in detail for about 38 million acres (1 :20,000 to 1:24,000). The entire state is covered at a scale of 1:1,000,000. Three survey areas: Mat-Su, Gerstle River, and Kenai River are in progress. The Copper River, Copper River Delta, Haines, Upper Tanana, North Star, Yentna, Chatham, Stikine and Ketchikan are completed and awaiting publication.

¹ Swampbuster = altering wetlands.

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Digital data are available for these. The Lower Kenai Peninsula Survey is planned to start by 1992.

The SCS continues to contribute to the research effort by collecting snow and related climatological data. Of significant importance in the Arctic is the amount of annual snowfall the region receives. The true amount of snowfall for the Arctic coast is approximately three times the amount historically reported by the National Weather Service (NWS). This is the average difference in total snowfall catch between the NWS non-shielded or Alter-shielded precipitation gages and the SCS Wyoming-shielded gages. SCS currently coordinates data collection at seven North Slope Wyoming-shielded gages. A non-shielded or Alter-shielded precipitation gage is inadequate shielding to provide an accurate catch of snowfall in the windy and exposed tundra environment of the arctic region. In July of 1989, SCS established a study site at Barrow at the NOAA Climate Modeling and Diagnostic Laboratory (formerly GMCC) in which precipitation gages with various wind-shielding are located within close proximity to each other. The windshields being evaluated are: 1) Wyoming shield, 2) the Canadian national standard Nipher shield, 3) Alter shield, and 4) the NWS standard - no shield. The results of total snowfall in 1990 for this configuration were: Nipher shield - 64% of Wyoming shield; Alter shield - 47% of Wyoming shield; no shield - 28% of Wyoming shield.

In addition, the snow survey data are used in the Arctic for engineering and development, river breakup timing forecast, snowmelt runoff volumes in arctic rivers, fresh water availability and augmentation, blowing snow control, caribou movements, and global warming modeling research.

DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
PREFACE

The National Oceanic and Atmospheric Administration (NOAA) is the principal Federal agency with operational and research responsibilities regarding the oceans and the atmosphere. As part of its mission and legislative authority, NOAA has maintained an effective presence in the Arctic, with projects designed to understand the unique features and resources of the Arctic. In addition, NOAA's participation in the Outer Continental Shelf Environmental Assessment Program (OCSEAP) since 1975 by sponsoring or performing research, information management, and related activities has culminated in a large amount of useful and authoritative information about Alaskan continental shelves and coastlines. This information, particularly when synthesized with data produced by other academic and research institutions, provides a basis to describe the air and water resources of the Arctic, as well as the means to predict consequences of environmental changes. However, the existing data base is sporadic in spatial and temporal coverages, non-uniform in quality, and often inaccessible; a lot more needs to be done to improve the present state of knowledge about the Arctic.

The summaries of presentations at this workshop provide a glimpse of NOAA's interests and activities in the Arctic; they are not meant to be comprehensive. The summaries are intended to supplement information already furnished by NOAA for the current biennial revision of the U.S. Arctic Research Plan.

Persons interested in knowing more about the NOAA projects being presented at this workshop should contact the speakers or the undersigned (telephone: FTS 868-3036; (907) 271 -3036).

M. J. Hameedi
Workshop Coordinator, NOAA

Presentations by:

Jawed Hameedi
Jim Balsiger
Jim Kemper
Mike Crane

NATIONAL ENVIRONMENTAL SATELLITE, DATA, AND INFORMATION SERVICE

Joint Sea Ice Studies

In a joint Navy/NOAA project, hardware has been procured to augment the Alaska Synthetic Aperture Radar (SAR) Facility at the University of Alaska, Fairbanks. This augmentation will allow the capture and storage of high and low resolution SAR data, data compression for high and low resolution data, and the communication of SAR data via the NOAA polar domestic satellite (DOMSAT) communications system to the Navy/NOAA Joint Ice Center in Suitland, Maryland. SAR data from the European Space Agency ERS-1 satellite will be used initially in an applications demonstration of its utility to operational Arctic ice analysis activities, including ice extent, ice classification, and ice motion. Currently, all parts of the communication system are expected to be ready for testing in the spring of 1991.

Every orbit of low resolution (4 km) data from the afternoon polar satellite, and occasional readouts of high resolution (1.1 km) data are being mapped over the Arctic and Antarctic. There are plans to map substantially more high resolution data during the next few years (when the new NESDIS mainframe computers become operational).

The NESDIS National Climatic Data Center archives Defense Meteorological Satellite Program (DMSP) Special Sensor Microwave/Imager (SSM/I) data received via tape from the Navy Fleet Numerical Oceanography Center (FNOC) and via the Shared Processing Network from the Air Force Global Weather Central (AFGWC). SSM/I temperature data records (antenna temperatures for all channels) have been archived since November 1987. SSM/I data received from the Air Force over Shared Processing have been archived since December 1989. During the coming year, the Environmental Data Records (measurements of snow, wind, ice, etc.) will be added to the archive.

Fairbanks Command and Data Acquisition Station

The primary mission of the Fairbanks Command and Data Acquisition Station (FCDIS), located 13 miles northeast of Fairbanks, Alaska, is to provide command, telemetry, and tracking support of the NOAA polar-orbiting meteorological spacecraft, and to receive imagery data from those spacecraft and distribute the data to a population of users.

In addition to this primary mission, the station serves as a landlord for tenants engaged in various research projects. These include:

Very-long-based Interferometry (VLBI) - Principal Investigator is Dr. Tom Clark, NASA Crustal Dynamics Project Office, Greenbelt, MD. The purpose of this research is to precisely measure the relative movement of earth crustal plates, using quasar radio sources and a number of fixed and mobile VLBI stations. FCDIS is the primary fixed facility.

High-powered Auroral Study (HIPAS) - Principal Investigator is Dr. Alfred Wong, UCLA. The purpose of this research is to determine the feasibility of earth-to-space and space-to-earth communications through an aurora, and by extrapolation through a nuclear cloud, Funding is from the Strategic Defense initiatives Office.

Extreme-low-frequency Radiation Study - Principal Investigator is Dr. David Sentman, Lawrence Livermore National Laboratory. The purpose of this research is to measure deviations in earth ground currents, correlating that data to occurrences of earthquakes and other geological phenomena.

In addition, the Centre National d'Etude Spatiale (CNES), the French space agency, and the Jet Propulsion Laboratory have installed Global Positioning Systems at the station for the precise measurement of orbits of specific spacecraft,

This summer, NOAA plans to install a precision cryogenic gravimeter in cooperation with several other agencies. This will be used to precisely measure earth gravity flux density.

The U.S. Department of Commerce has identified the facility as a Proprietary Research Facility, at which organizations can conduct proprietary research. The organizations compensate the Government for costs incurred in providing support and are permitted to retain the rights to research results.

Arctic Programs

The Arctic programs within the National Environmental Satellite, Data, and Information Service (NESDIS) are managed by the major National Centers and the Satellite Departments. The data missions and the satellite service missions incorporate Arctic activities as an integral part of the global perspective. There are several region-specific projects that support Arctic research and operations,

Fiscal Years 1989 and 1990 Projects

Satellite Programs: Data from the NOAA polar-orbiting satellites are distributed to the research community. Primary data are from the Advanced Very High Resolution Radiometers (AVHRR). Data from the NOAA geostationary satellites are distributed to the research community.

Data Services: Arctic databases are maintained from submittals by NOAA and National Science Foundation (NSF) researchers. Oceanographic data are managed by the National Oceanographic Data Center (NODC), geophysical data at National Geophysical Data Center (NGDC), and climatic data at National Climatic Data Center (NCDC).

World Data Center A (WDCA) maintains files of international data holdings for oceanography, snow/ice, geology/geophysics and meteorology.

Satellite data from the NOAA, US-sponsored, and foreign-sponsored satellites have been managed as archive databases used in retrospective searches. DMSP and SSM/I data are distributed to researchers via the WDC A Glaciology.

Fiscal Years 1991 and 1992 Plans

Satellite Programs: Data from the ERS-1 satellite will be a priority for analysis and archiving.

Advanced Microwave Sensing Unit (AMSU) will be added to the new fleet of NOAA satellites and will complement the SSM/I sensors,

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AVHRR data will be incorporated into a 4.0 km Global Area Coverage database.

Sea ice measurements from SAR data will be developed.

Data Services: Arctic databases will be expanded and the existing Arctic data directories will be updated.

A NOAA Arctic Data Operations Office will be expanded from the existing NOAA offices in Anchorage. The emphasis will be regional support of data.

Coast Watch for Arctic data will promote data distribution to Coast Watch clients. Near real time transmission of data for remote sensing platforms will be developed.

Dissemination of Joint Ice Center Digital Data will be promoted by the Cooperative Institute for Research in Environmental Sciences located at the University of Colorado.

NATIONAL MARINE FISHERIES SERVICE

Bering Sea Resource Assessment

NOAA's National Marine Fisheries Service (NMFS) assesses stock condition for crabs and groundfish in the Gulf of Alaska and the Bering Sea. These assessments provide measures of abundance independent of those derived from analyses of fisheries landings statistics, and they cover conditions of the multi-species community as a whole. The data serve multi-species and multi-disciplinary purposes (fish/fish, fish/mammal, fish/bird, fish/environment). Combined with information from the fishery itself (catch, effort, size, age, location, etc.), these data result in analyses of stock condition and recommendations for management of both the fishery and its environment. The information included stock unit identification, estimates of potential yield, contemporary condition of stocks, short-term (1 to 3 year) prediction of change, interaction of the separate species and groups, and response to environmental change. Major surveys occur every three years in the eastern Bering Sea, the Gulf of Alaska, and the Aleutian Islands. Annual surveys are made for critical species such as pollock, cod, yellowfin sole, and king and Tanner crab. Special-purpose surveys are made to reconnoiter new areas and to study processes that affect predictions.

Survey methods include bottom trawls for crabs and demersal fish, hydroacoustic and midwater trawls for semipelagic fish, and special purpose sampling for eggs, larval and juvenile fish, and shellfish. Trawl and acoustic surveys are used to estimate minimum biomass and are analyzed to define community structure; biological samples are taken to examine variability in growth, mortality, and recruitment of the stock. Recruitment indices and processes that result in variations in abundance are studied to improve prediction. To increase the accuracy and precision of these assessments, NMFS conducts biological research to define recruitment processes, develops computer models to simulate the interactions and dynamics of population change, and supports contract research to improve methods and survey designs.

In addition to conducting annual surveys in the eastern Bering Sea in 1990, the NMFS cooperated with OCSEAP scientists in a bottom trawl survey of demersal and benthic organisms of the Chukchi Sea. NMFS scientists also participated in a USSR survey of fishery resources on both sides of the US/USSR extended jurisdiction boundary and well into the Soviet waters

of the western Bering Sea. The abundance and structure of pollock stocks in the Aleutian Basin were surveyed cooperatively aboard a Japanese research vessel.

Arctic Marine Mammals

NOAA's National Marine Mammal Laboratory at the Alaska Fisheries Science Center in Seattle, Washington, is conducting long-term research on the population biology and ecology of Steller sea lions, northern fur seals, and bowhead whales in the western North American Arctic. Research in 1990 was conducted jointly with the Soviet Union under the US-USSR Environmental Protection Agreement (Project V-Marine Mammals), the Alaska Department of Fish and Game on Steller sea lions, and with Japan on northern fur seals.

During the past two decades, significant changes have been observed in the numeric composition of several vertebrate populations (birds, fishes, and marine mammals) in the eastern North Pacific and Bering Sea ecosystems. Apex predators such as the Steller sea lion and Pacific harbor seal have declined significantly, and the northern fur seal population on the Pribilof Islands has declined by 60% since the 1950s. The causes for these declines have not been clearly identified, although the synergistic effects of commercial fisheries and changes in oceanographic and atmospheric conditions (for example, water temperature and frequency of storms) appear to be important.

The Steller sea lion population, from the western Gulf of Alaska to the western Aleutian islands including the Bering Sea, where more than 70% of the species reside, declined 63% in just four years; from 67,617 animals observed on land in 1985 to 24,953 in 1989 -- a reduction of 16% per year. Since 1960, the population in western Alaska has declined by over 80%, a result of increased mortality of all sex and age classes and a reduction in pup production. Mass emigration is not a factor in the decline of the population in Alaska, because the number of sea lions in Soviet waters has also declined since about 1970; and no significant increase in the population has occurred in other areas of the species' range. Further work is being planned to identify the locations and causes of mortality once the animals leave the summer breeding rookeries to feed at sea. Because Steller sea lions have declined to a fraction of their former numbers, the species was listed in November 1990 as threatened under the U.S. Endangered Species Act.

Research on bowhead whales is conducted to assess the recovery of the population by studying recruitment, other life history events, and the catch by Alaska Eskimos. Recent work on the lengths of individually measured and identified whales suggests that the population is composed of about 40% adults, and the calving interval is about four years.

NATIONAL OCEAN SERVICE OFFICE OF OCEANOGRAPHY AND MARINE ASSESSMENT

Beaufort Sea Mesoscale Circulation

The Beaufort Sea Mesoscale Circulation study was recently completed. The study was initiated in 1985 in order to describe circulation over the inner- (seaward of the barrier islands to about the 50 m isobath) and outer-shelf (between the inner-shelf and the shelf-break) regions of the Beaufort Sea in both open water and ice-covered conditions. A synoptic set of data from moored instrument records, drifting buoys, hydrographic surveys and coincident meteorological data was obtained from an area extending from the northern Bering Sea to the US/Canadian border over a two year period (1987 and 1988). The data were used primarily to: 1) describe

the regional circulation on the Beaufort Sea Shelf, its seasonal variation, and cross shelf fluxes of salinity enhanced water formed during freezing, and 2) to examine statistical and dynamical relationships among the observed currents, sea ice trajectories, and winds.

In addition, the study data were utilized to update and calibrate parameters of circulation models being used to compute oil spill trajectories in this region.

This four-year study was performed by NOAA/Pacific Marine Environmental Laboratory as part of the OCSEA Program with contributions from NOAA and MMS.

Yukon River Delta: Nutrient Enhanced Coastal Productivity

NOAA has embarked upon a program entitled Nutrient Enhanced Coastal Ocean Productivity (NECOP) to assess the magnitude of eutrophication in coastal waters of the United States. The problem of eutrophication and anoxia (or hypoxia), which can result in mass mortality of fauna, has been documented from many regions of the world, particularly in coastal waters receiving large quantities of municipal or agricultural runoff.

Concentrations of both dissolved nutrients and suspended particulate are low in Yukon River water. This is partly due to the negligible urban and agricultural development of the drainage basin, and partly to the subarctic climate and vegetation. Data on the nutrient load of the Yukon River and the processes governing it are extremely few and sporadic. However, available data on the amount of nitrate discharged from the river each year (2.4×10^{10} g) and primary productivity of the coastal waters of the northeastern Bering Sea (ea. $50 \text{ g C/m}^2/\text{yr}$) suggest the influence of the Yukon River is probably very significant: the river may provide nutrient requirements for observed primary productivity over an area of $20,000 \text{ km}^2$, which is about 25% of the area of Norton Sound and adjacent coastal waters,

A field program has been proposed to assess how natural biogeochemical processes within the Yukon River drainage basin produce the observed transport and utilization of nutrients. An understanding of naturally-occurring processes affecting the concentrations and fluxes of nutrients and associated materials from a pristine river will provide a basis to evaluate nutrient enrichment and eutrophication problems in other regions. Without this information the proportion and trend of anthropogenic - and potentially controllable - sources of nutrients would not be assessed properly.

Chukchi Sea: Ecological Dynamics and Biogeochemistry

An interdisciplinary study to describe the environment and biological resources of the southeastern Chukchi Sea is nearing completion. The study data indicate that, in addition to the well-documented influence of the water flowing through the Bering Strait, the influence of Kotzebue Sound is also significant in several aspects. Although much smaller than the transport through the Bering Strait, the Kotzebue Sound water reinforces the Alaska Coastal Current quite markedly. The bottom water formation in Kotzebue Sound may also be important, notably in affecting the water mass properties and features of benthic habitats along the Kivalina coast.

Stable isotope data (both carbon and nitrogen) indicate that the benthic fauna is closely tied to phytoplankton production through only a few trophic levels. Assuming a trophic enrichment of approximately 3 ppt for delta nitrogen-15 values (i.e., phytoplankton with 6 to 7, copepods and euphausiids with 9, etc.), regional trophic structure can be construed as follows: phytoplankton - herbivores - benthos/fish - seals - polar bears. There is no evidence from this

study's data for any significant transfer of terrestrially-derived organic matter (of which there is plenty) through the food webs leading to top consumers.

Maps of surficial sediment distribution, stable carbon isotope ratio, and organic carbon-to-nitrogen ratio have been prepared. This information, in conjunction with sulfate reduction rates determined in the field, indicate that the nutritional quality of organic matter increases from within Kotzebue Sound toward the US/USSR convention line to the west. Synthesis of these data with other similar data, notably those from the NSF-funded Inner Shelf Transport and Recycling (ISHTAR) study, indicate spatial trends that can be explained in the context of a simple mixing model, consisting of two sources of organic matter to the bottom sediments: terrigenous and marine, with each source having a distinct isotopic signature,

The study is being performed as part of the OCSEA Program with contributions from NOAA, MMS, and the University of Alaska Fairbanks.

Arctic Coastal and Anadromous Fish Habitats

Studies are underway to ensure the protection of fishery populations and their habitats from potential adverse effects of oil and gas developments in the Alaska Beaufort Sea. The research focuses on the identification and characterization of important marine habitats and temporal-spatial features of their use by arctic fishes. Anadromous species are of special concern as their populations in this region are usually small and tend to be comprised of discrete stock units having low recruitment rates. They are valued subsistence resources to coastal residents and several are targeted in small commercial fisheries located in the Colville River delta. The management of several stocks has international implications as well because of their extensive summer migrations between Alaska and Canada or overwintering in transboundary rivers.

The studies are designed to achieve an understanding of the physical and biological mechanisms and processes responsible for fish dispersal patterns across the continental shelf. The distribution and abundance of arctic fish in habitats located seaward of the brackish water zone and adjacent marine habitats are being emphasized. This provides an offshore component that is presently lacking from the existing arctic fish database. Biological sampling is being supplemented with data on temperature, salinity, winds and currents.

Another objective of these studies is to delineate the migration corridor of juvenile arctic cisco to Alaskan waters. A wind-aided migration has been hypothesized. Growth and condition parameters are being described for the most abundant populations sampled in the offshore fishing,

Bio-telemetry is being used to record the distributional responses of selected anadromous fish species to physical-forcing and thermoregulatory behavior in the arctic environment.

These studies are being performed under interagency agreements between NOAA and MMS, and between NOAA and U.S. Fish and Wildlife Service.

Salmon Scale Pattern Analysis

This study is designed to identify sockeye salmon stocks in the southeastern Bering Sea, and to describe the salmon's migratory patterns and behavior during early life stages. A microcomputer-based optical pattern recognition system is being used to acquire and analyze data from smelt scales that were collected during freshwater and early marine portions of their life cycle. The salmon scales were obtained from existing archives of the Alaska Department of

Fish and Game and the National Marine Fisheries Service. The automatic digitization process involves creation of measurement variables describing the spacing, shape, and width of scale circuli. Circuli count and distance data provide estimates of growth and age and these are being evaluated in the context of existing oceanographic records (currents, salinity, temperature, prey availability and utilization). The final analysis will examine estuarine influence and variability effects on migration and growth in migrant salmon.

The scale pattern parameters are also used to develop classification accuracies for stocks originating in the Naknek, Egegik, Ugahik, Kvichak, and Wood rivers. These are the major sockeye salmon producing systems in Bristol Bay. When this is completed, stock identification procedures will be used to estimate the stock composition and origins of juveniles collected at various areas and time periods along their migration route.

This study is a relatively low priority endeavor with no direct funding to support it.

Alaska Marine Mammal Tissue Archival Project

The goal of the Alaska Marine Mammal Tissue Archival Project (AMMTAP) is to collect and archive a representative collection of Alaska marine mammal tissues for future analyses and documentation of long-term trends in environmental quality. Marine mammals are long-lived and are generally considered as top predators in the marine environment. In many Arctic communities, they are the principal source of meat in people's diets. Chemical analysis of the mammal tissues can be useful in determining whether bioaccumulation of toxicants associated with industrial activities or global proliferation of pollution is occurring in marine food webs.

The project uses standardized procedures for sampling, preservation, and archival of tissues, which have been documented in a number of reports. The procedures developed by the AMMTAP have been adopted by NMFS' National Marine Mammal Tissue Bank Program, a similar program designed for United States outside the Arctic.

Samples are collected from animals taken by Alaska Native subsistence hunters. This is accomplished through extensive coordination with local Native hunters and their organizations and local Alaska village governments. This work has also involved cooperative field sampling with the North Slope Borough Department of Wildlife Management, Alaska Department of Fish and Game, the National Marine Fisheries Service, the University of Alaska, and others.

Since the beginning of the project in 1987, the following have been sampled in the Alaska Arctic: northern fur seals, ringed seals, bearded seals, and beluga whales. Aliquots of a limited number of samples have been analyzed for trace element and organic micropollutant concentrations. The AMMTAP is coordinating with the Northwest Fisheries Science Center, NMFS, and the Nuclear Research Center, Julich, Germany, in developing analytical procedures for marine mammal tissue analysis. It is also collaborating with the Canadian Department of Fisheries and Oceans (DFO) on a circumpolar survey of organochlorine compounds in beluga whales, and is working with the Canadian DFO, NMFS, and the University of Ulm, Germany, to develop standard reference materials for use in quality assurance programs.

National Status and Trends Program

NOAA initiated the National Status and Trends (NS&T) Program for Marine Environmental Quality in 1984. The purpose of this program is to determine the current status of, and to detect any changes that are occurring in, the environmental quality of our nation's estuarine

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and coastal waters. The program monitors concentrations of trace metals and organic compounds in sediment and in animal tissues. Concentrations of selected trace metals, for example chromium, copper, lead, and mercury or organic compounds, for example DDT, chlordane, polychlorinated biphenyls, and polycyclic aromatic hydrocarbons are routinely measured at nearly 300 sites around the nation. An important aspect of the program is to determine the distribution of locations where contamination is of biological consequence.

NS&T sampling in the Arctic has been limited to just one set of sediment samples obtained off Prudhoe Bay in 1986. New sampling sites are being planned, and it is expected that the frequency of samples will be increased in the future.

Digitization of Alaska Environmental Sensitivity Atlases

Environmental Sensitivity Index (ESI) Atlases are maps that depict natural resources and certain socioeconomic resources associated with the coastline. In addition, they classify the coastline in terms of its oil spill vulnerability. They are used for oil spill contingency planning and for the initial resources evaluation during an actual oil spill. To date these atlases have existed in the form of large thematic albums, which are relatively non-portable due to their size, relatively scarce due to their expense, and are impossible to update because of their static format. The need to digitize this information into a dynamic, readily available database is clear; and the Hazardous Materials Response Branch has adopted this as a long-term goal, not only for the Arctic and sub-Arctic regions of Alaska, but for the entire United States coastline.

Over the past twelve years, the NOAA HazMat and OCSEAP offices, together with MMS, have funded and overseen the development of ESI atlases for the entire sub-Arctic coastline (Bering Sea with the exception of the Aleutian Chain) of Alaska and a portion of the Chukchi coastline. The oil industry has sponsored preparation of similar maps for the Beaufort and Chukchi coastlines.

Alaska Clean Seas, the oil-industry oil spill clean up cooperative for the Arctic Ocean coastline, is planning to digitize the natural resource and oil spill vulnerability information for that coastline. The NOAA HazMat role will be to coordinate and facilitate this effort so that the final product is of the highest quality and is usable by the state and federal resource management and regulatory agencies in Alaska.

For the remainder of the Alaska coastline, NOAA HazMat has adopted, as a long-term goal, the project of digitizing the ESI information that has already been developed. At present it is negotiating with the industry Marine Spill Response Cooperative (MSRC) to support this very important project for Alaska oil spill response and contingency planning.

Information Products and Databases for Strategic Assessments

A very large amount of environmental data has been obtained in the Arctic and elsewhere by numerous organizations and individuals. The data, usually stored at data archives, are neither easily accessible nor are they amenable for use in resource use decisions. An important ongoing effort within NOAA/OMA is to develop a number of computer-based systems that organize existing data and synthesize the information for effective use in strategic assessments, i.e., those appropriate for setting, modifying and evaluating regional strategies for balanced resource development. These systems, combinations of commercially available hardware and software, as well as customized applications, are run on both mainframe and microcomputers.

The Computer Mapping and Analysis System (CMAS) is a Macintosh-based system used to analyze spatial and temporal distributions of marine species. It provides rapid comparisons and statistical analyses of user-specified combinations of species and their attributes. Outputs include maps, histograms, and tabular summaries. This system has a well-developed data set for the Bering, Chukchi, and Beaufort Seas. A new capability has recently been added permitting users to add new maps of species distributions. A new data systems and atlas, featuring marine fish and invertebrate resources of the west coast of the United States, including the Bering Sea, is nearing completion.

The Coastal Ocean Management, Planning, and Assessment System (COMPAS) will use microcomputers to bring existing, but disparate, coastal resource information into a single, user friendly environment, and simplify the transfer of information to and from decision-makers so that accurate and consistent resource assessments can be made. An operational test of this system is now underway in Texas; applications in other states are planned by NOAA in the future.

The GeoCOAST geographic information system is being developed to address environmental issues concerning the management and protection of coastal areas. Its function is to provide powerful resources for developing and supporting systems used to store and analyze the spatial and temporal relationships of data. This system will provide analytical tools and support, including satellite image processing, to other desktop information systems for studying the impact of activities on our coastal and estuarine waters.

Information System for Colonial Seabirds

A desktop information system has been developed for analyzing spatial and temporal distributions of colonial seabirds along the west coast of North American and the northeastern coast of the Soviet Union. Some 2,600 colonies and 45 seabird species are included, along with information on species life history and breeding characteristics. System capabilities include data base management functions, 1:2,500,000 scale maps, and spatial analysis tools.

Substantial resources have been invested in censusing seabird populations throughout the coastal United States. The resulting data base, though rich and detailed, has not been accessible to most research scientists and resource managers, nor has it been in a form that can be combined easily with other coastal and marine data for planning, hazardous materials spill response, or scientific inquiry. The development of this system is an outgrowth of a cooperative effort between NOAA and the U.S. Fish and Wildlife Service.

The Macintosh-based desktop information system is designed to provide information at a wide range of scales, from site-specific data needed in state decision-making (e.g., coastal development decisions) and emergency response (e.g., oil spills) to large-scale analyses of distributional patterns useful in biogeographic investigations. The system has three major components: 1) simple data management and query, 2) maps and mapping, and 3) data analysis. This system continues to evolve, and will be refined and new applications added as more experience is gained. The major objectives of providing increased access to coastal data and expanding the range of communication between scientists and managers will remain the central thrusts of this effort.

Alaska Marine Contaminant Database on CD-ROM

The Alaska Marine Contaminant Database on Compact Disk/Read Only Memory (CD-ROM) is a collection of data sets dealing with contaminants in faunal tissue and sediment samples taken in Alaska marine waters. These data were obtained from a variety of studies done from the 1950s to 1987, and represent about half of the total volume of contaminant data collected in Alaska waters prior to the *Exxon Valdez* oil spill.

The Window-based program supplied with the CD-ROM features a graphic user interface that allows 'point and click' selection of species, sample type, responsible program, contaminant, and quality grade of data. The user can specify the location of interest by using a map displayed on the screen. Area selection can be made by OCS Planning Area, ocean region name, or by searching a rubber band box around the area to be searched for data.

This effort is significant in the following ways. First, scientific data are rapidly lost as priorities shift, people retire or change jobs, and the evolution of computer hardware renders storage methods obsolete. Publishing these data in an easily approachable form both halts the erosion of data holdings and makes them available to interested parties without undue difficulty. Second, the CD-ROM is a cost effective medium to provide wide access to large volumes of data. The Alaska Marine Contaminants Database CD-ROM was prepared as a test of the benefits of this form of data storage and distribution.

A proposal has been made to restructure and format fisheries data from the Beaufort Sea for publication on CD-ROM. These data, many of them collected under industry sponsorship, could then be made available for independent analysis by academia, resource managers, and different interest groups.

NATIONAL WEATHER SERVICE

Technological Changes In Alaska In the 1990s

The 1990s is a decade of change in the National Weather Service (NWS). The scientific and technological modernization will impact the NWS from the below the ground (hydrology) to high into the atmosphere.

In Alaska, the combination of the Mt. Redoubt volcano eruptions and the general modernization program in the NWS is generating a major overhaul in the support to forecast operations. Associated with the overhaul is potential for access to meteorological data never available before in such large time and space densities. The satellite data are digital; the numerical model data are in gridded format.

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New to Alaska are the following data streams and capabilities:

| Technology | Number of Units | Implementation |
|------------------------------------|-----------------|-----------------------|
| Conventional Radar | 1 (Kenai) | October 1990 |
| HRPT Information Processing System | 1 (Anchorage) | May 1991 |
| Radar Vertical Profiler | 1 + 4 (?) | Homer 1991 (others ?) |
| Doppler Radar | 9 | 1993 - 1995 |
| Automated Surface Observing | >100 | 1991 - 1993 |
| Advanced Numerical Modeling | | Fall 1991 |
| Alaska Region Operations Network | | Summer 1991 |
| Experimental Forecast Facility | 2 | Fall 1991 |

The integrated data stream from these new technologies will flow over the Alaska Region Operations Network, a state-of-the-art Local and Wide Area Network linking advanced forecaster work stations at Anchorage, Fairbanks, and Juneau. On-line historical data and analysis facilities will provide enhanced opportunities for forecaster research.

OCEANIC AND ATMOSPHERIC RESEARCH

Arctic Drifting Buoy Program

The Joint Ice Center (JIC) is responsible for the management of the Arctic Drifting Buoy Program (ADBP). Presently, it is a combined U.S. Navy/NOAA effort. The ADBP has requirements for 38 buoys. The ADBP is also working on increasing the accuracy of ice drift models.

Arctic Productivity: Ice Edge Ecosystems

Goal:

To quantify seasonal and interannual variability of the ecosystem, including the limiting aspects of transport and recycling of nutrients.

1991:

NOAA will study sea ice extent, formation, and melt as critical factors in the annual biological production cycle of the Bering Sea shelf.

Work with Soviet and U.S. research institutions.

Coordinate research with:

- NSF - Arctic System Science Program (ARCSS)
- ONR - Arctic Leads Experiment
- NASA - Modeling at the Alaska SAR facility

Future:

Relate variability in the physics and biology of the ecosystem to variability in recruitment of commercially valuable species.

Upper Atmosphere and Near-Earth Space Physics

The Space Environment Laboratory (SEL) has continued to monitor solar activity and its effects on the space environment near Earth and on man's activities. The real-time monitoring and forecasting service provided by SEL's Space Environment Forecast Center in collaboration with the U.S. Air Force Air Weather Service serves the needs of federal agencies, including Department of Defense, and non-government users. The most dramatic effects on and above Earth occur in Arctic and Antarctic regions, where the geomagnetic field lines pass through the upper atmosphere vertically.

The Space Environment Laboratory plans to continue its solar monitoring and predicting activities, and has submitted an initiative to 'modernize' these activities.

Tropospheric and Stratospheric Chemistry

During the Airborne Arctic Stratospheric Expedition (AASE), aircraft measurements of polar stratospheric clouds were obtained along with observations of chemical species including chlorine monoxide, a key substance in photochemical destruction of ozone. Coupling these observations with a trajectory model including both photochemical effects and cloud microphysics, it has been shown that rapid development of a polar stratospheric cloud was accompanied by a large enhancement in chlorine monoxide, in quantitative agreement with theory. A clear diurnal variation was also obtained, providing strong evidence for the influence of clouds on reactive chlorine radicals. This study has provided the first *in situ* evidence supporting the view that important heterogeneous reactions previously identified only in laboratory and theoretical studies do take place in the lower stratosphere.

The Geophysical Monitoring for Climatic Change (GMCC) Program has continued its monitoring of the background atmosphere at Barrow, Alaska, and other non-arctic sites. The Barrow station is a vital component of the network representing Arctic background conditions. These monitoring activities included: 1) determination of concentrations, variations with time, and other properties of atmospheric trace gases and aerosol particles that can potentially impact climate; and 2) measurements of radiation and meteorological factors to determine long-term means and any trends that could be associated with climatic changes. Data from the 1983, 1986, and 1989 Arctic Gas and Aerosol Sampling Program (AGASP) continues to be analyzed.

The Climate and Monitoring and Diagnostics Laboratory (CMDL) has expanded the Arctic radiosonde data archive by acquiring a nearly complete series of soundings from the Soviet ice stations and completing the digitizing of the US. Ptarmigan dropwindsonde files. This archive now holds about one million soundings dating back to the 1930s.

The CMDL has continued its study of arctic climatology by calculating monthly mean tropospheric temperatures from the thickness of the 850/700 and 700/500 mb layers for each of 1977 grid points in an octagonal grid centered on the North Pole for the period 1960 to 1989. Temperature trends were estimated by comparing mean values between the first and last 13 year periods of the record.

Arctic Research at Pacific Marine Environmental Laboratory

Arctic research in oceanography, sea ice physics, and meteorology is being carried out in both the eastern and western Arctic by Pacific Marine Environmental Laboratory (PMEL) investigators. The goals are to attain an integrated understanding of the physical processes that maintain the present state of the arctic seas, the connections between the arctic seas and the global ocean, and the physical controls on biological productivity in the marine Arctic. The initial emphases are on the influence of the Pacific on the Arctic and on the contribution of the Arctic to ocean ventilation. The work is closely tied to that of a number of other investigators and programs, both domestic and international. An example described here is the US/USSR joint oceanographic study of the Bering Strait and the Chukchi Sea.

On the average, about 25,000 km³ of Pacific waters pour northward through the Bering Strait every year, but with a very large seasonal and interannual variability. Much of this water has upwelled onto the shelf in the northwestern Bering Sea, and it carries a large nutrient load that fertilizes the northern Bering and Chukchi seas, supporting some of the highest biological production rates in the world ocean. The northward flow of Pacific waters also markedly influences the physical state of the ocean, including the ice cover, exchanges with the atmosphere, and the upper ocean structure over the majority of the Polar Basin, the latter probably with profound climatic consequences.

Because the physical system is divided between the US and USSR Exclusive Economic Zones (EEZ) neither the biological nor the physical regime can be understood without extensive work on both sides of the US/USSR convention line. A comprehensive joint research program with the USSR was initiated in 1990. Its goals are to define the shelf circulation and its controlling dynamics, ascertain in detail the means by which the high biological production is supported, determine the transformation on the shelf of Pacific waters and the means by which they are exchanged with the Arctic Ocean, and elucidate the dynamics and thermodynamics of the interactive ocean-ice-atmosphere system.

The work during 1990 included a two-ship field program involving the deployment of 23 long-term instrumented moorings, the occupation of well over 200 hydrographic stations, and the establishment of a number of drifting buoys and coastal meteorological stations. These joint efforts will continue in 1991.

**OCEANIC AND ATMOSPHERIC RESEARCH/PMEL
AND
NATIONAL MARINE FISHERIES SERVICE**

Bering Sea Fisheries Oceanography

Goal:

To understand the physical and biological mechanisms that determine recruitment of commercially valuable species.

Department of Commerce - National Oceanic and Atmospheric Administration

1991:

Focus on the circulation and physical properties in the western Bering Sea for transport of larvae. This is mainly a physical oceanographic effort and represents an excellent opportunity to sample in the Soviet sector.

Future:

Integrate knowledge of the regional physics with fisheries research in the Bering Sea including an area in the center of the Bering Sea lying outside the 200 mi. Exclusive Economic Zone (EEZ) of the US and the USSR known as the Donut Hole. This area is known for its consistently high fisheries catch.

DEPARTMENT OF DEFENSE
COLD REGIONS RESEARCH AND ENGINEERING LABORATORY
ARCTIC RESEARCH

Presented by: Jerome Johnson

The Department of Defense (DOD) conducts Arctic research to ensure the development of the knowledge, understanding, and capability to meet national defense needs in the Arctic. The military services conduct Arctic research to address specific needs stemming from the identified requirements of each service. The Army is strongly driven by requirements to understand the Arctic terrain and its impact on ground operations and equipment performance; to understand the performance of troops in the field under adverse conditions; and to understand the constraints imposed by the Arctic environment on construction, roads, buildings, and support systems such as waste water. The Army must be sure of its capability to conduct combat operations in northern regions. The recent stationing of the 6th Light Infantry Division in Alaska has focused Army attention on the special environmental conditions of the Arctic.

The mission of Cold Regions Research and Engineering Laboratory (CRREL) is to study and understand the characteristics of cold regions and to use this knowledge to solve cold regions problems of the Army and other federal and state agencies. CRREL conducts the largest share of the Army's Arctic-related research, concentrating on snow, ice, frozen ground, and cold weather engineering. It sponsors the Cold Regions Bibliography at the Library of Congress, which includes over 140,000 citations.

Specific arctic engineering areas of interest include the design, construction, operation, and maintenance of roads, airfields, buildings, foundations, and water and waste water systems. Recent accomplishments in the arctic engineering area include the following:

A patent application has been submitted by CRREL for a device developed to measure the impact of pressure on the internal friction and creep of ice. This device will provide previously difficult to obtain coefficients that are of great interest to the Navy acoustics community as well as contributing to a better understanding of the material properties and failure processes in ice,

Studies at CRREL were completed on the use of insulation under pavements to reduce frost effects, and on the use of scrap rubber from tires in asphalt concrete to reduce the retention of ice on roadways. A thermal stress device was developed to test the susceptibility of pavements to low temperature cracking. New methods were developed for interpreting non-destructive test data obtained from falling weight deflectometer tests on frozen and thawing pavements, and a refrigerated test chamber was fabricated to measure the drainage of water through pavement structures during freezing and thawing,

A CRREL study evaluated a unique Dual Energy Gamma Device to non-destructively characterize the performance of insulations subjected to harsh environments. This technology can provide significant savings in the life cycle costs of strategic national programs such as the new chilled gas pipeline planned for Alaska as well as providing improved operating efficiencies for DOD installations in extreme climates.

During 1990, CRREL evaluated a commercial ice breaker design. The effort included towed resistance, propulsion and ramming tests of a scale model ice breaker. The effort was

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successful and construction of the vessel, the *R/V Nathaniel B. Palmer*, has been completed. The ice breaker is now under lease to the National Science Foundation for polar research.

CRREL also developed and tested a hybrid thermosyphon system. The concept combines horizontally placed passive thermal piles with backup active refrigeration to stabilize ice-rich, warm permafrost. This work was conducted in support of the USAF Alaskan Over-the-Horizon Radar project.

In 1990, a model hydropower intake trash rack incorporating a new concept in trash rack heating was tested in the CRREL refrigerated flume facility. In this new concept only the leading edge of each trash rack bar is heated, greatly increasing the efficiency of the heat application by decreasing power requirement,

CRREL revisited a large experimental crude oil spill conducted in Caribou-Poker Creeks Research Watershed in the late 1970s in Alaska and reassessed long-term effects of the oil spills on permafrost, vegetation, and soil chemical and biological properties. The site presented unique opportunities to study the long-term effects of crude oil on a terrestrial subarctic ecosystem since the spill simulations were conducted under controlled conditions on a well characterized site which has since remained undisturbed.

DOD research on permafrost and frozen ground is primarily conducted and supported by two agencies, CRREL and Army Research Office (ARO). This research provides design data and criteria for construction and operation of facilities in cold regions. Other efforts include studies of toxic and hazardous waste movement and control in frozen soils. Basic research is conducted to assess and predict the disturbance and recovery of permafrost terrain following natural and human-induced changes.

During FY90, CRREL investigated the concept that variations in the surface concentration of radon gas could provide an indication of permafrost distribution at depth and provide a rapid means of performing preliminary site investigations for planning and design of facilities. Preliminary observations indicated that permafrost and seasonal frost can have a significant effect on the movement of radon gas,

DOD research on snow and ice hydrology is focused on identifying the types, directions, magnitudes, and processes of human-induced and natural changes in cold regions environments. Research is in progress to quantify the effect of *snow* and ice on military and civilian systems and facilities and to quantify snow properties, including depth, density, stratigraphy, grain size, and crystal type.

Accomplishments in snow and ice hydrology have involved a CRREL project to track coarse (gravel) sediments in glacially-fed rivers via radio transmitters. This provides a major breakthrough for understanding sediment transport regimes in gravel bed rivers. This technique provides the first ever comprehensive data on both rates of movement and transport sequences correlated to specific flow events,

Other related research involved hydrologic investigations that were carried out by CRREL at several sites in Alaska. High-resolution ground penetrating radar was utilized to determine the radar's ability to locate and define highly localized sources of water in permafrost. In a separate radar study, at the margin the Matanuska Glacier in southeastern Alaska, water conduits were located at depths between 5 and 25 m below the basal ice layer at the sole of the glacier.

DEPARTMENT OF DEFENSE
CORPS OF ENGINEERS
ALASKA COASTAL DATA COLLECTION PROGRAM

Presented by: Carl D. Stormer

The Alaska Coastal Data Collection Program (ACDCP) was originally started in July 1982 as a cooperative effort between the Alaska District Corps of Engineers (ADE) through the Corps of Engineers Coastal Engineering Research Center (CERC) and the State of Alaska, Department of Transportation and Public Facilities (DOT/PF). The purpose of the ACDCP is to facilitate the systematic accumulation of statistically significant coastal field measurements of wind, waves, and other data necessary for more efficient planning, design, construction, operation, and maintenance of port, harbor, and shore protection facilities in Alaska. The ACDCP is part of the congressionally authorized National Coastal Field Data Collection Program (CFDC) administered by CERC. Similar programs are active in California, Florida, and Virginia with the probability that more states will establish cooperative programs in the future.

The original concept was to develop the capability to monitor select sites for one or more years to provide baseline data for current and future coastal development. A long term goal was to establish regional data collection sites such as Lower Cook Inlet and Prince William Sound. Regional measurements could serve multiple purposes including engineering applications, real time information on winds and waves and regional wind-wave correlations. Long term data collection at specific coastal facilities was also contemplated to evaluate structure performance.

Data collection equipment and methods were developed and installed at about five sites in the first years of the program. As with all data collection in remote and severe climates there were successes and failures. Much good site-specific data has been collected in the Kodiak and Homer, Alaska areas.

The ADE has an inventory of nine waverider buoys, two capable of transmitting through the GOES satellite. The 'standard' deployment would include one or two waverider buoys reporting to a nearby shore base station. Wave records are collected, stored on magnetic tape cartridges and summary analyses made. Data summaries, often including wind data, are then transmitted via the Alaska Meteor Burst System to the ADE Anchorage office to obtain the buoy status and current conditions. Raw data tapes collected from the shore base stations are then periodically spectrally analyzed and published in data reports.

Currently no buoys are deployed by the ADE. The most recent deployment in the St. Hermans harbor adjacent to Kodiak was demobilized in June 1990. The DOT/PF in recent years has initiated data collection at several sites. They are currently receiving data via satellite from Port Lions and may soon be obtaining data at Larson Bay, both sites on Kodiak Island. The Corps of Engineers is in the process of developing a data collection plan for Alaska. First priority is anticipated for a deep water buoy offshore of Sitka, Alaska, which could assist with harbor development in Sitka and provide another verification point for the North Pacific wave hindcast.

One of the most important ongoing activities started about one and a half years ago is the development of the Alaska Wave Data Index. This index will catalog the Alaska coastal wave data bases to help agencies plan and prioritize future monitoring studies and provide a reference of data sources for current or contemplated future work. It is anticipated that as the

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obvious merits of the index become known, additional data will become available for including in the index. A second phase of the work would be development of an Alaska Coastal Wave Climate Atlas from data made available. Work on the index has been by contract with the University of Alaska's Arctic Environmental Information and Data Center (AEIDC). Information regarding the Alaska Wave Data Index is available from the ADE, CERC or AEIDC.

DEPARTMENT OF DEFENSE
OFFICE OF NAVAL RESEARCH
ARCTIC SCIENCES PROGRAM REVIEW

Presented by: Jawed Hameedi

AIR-ICE-OCEAN INTERACTION

1) Physics of momentum and buoyancy fluxes in the oceanic and atmospheric boundary layers, 2) stress/rate of strain horizontal scale interaction in the air-ice-ocean coupled system, 3) local and regional effects of discontinuities in the ice cover.

MARGINAL ICE ZONE PROCESSES

1) Stress divergence mechanisms/vertical circulation patterns/frontogenesis, 2) relative roles of wind and buoyancy forcing/air-sea feedback mechanisms, 3) instability processes/eddy generation, 4) surface gravity wave dispersion/dissipation, 5) primary productivity: biological/physical regulation mechanisms, 6) role of mesoscale processes in ice edge equilibrium, 7) role of marginal ice zone mesoscale processes in deep convection.

SHELF-BASIN DYNAMICS AND STRUCTURE

1) Cross-shelf transport mechanisms, 2) location/dynamics of persistent coastal ice divergences, 3) inner shelf convection/mixing, 4) lateral entrainment/gyre boundary currents/basin eddy KE, 5) Atlantic water inflow magnitude and variability, 6) coupling to marginal seas, 7) preconditioning for deep convection.

ICE-ACOUSTIC INTERACTION

1) Low frequency ice reverberation/transformation, 2) high frequency ice scattering/absorption, 3) under ice propagation/coherence, 4) broadband ambient noise generation/event physics.

ICE-ELECTROMAGNETIC INTERACTION

1) microwave emission/attenuation: effects of dielectric constant, porosity, surface morphology, 2) broadband visible transmission: inverse theory/constraints/uniqueness for air-snow-ice-ocean interaction, 3) integral spectra over a hierarchy of spatial scales.

INFRASTRUCTURE AND INSTRUMENTATION

1) Platform support for international, multi-disciplinary field efforts, 2) reliable sensor systems for high latitude observations.

**DEPARTMENT OF ENERGY
ARCTIC RESEARCH IN FY 1991**

Presented by: Helen McCammon

The Department of Energy (DOE) has Arctic research programs in two offices of the Department. The Office of Energy Research supports programs amounting to \$1.98 million in FY 1991 and includes terrestrial ecology research to quantify and predict effects of disturbance on Arctic tundra for optimal management strategy of Arctic ecosystems. This research is conducted at Imnavait Creek in the foothills of the Brooks Range. Isotope tracer studies indicate that trace metals migrate down slope to concentrate in the sensitive riparian zones of streams. Not only ^{37}Cs is bound tightly in the top 10 cm of the tundra, but Na, K, NH, appear to be bound there as well. Particle trajectory (road dust) models have been developed to predict alteration of drainage, thaw depth and effects in different ecosystems.

Other research projects in Energy Research include studies on CO_2 flux from tundra that have shown there is a net inflow to the atmosphere in dry tundra but a CO_2 flow into vegetation for wet tundra. Cryosphere related research is conducted to forecast future sea level changes due to global warming from glaciers and ice caps. Monitoring of radionuclides in the atmosphere is conducted at Barrow, Alaska, and in Greenland at Thule and Constable Point. Research on the aurora is focused on basic plasma processes associated with magnetic reconnection in the earth's magnetosphere.

The Office of Fossil Energy supports research totaling \$1.20 million in the Arctic in FY 1991. A report has just been completed by DOE and the State of Alaska on a comprehensive study of the Alaska North Slope oil production and delivery system as it relates to national energy" security. Research projects include evaluation of unconventional energy resources especially addressing gas hydrates. Gas hydrates were identified in 50 exploration and production wells with volume of gas estimated at twice that of the conventional gas in the Prudhoe Bay field. Funding to conduct some of these studies was provided to the U.S. Geological Survey.

Reservoir characterization is being explored with advanced methods to improve predictive capabilities and recovery of petroleum reservoirs through field, laboratory, and modeling research. An Arctic and Offshore Research Information System (AORIS) has been developed containing extensive databases on fossil-related Arctic topics. Also, a Seafloor Earthquake Measurement System (SEMS) that was developed to provide seismic characterization of offshore oil-gas leasing regions is now in full operation. A new project addresses the feasibility of natural gas conversion to a more easily transportable hydrocarbon.

DEPARTMENT OF HEALTH AND HUMAN SERVICES
ALASKA AREA INDIAN HEALTH SERVICE
INDIAN HEALTH SERVICE FUNDED PROJECTS

Presented By: David Barrett

Fiscal Year 1990

1. The evaluation of long-term immunogenicity of pneumococcal polysaccharide vaccine, Hepatitis B vaccine, and D-T toxoid in the Alaska native alcoholic patient.

Principal Investigator Brian McMahon, MD
Amount: \$17,500

2. A proposal to reduce the mortality and morbidity of alveolar hydatid disease in Alaska through screening and early detection of lesions in hyperendemic areas.

Principal Investigator: Brian McMahon, MD
Amount: \$37,530

3. Characterization of clinical features and HLA DR/DW types in Alaska Indians with rheumatoid arthritis.

Principal Investigator Thomas Krahn, MD
Amount: \$21,850

4. Alaska native food analysis: Phase II of assessment of current dietary intakes of Alaska native adults.

Principal Investigator Elizabeth D. Nobmann, MPH, RD
Amount: \$24,518

5. An oral health plan for the native population in the North Slope Borough.

Principal Investigator Candace M. Schlife, RDS, MPH
Amount: \$15,190

6. Efficacy of pneumococcal vaccine in a high risk, high rate population of Alaska Natives.

Principal Investigation Michael Westley, MD
Amount: \$36,920

Fiscal Year 1991

1. Risk and protection factors in the Yukon-Kuskokwim cohort,

Principal Investigator Sheila Carlson, Ph.D.
Amount: \$30,000

DEPARTMENT OF HEALTH AND HUMAN SERVICES

**CENTERS FOR DISEASE CONTROL
ARCTIC INVESTIGATIONS PROGRAM**

Presented by: **Robert Wainwright, M.D.**

CENTERS FOR DISEASE CONTROL

For many years Centers for Disease Control (CDC) has been involved in conducting research on the prevention and control of diseases of high prevalence in the U.S. Arctic. Numerous research projects have been conducted by CDC investigators in collaboration with other federal agencies, state agencies, and Alaskan Native organizations, CDC will significantly increase its activity in the U.S. Arctic during 1991 with the development of new research programs in occupational injury and fetal alcohol syndrome.

Prevention and Control of Infectious Diseases

The CDC conducts research on the prevention and control of infectious diseases in the U.S. Arctic through its field station, the Arctic Investigations Program (AIP) in Anchorage, Alaska. In past years, this field station has conducted research in respiratory disease, botulism, and streptococcal disease among many others. AIP works closely and collaboratively with the Alaska Area Native Health Service, Indian Health Service (IHS). The research conducted in Alaska by AIP and IHS is an outstanding example of focused interagency cooperation. More recently, the AIP has extended its collaboration to state Alaskan Native agencies and organizations. The following are new and continuing research areas planned through 1992:

- Meningitis
- Hepatitis
- Pneumonia
- Cancer
- Alveolar Hydatid Disease
- Anemia
- Sexually Transmitted Diseases

Prevention of Occupational Trauma

The National Institute for Occupational Safety and Health (NIOSH), Division of Safety Research (DSR) is establishing an Alaska field site to develop program activities focusing on occupational injury research and prevention in the nation's geographic area of highest risk. This program is being conducted in collaboration with the Alaska State Department of Health and Social Services and the Alaska Department of Labor, the Indian Health Service, other federal agencies, industry and labor, communications media, health care providers, universities and community colleges, and other private sector individuals and organizations with an interest in public health. The field site will be located in Anchorage, Alaska.

The primary objectives for the program are:

- Study occupational injury and fatality reporting systems in order to develop and pilot test selected aspects of the Division's new national electronic surveillance and investigation system for fatal occupational injury.

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- Characterize and reduce occupational risks in work places and industries using a combination of epidemiologic surveillance and analytic methods, and engineering hazard and task analysis techniques.
- Conduct prevention-oriented research addressing high-risk operations and populations (e.g., fishing, air transport, trucking, logging, mining, and oil exploration) that have already been identified by the Division's National Traumatic Occupational Fatality system (NTOF).
- Use the on-site location as a 'living laboratory' for conducting intervention trials and demonstration projects based on other DSR research or research conducted elsewhere in the circumpolar regions.
- Promote the transfer of worker protection technologies that prove to be effective in Alaska to all workers in the state, and to other states and nations where similar work place risks exist. Likewise, promote the transfer of worker protection technologies effective in other nations and states to Alaska,

In addition to surveillance and investigative activities, an initial, in-depth study will focus on identifying and reducing risks associated with commercial fishing in Alaska. Epidemiologic and engineering disciplines will be integrated to comprehensively analyze the risks inherent in Alaskan commercial fishing operations and identify prevention strategies. This multi-disciplinary approach will be used in studies of other high-risk areas (e.g., construction, logging, and air transport).

Prevention of Fetal Alcohol Syndrome

A joint effort is being developed between CDC and IHS to understand the magnitude of Fetal Alcohol Syndrome (FAS) through surveillance and to evaluate the effectiveness of programs designed to prevent FAS in Alaska Native populations. FAS is completely preventable yet it is the most common known environmental cause of birth defects and developmental disabilities. The rate of FAS is very high among Alaskan Natives: 42 per 10,000 live births compared to an estimated 6 per 10,000 in the general population in the US.

This joint Fetal Alcohol Prevention Project is for research and training (collaborative epidemiologic, operational, behavioral, evaluational, and health education communication) related to FAS prevention/intervention in Alaska, and the lower 48 states.

General goals are the following:

- Provide technical and programmatic review of IHS FAS programs and data, actively analyzing and evaluating these programs.
- Assist the State of Alaska and others (initially Montana and South Dakota) in developing and implementing FAS surveillance systems to capture data from program services currently being provided by the state and by IHS.
- Develop model surveillance, data analysis, and program evaluation methods that could be used to assist other states, communities, and American Indian populations. These goals are expected to optimize potential for long-term statewide FAS surveillance systems.

Prevention of injury

The Center for Environmental Health and Injury Control (CEHIC), in collaboration with IHS, has developed an Injury Surveillance System currently being used by IHS in American Indian villages and the IHS regional office in Anchorage. The objectives of this system are to provide routinely collected data on injury in order to help to identify priority injury problems, determine trends, and evaluate interventions. This system is being used routinely as part of the IHS injury prevention program in Alaska.

CEHIC has recently awarded the Alaska Department of Health and Social Services two grants to support work in injuries that affect rural Alaskans. The first, a grant in Applied Methods in Injury Surveillance, will be used to establish a statewide system for surveillance of head and spinal cord injuries that can serve as a model for other states. In addition, the Alaska Department of Health and Social Services has been awarded a grant for the development of a state-based injury control program that will establish a statewide injury control focus. The department, through an established Emergency Medical Services Unit, will focus on intentional and unintentional injuries. This unit will help provide services to 70% of Alaska Natives dispersed among 175 villages as well as 70 rural towns with primarily non-Native populations.

DEPARTMENT OF INTERIOR

BUREAU OF INDIAN AFFAIRS

RESEARCH IN ALASKA

Presented by: Ken Pratt

The Juneau Area Office of the Bureau of Indian Affairs (61A) administers two research programs in Alaska; both are based in Anchorage and are archeological in nature. One program researches and reports upon Alaska Native historical places and cemetery sites identified under Section 14(h) (1) of the 1971 Alaska Native Claims Settlement Act (ANCSA). It is commonly known as the 'ANCSA 14(h)(l) program.' In addition, the BIA maintains a separate Archeology program responsible for ensuring that the Bureau undertakings comply with Section 106 of the 1966 National Historic Preservation Act and other federal cultural resource laws,

THE ANCSA 14(h)(1) PROGRAM

The ANCSA legislation (Pub. Law 92-203) granted Alaska 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 (Figure 1) to receive a portion of their acreage entitlements in the form of historical places and cemetery sites. The BIA ANCSA Office was established in 1978 for the purpose of directing the required Section 14(h) (1) site investigations. These investigations have been performed annually since 1979 and are ongoing.

The 14(h)(1) program has been one of the largest employers of archeologists in Alaska during the past decade. Although anthropological and archeological data are used, however, the BIA ANCSA Office was not created to conduct 'pure' research. Rather, BIA ANCSA site investigations are conducted so that investigative reports can be used by the BIA to determine if selected tracts of land are eligible for conveyance to Native regional corporations as 14(h)(l) sites. Although the 14(h)(1) site eligibility criteria contained in the ANCSA regulations (43 CFR Subpart 2653.0-5) are modeled after those established for the national Register of Historic Places, they differ in significant ways. Consequently, 14(h)(1) eligibility determinations are not indicative of the sites' potential eligibility for inclusion on the National Register.

The BIA ANCSA investigative methodology is prescribed to facilitate the determination of site eligibility under the 14(h)(1) criteria. It includes a reconnaissance-level archeological survey at each site. Emphasis is placed on surface indications of cultural activity, thus, relatively detailed site maps are prepared. No site excavation is performed, and subsurface tests are conducted only on a very limited scale. A literature search is made for data pertinent to the site or general area. Additionally, the gathering of oral history data is emphasized. This is done because of the relatively recent age of many of the sites and because many project areas are poorly represented in the literature.

Nearly 2,100 site investigations - or approximately 93% of the required 14(h)(1) investigations - have been conducted to date (Table 1). During 1989 and 1990 BIA ANCSA completed the investigation of 130 14(h)(1) sites, more than half of which were in the Aleutian Islands. Based on "new information" about previously investigated 14(h)(l) sites, an additional 31 sites have been 'reinvestigated' by the Office in the past two years. About 170 sites remain to be investigated by BIA ANCSA, 143 of which are located in the Aleutian Island region. Given the logistical problems and great expense associated with fieldwork in the Aleutians, it is

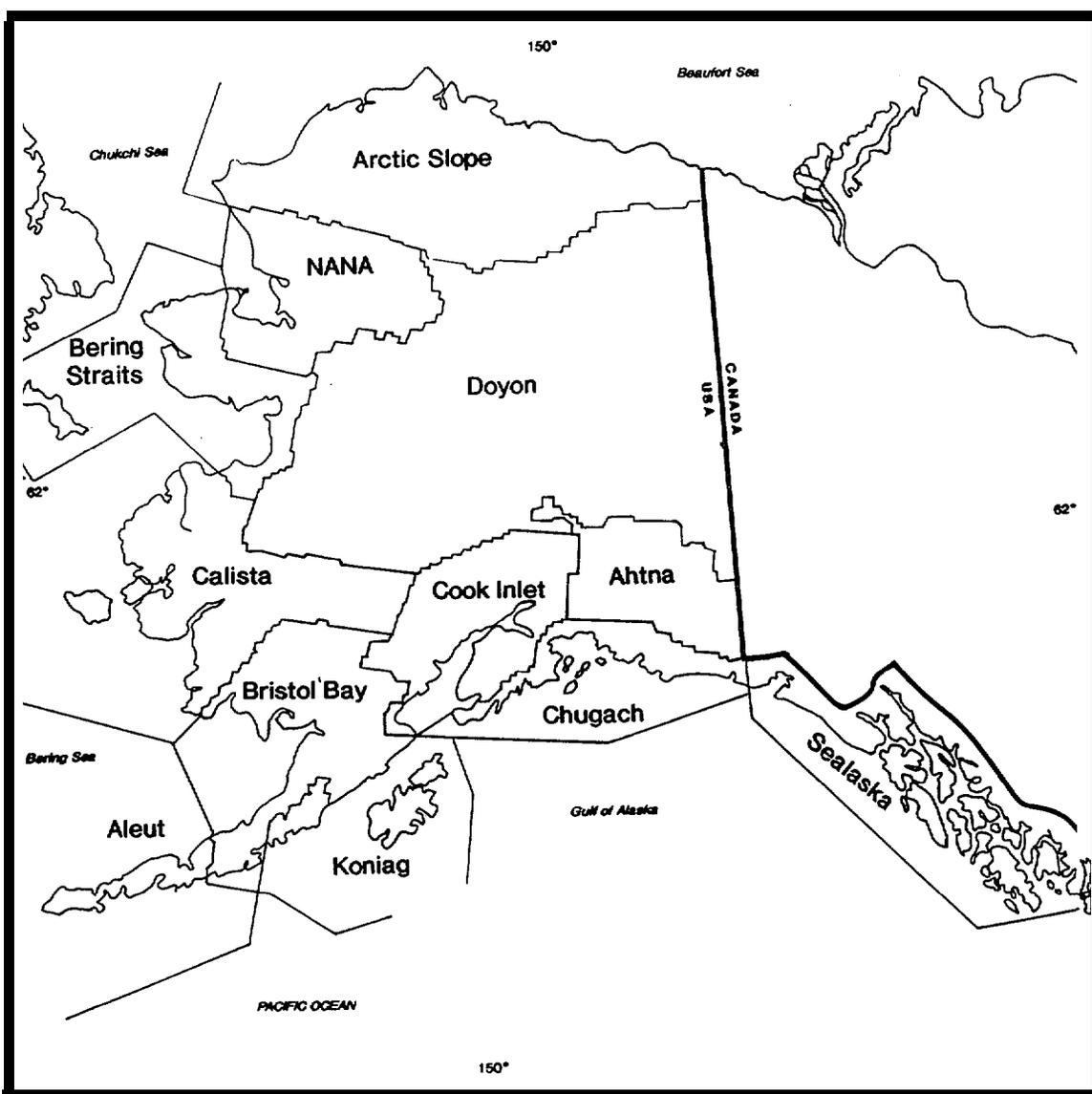


Figure 1. Geographic boundaries of Alaska native regional corporations.

anticipated the investigations which remain will not be completed before the close of the 1993 field season.

The ANCSA 14(h)(1) program has generated an extensive and diverse body of data relevant to archeologists, cultural anthropologists, linguists, historians and land planners, among others. In addition to the cultural resource information compiled in its 2,100 completed site investigations, the program has minimally recorded several hundred non-14(h)(1) sites. As important as these data are, however, the largest and most valuable body of data is found in the 14(h)(1) oral history collection - which contains over 1,400 taped interviews with Alaska Native elders. Approximately one-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. The major reason for conducting ethnographic interviews is the collection of site specific data on 14(h)(1) selections. But these interviews have yielded data on a wide range of related subjects, including site types, land use patterns, culture change, social organization, mythology, language and ethnogeography. Many of these subjects are poorly represented in the literature, if they are represented at all.

It is uncertain what the BIA ANCSA Office's status will be once all of the required 14(h)(1) site investigations are completed. 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 for use in the development of local cultural heritage programs, academic research, and the management and protection of Alaska's cultural resources.

THE BIA ARCHEOLOGY PROGRAM

This program's activities are primarily related to the Bureau's administration of Native allotments and townsites, and are conducted in accordance with a 1988 Programmatic Agreement executed with the Bureau of Land Management, the Alaska State Historic Preservation Office and the Advisory Council on Historic Preservation. Under the agreement, Bureau archeologists consult with external agencies, and conduct surveys and mitigation projects in order to avoid or reduce impacts to cultural resources on restricted native properties. The program also performs compliance and environmental assessment work at locations throughout Alaska where BIA anticipates actions such as road or housing improvement projects,

In 1989 and 1990 the program's three archeologists, aided by seasonal crew members, inventoried 172 Native allotments totaling over 16,000 acres. Twenty-eight archeological and historic properties were recorded, most of which appear eligible for the National Register. Mitigation work over the same period included excavation of a 2,400 year-old Eskimo village in the Wood River drainage of southwest Alaska. Analysis of the resulting collection of over 300 artifacts is underway and will be made available upon completion.

Although BIA Archeology has now inventoried over 1,100 allotment parcels, more than 10,000 remain unexamined. Current ratios suggest about 1,500 unrecorded archeological and historic properties exist on these remaining allotments. It will be years before BIA Archeology's relatively small staff can complete its goal of examining the enormous land base under its

Table 1. Status of ANCSA 14(h)(1) site investigations, Spring 1991.

| Corporate Region | Number Completed | Number Remaining* |
|--|------------------|-------------------|
| Arctic Slope** | 0 | 0 |
| Aht na | 45 | 6 |
| Al eut | 241 | 143 |
| Bering Straits | 167 | 0 |
| Bristol Bay | 33 | 0 |
| Calista | 938 | 17 |
| Chugach | 270 | 0 |
| Cook I nlet | 27 | 0 |
| Doyon | 177 | 1 |
| Koni ag | 30 | 1 |
| NANA | 67 | 0 |
| Sealaska | 96 | 0 |
| | 2091 | 168 |
| * 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. | | |

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jurisdiction, but the program's long term contribution with respect to the inventory, management and study of Alaskan cultural resources promises to be highly significant.

DEPARTMENT OF INTERIOR
BUREAU OF LAND MANAGEMENT

Presented by: Gene Terland and Joe Dygas

The Bureau of Land Management (BLM) Arctic research program consists primarily of inventory, monitoring, and applied research activities focused on energy, minerals, and renewable resources. These activities cover 32 million acres of surface and subsurface lands and are performed entirely in terrestrial and freshwater environments. BLM's Arctic research activities are conducted under the authority of the Federal Land Management and Policy Act and the Petroleum Reserve Production Act.

The following is a brief summary of some of the past and current activities related to renewable resources:

Aquatic Resources

In the past two years we have added two fisheries biologist positions to the Kobuk and Arctic Districts. The primary objective is to gather baseline data for planning purposes and from which trends and impacts can be measured. In addition, fisheries habitat enhancement opportunities are being explored and potential for conflicting uses examined. Specific examples include:

Norton Sound Habitat Management Plan implementation:

- anadromous fisheries habitat condition
- habitat enhancement opportunities
- subsistence use levels versus sport use
- hatchery at Nome schools

Corridor:

- baseline inventory to plan for and measure impacts due to increased tourism/use

Cooperators include the Alaska Department of Fish and Game and the Alaska Department of Transportation and Public Facilities.

Terrestrial iology and Ecology

Until July of 1990, our primary role in terrestrial biology was that of working with habitats. With the change in roles regarding subsistence we are moving into the area of studying populations, and are expanding staff to accomplish these tasks. We continue our work with the 14 active grazing permits for approximately 20,000 reindeer on 15,520,000 acres on the Seward Peninsula area. Wetlands/riparian habitats and associated waterfowl are receiving increased emphasis and priority.

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Specific examples include

Corridor:

- Areas of Critical Environmental Concern (ACECs) established for Dan sheep salt licks
- subsistence versus sport hunting usage
watchable wildlife, habitat, and viewing opportunities

Teshkepuk Lake:

- black brant study to determine energy requirements and how development activities might impact the species (1991 is last year)

Sagavanirktok and Colville Rivers:

- monitoring of peregrine falcon recovery

McCarthy Marsh:

- waterfowl habitat mapping/monitoring

Buckland Valley:

monitoring of caribou movements and usage as they relate to potential conflicts with reindeer grazing

Western Tozitna Watershed Activity Plan (ACEC):

- baseline hydrology information on the watershed and water quality data

Tozitna North and South ACECs, Galena Mountain ACEC:

monitoring endemic caribou herds

Seward Peninsula

- five-year strategic plan for reindeer grazing
- snow survey stations

Oceans and Atmosphere

Work in this area has been limited in the past to a system of Remote Automatic Weather System (RAWS) stations which are active during the summer months to supply climatological data for our fire suppression program. Efforts are being expanded in this area in response to the global climate change initiatives.

We are cooperating in a bureau-wide project initiated by the Wyoming State Office and Colorado State University to monitor long-term meteorological and climatological changes in BLM wilderness areas in the western U.S. and in remote areas of Alaska that are isolated from direct activities of man. New remote monitoring packages are being developed as part of this effort. The Alaska sites will be identified this year. Other potential projects include a look at controls over primary productivity and range quality of alpine tundra, particularly lichens, and how production may be influenced by changing conditions.

Other efforts would focus on the effects of current fire management practices and the potential for increased fire frequency, atmospheric pollution, and conditions likely to occur under current global climate change scenarios. The potential of expanding BLM RAWS technology for year-round data collection to assist with investigation through remote monitoring of selected study areas is also to be explored.

BLM will be cooperating with other DOI bureaus to develop an integrated global change research effort in Alaska. This effort will be consistent with BLM's mission and management responsibilities and will focus on understanding changes which may affect the programs of BLM.

Geology

The BLM Alaska Division of Mineral Resources was formerly the Onshore Division of the Minerals Management Service (formerly the USGS Conservation Division). The Onshore Division was transferred to BLM from the Minerals Management Service, to place both surface and subsurface public land management responsibilities under one agency.

Responsibilities of the Division are lease and reservoir management of all oil and gas leases on federal lands, mineral assessment of all BLM lands and economic evaluation of all federal lands. Accurate and up-to-date minerals information in the Arctic is necessary for developing minerals strategies under the BLM multiple use mandate, while at the same time protecting the ecology of the unique Arctic ecosystem.

In context with these responsibilities, the Division of Mineral Resources has the following ongoing studies:

a detailed oil and gas study of the Utukok Special Management Area of National Petroleum Reserve in Alaska (NPRA)

a Petroleum Geology and Geochemistry study of Arctic National Wildlife Refuge (ANWR), published as BLM-Alaska Technical Report 12.

a bedrock geology study of the Northernmost Bulge of the Rocky Mountain Cordillera, now published as BLM-Alaska Technical Report 13.

a minerals GIS/database for microcomputers which allows extraction of current lease, well, and oil and gas assessment information in text or map overlay format.

In addition, the following papers will be presented at the AAPG meeting in April:

- Reservoir Quality Studies in ANWR and NPRA
Petrologic-Petrophysical Engineering Studies of Selected Wells near ANWR
- Geochemistry of Biological Marker Compounds Extracted from Sediment and Oils of the Bulge, Northern Alaska and Yukon Territory

Cultural

Work in this area is primarily related to the identification of cultural resource sites on public lands. A research study plan has been developed and submitted on *Obsidian Hydration Dating of Small and/or Surface Archaeological Sites in Northern Alaska*. An effort is also being

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undertaken by the Kobuk District to develop an oral history on early mining on the Seward Peninsula. Specific examples include:

Utility Corridor:

inventory of 6,300 acres with documentation of 20 prehistoric and historic sites

Nanagiatchuk:

testing of an early contact period whaling site

Nome

collected descriptive material of the Gold Rush-era 'Wild Goose' Pipeline

Unalakleet River drainage:

- test excavations on four sites undergoing river erosion

Colville Rivet

- paleontologists working on BLM managed lands discovered a skull of a pachyrhinosaurus

Mapping and Data Management

A GIS project proposal has been prepared by the Kobuk District in support of resource management planning in the Bendeleben, Nulato Hills and Kigluiak Mountains areas. Another effort currently underway in other parts of the state which may be expanded to include public lands in the Arctic is a cooperative effort with Ducks Unlimited and their GIS project for mapping wetland/riparian areas. Also, the Division of Minerals uses Geographies and CPM mapping software to generate various kinds of geologic maps.

External Coordination of Federal Research

Many of the efforts identified above are cooperative efforts involving the State of Alaska, other Federal agencies, or private organizations.

Our over-arching strategy to address the Bureau's global climate change initiative emphasizes cooperation and coordination with other research and institutional entities. This strategy paper defines the 'what' of the global climate change initiative and states in part 'The Alaska over-arching strategy will be to conduct research in a format of research questions that allows BLM Alaska to collect information; to build a database; to emphasize cooperation and coordination with other research and institutional entities that collect information; and to cooperate those who do hypothesis testing.' As we prepare our multi-year program defining the 'how' of our research program including information management and cooperation within the international community, we will be submitting updates to the Interagency Arctic Research Policy Committee and the National Science Foundation for their review and participation in our program.

Department of Interior - Bureau of Land Management

**ALASKA RESOURCES LIBRARY
POLARPAC**

Presented by: Martha L. Shepard and Tina Huffaker

POLARPAC is a compact disc product funded through a grant from the National Science Foundation, Division of Polar Programs. The compact disc contains the Arctic library holdings of the Alaska Resources Library, Bureau of Land Management, Anchorage; the Fish and Wildlife Service Library, Anchorage; the Alaska Department of Fish and Game Library, Anchorage; the University of Alaska Anchorage and Fairbanks; the Dartmouth; and the Institute of Arctic and Alpine Research, Colorado. The compact disc is one phase of a project to establish a U.S. Polar Bibliographic Network and was completed in June of 1990. The second edition which will be even broader in scope and contain holdings from additional libraries will be out in December 1991.

DEPARTMENT OF INTERIOR

BUREAU OF MINES

Presented by: Steven Fechner

The Bureau of Mines' (Bureau) mission is to insure an adequate supply of minerals at acceptable costs. The Bureau is organized into three directorates: Finance, Research, and Information and Analysis,

The Research Directorate has nine centers scattered around the lower 48 states involved with the following research: Health, Safety, and Mining Technology; Minerals and Materials Science; and Environmental Technology.

The Information and Analysis Directorate has three field centers: Intermountain Field Operations Center in Denver; the Western Field Operations Center in Spokane; and the Alaska Field Operations Center in Anchorage.

The Alaska Field Operations Center (AFOC) along with many research centers are involved with Arctic Research. AFOC has three offices; Juneau, which is a branch office; Anchorage, which is the headquarters and a branch office, and Fairbanks, which is a section of the Anchorage branch.

AFOC deals with three basic programs collectively known as the Land and Mineral Resources Program:

1. Mineral land assessment
2. Minerals availability
3. Policy analysis

I will discuss the three basic programs and the projects that the Alaska Field Operations Center has had and has north of the Arctic Circle and also discuss the Bureau's research activities.

Mineral land assessment is divided into two program areas: Mining District and Strategic and Critical.

MINING DISTRICT PROGRAM

In 1985, the Bureau of Mines developed a long-term plan to guide its minerals engineering and economic evaluation activities in Alaska. The Bureau developed a program that systematically examines federal lands within Alaska mining districts. The studies are designed to determine the development potential of mineral deposits in the district by identifying resources and reserves and evaluating their mining feasibility. The typical district study requires four years and results in interim reports and a final summary report. The mining district studies are conducted in conjunction with other federal and state agencies (e.g., U.S. Geological Survey and Alaska Division of Geological and Geophysical Surveys).

In 1991, the Bureau is beginning the study of the Colville Mining District. The Colville Mining District encompasses the Colville River drainage basin. Field investigations during a mining district study include reconnaissance sampling, which consists of collecting sediment samples

from streams and rock samples from mineralized outcrops; and detailed examinations of mineral properties, which consists of mapping the extent of mineralization and collecting rock chip samples, Computerized feasibility studies on typical ore deposits in the district and a computerized probabilistic assessment of the mineral resource endowment of the district will also be completed.

Three years (starting in 1991) will be spent doing field work in the Colville Mining District. After each of the first two years of field work a report, which lists the samples and chemical analyses of the samples collected in the district, is written and published. A map of the sample locations is also published. In the final year, the following are produced: 1) a report that lists all the samples and their analytical results, and contains maps of sample and mineral property locations; 2) a report that summarizes the data that was collected on individual mineral properties; 3) a report that discusses the feasibility of mining certain deposit types in the district; and 4) an Executive Summary that summarizes all the known data.

STRATEGIC AND CRITICAL PROGRAM

The Strategic and Critical Minerals (SCM) Program was initiated in 1981. Strategic and critical minerals, materials, and elements have been targeted for government studies because the U.S. is dependent on sources outside the U.S. for these commodities, and they are essential to industry and national defense. To date, the Bureau investigations have focused on chromium, cobalt, gallium, germanium, iridium, manganese, niobium, platinum-group metals (PGM), rare-earth elements (REE), tantalum, tin, vanadium, yttrium, and zirconium. Nearly 300 Alaskan sites that contain SCM have been, or continue to be under investigation.

Specifically, the SCM project is designed to locate, characterize, and quantify strategic and critical mineral deposits. This includes estimation through field studies of the identified resources, characterization of deposit-types and mineralogy, and beneficiation and metallurgical testing. Reports specifically addressing the results of examinations of strategic and critical mineral deposits are published once all of the information is compiled, The compilation of information sometimes takes several years.

1989

Three deposits were examined: Misheguk Mountain, which contains platinum and chromite; Sheep Mountain, which contains tin, zinc, lead, and silver; Zane Hills, which contains rare earth elements, uranium, and gold.

1990

Two deposits were examined: Ray River, which contains tin; and Sithylenkat, which contains tin.

1991 -1994

The Bureau will be evaluating the strategic and critical mineral deposits of the Colville Mining District.

MINERALS AVAILABILITY PROGRAM

This program is part of a worldwide Bureau program responsible for developing the Minerals Availability System (MAS) computer data base and Mineral Industry Location System (MILS), a subset of MAS. MILS contains basic information about the identification and location of known mineral deposits. MAS is more extensive, containing information about reserve estimates, mineral extraction and beneficiation methodologies, environmental constraints to mining, and cost analysis for selected major mineral deposits. A computer and communication system allow the information to be stored, manipulated, and retrieved as computer-plotted map overlays and printouts of MAS/MILS data, enabling rapid and uniform development of cost data for MAS mineral-deposit evaluations. MAS and MILS mineral-deposit data are cross-indexed to several other mineral-information data bases.

1989

A study to examine the impact that environmental constraints have on lode and placer mining in Alaska was completed and was published in 1990. The report estimates the impact of different placer mines and their rate of return. Three models (1,500, 1,000, and 500 yd³/d) were simulated in the study. The study found that rates of return for placer mines have a marked decrease as increasing effluent treatment increases. The incremental increase in operating cost from one treatment option to the next is relatively small. However, the opportunity cost of 'down time' is significant. Lost production during a short operating season accounts for the decreasing rate of return as effluent treatment is increased.

Lode mines face greater permitting and compliance costs than similarly sized placer mines due to the impact of the operation. Direct permitting costs for lode mines range from 2 to 6% of total project cost, with 4% being the most common figure cited by industry. Total permitting and compliance costs are approximately double that for direct permitting costs. Indirect costs associated with compliance include mitigation, monitoring, and reclamation.

Statistics on the use or proposed use and disposal of cyanide compounds by the Alaska mining industry were collected and forwarded to the U.S. Bureau of Mines (USBM) Western Field Operation Center (WFOC) in Spokane, Washington. WFOC compiled the Alaska data with data collected for the U.S. mining industry into a report entitled *Solution Control Strategies at Domestic Heap-Leach Operations*. The report is scheduled for release in 1990. Data on heap leaching and its applicability to Alaska was published in *Arctic Research* and in 1990 as an Open File Report.

This report discusses heap leaching methodology and evaluates the capital and operating costs of a 'Typical' Nevada heap leach operation of variable tonnage as it would exist in Interior Alaska. Cost data was generated by the USBM's Cost Estimation System (CES), Western Mine Engineering's Mining Cost Service (MCS), and published case histories. The objectives of these analyses is to compare the hypothetical costs of heap leach mining in Alaska to those of Nevada.

Although, there are a few problems unique to northern heap leaching, such as short leach season, snow melt, and permafrost, which may be resolved by further research, this study showed that heap leaching is economically viable in Alaska. Based upon the USBM's analyses, an Alaskan precious metal deposit that would be amenable to cyanide heap leaching requires a recoverable metal value (RMV) 1.71 times greater than those of similar deposits in Nevada at the break-even level of probability. For a 15% discounted cash flow rate of return (DCFROF), an Alaskan deposit requires an RMV 2.01 times greater than those in Nevada. This increase in

costs is due to the short leaching season and increased costs of transportation, shipping, and labor. Environmental factors also contribute to greater costs in Alaska due to such factors as Alaska's heavier precipitation rate, permafrost, and vegetation cover. As a consequence, containment of effluent during flood events will cost more in Alaska due to the necessity for larger holding ponds.

A problem unique to Alaska heap leach operations is permafrost. If possible, pads should be placed on thaw-stable ground. In the event that this is not possible, all efforts must be taken to keep the ground beneath the pad frozen. This can be accomplished through the use of thaw-pipes, or insulating gravel bases. Because the heap itself will provide insulation for the heaps (unless the leach solution is heated), the perimeter around the heap will be most likely to thaw. If this happens, the pad may be torn, solution may escape, or the edge of the heap may collapse.

1990

Congress, recognizing Alaska's assets and infrastructure problem, asked the Army Corps of Engineers (COE) to study the need for future port facilities in Alaska. Realizing that future port development might occur because of the development of mineral resources, the COE contacted the USBM. The USBM maintains a comprehensive computerized data base of over 7,000 mineral deposit locations in Alaska, and has the expertise to evaluate the significance of these deposits.

In October 1989, the COE and USBM entered into a joint agreement, in which the COE supplied the locations of the proposed port sites and the USBM, in turn, would supply: an inventory of the mineral deposits around the port sites; a list of the commodities found in each mineral deposit; and a determination of the likelihood of mineral development around each site. The results of the evaluations were published in Open File Report 15-90, 21-90, 22-90, and 36-90,

The COE provided the USBM with 10 existing or potential port sites: Balboa/Herendeen Bay, Beluga, Bethel, Iliamna Bay, Kivalina, Kotzebue, Lost River, Nome, Omalik Lagoon, and Point MacKenzie.

The USBM used its data base to determine the number and type of mineral deposits within a radius of 100 miles each site. For the Point MacKenzie site, deposits were identified that are within 30 miles of a major road or the railroad because of the transportation system in place in southcentral Alaska. In January, 1990, the results were delivered to the COE in a report entitled *Mineral Deposit Inventory for Ten Alaska Port Sites* (OFR 15-90). The inventory provides map locations and summaries for the mineral deposits.

The USBM identified 859 deposits that meet the criteria for development within the proposed access area of the proposed ports. The deposits contain aluminum, antimony, asbestos, barium, bismuth, calcium, chromium, clay, coal, cobalt, columbium, copper, diatomite, fluorine, gemstone, gold, graphite, iron, kyanite group, lead, mercury, mica, molybdenum, pumice, silver, sulfur, tin, uranium, and zinc.

After the inventory was completed, the USBM determined the likelihood of mineral development around each port site. This determination was done by USBM staff evaluating the

feasibility of developing the most significant mineral deposit types (models¹) around each site. Feasibility studies were not done on individual deposits and factors such as land status and permitting requirements were not considered. The USBM's findings were delivered to the COE in three reports in May 1990.

There is presently a port at Kivalina. The USBM determined that there is a possibility of increased mineral traffic through the port in the future. The Kivalina port is part of the DeLong Mountains Transportation System, It services Cominco-Alaska Inc.'s Red Dog lead-zinc mine, which is scheduled to operate for the next 50 to 100 years. There are additional smaller lead-zinc massive sulfide deposits in the region surrounding the Red Dog Mine. While there is little data on the specifics of the deposits, they may have potential for development in the near term. Analysis of the model indicates that such a deposit is subeconomic if a 15% return on investment is used as a cutoff. However, the rate of return on investment is relatively close to the cutoff and, depending on economic conditions, mines in the area may become feasible in the near future. The presence of the DeLong Mountains Transportation System is a real asset for those deposits in the regions which could use the existing infrastructure.

It was found that the proposed ports at Omalik Lagoon and Kotzebue could be used to export coal. The Bureau found that in northwestern Alaska, coal could be shipped from ports at Omalik Lagoon and Kotzebue, if villages in northwestern Alaska replace oil-fired power plants with coal-fired power plants. Analysis of the coal mine model indicated that coal could be produced at prices, which would equate to approximately \$1.46/gallon of fuel oil (\$1.28/gallon for fuel oil for the Kotzebue port site) for coal delivered to villages around Omalik Lagoon (15% return on investment), At the time that the study was done, it was considered unlikely that a village would find it economic to shift to a coal-fired power plant. However, events such as the tensions in the Middle East, with the consequent rise in fuel oil costs, have currently made the switch to coal a more viable alternative. Production of coal on a large scale for export from these northern deposits is considered to be unfeasible at present time, due to the expense and hardship of operating in an Arctic environment. While operating in such an environment is technically feasible, competition in world export markets would be difficult; particularly with the short shipping season and consequent intermittent supply to coal to market.

The Minerals Industry Location System (MILS) data base continued to receive widespread use by the government, industry, and the public in 1990. An example of a MILS request received during 1990 is a request from a State Senator for information on mineral resources and potential along the route of the proposed Trans-Alaska Highway. The road would be built from Prospect on the Dalton Highway, through Bettles to Bornite, and on to Nome. Major copper mineral deposits along the route include Bornite, Arctic, Sun, and Smucker. Less than 24 hours were available to provide the information in time for use by the Senator. Using the MILS data base, the request for information was delivered to the Senator the following morning. The material provided included 1) a map showing the proposed route and the location of mineral deposits along the route; 2) a list of the 374 deposits showing name, type, current status, and primary commodity; and 3) an estimate of the gross dollar value for deposits with known reserves along the road corridor.

¹ model refers to a mining and milling scenario, based on deposit size, grade, ore body shape and attitude, type of wall rock, ore body depth and overburden. Models were used to estimate operating costs, mine life, transportation costs, annual tonnage produced, and mine feasibility. Models were built and applied to each port site based on the types of deposits that occur nearby.

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The Bureau also compiled data on the coal deposits in northern Alaska.

1991-1992

The Bureau is not conducting any MAS projects specific to the Arctic in 1991. Plans for 1992 are unknown because most of the MAS projects are short, one year projects that deal with a recognized problem (e.g., Army Corps of Engineers). I would be glad to discuss any ideas that anyone would have for the need to evaluate problems in the Arctic.

POLICY ANALYSIS PROGRAM

This program emphasizes analyses of newly developed and existing mineral data to interpret their significance relative to local and national mineral needs. Assessment of technical, institutional, political, social, and economic factors that affect the supply of, and demand for, domestic and international minerals is the key to identifying minerals issues.

1989

In 1989, a report summarizing the availability of Alaska land for mineral exploration and locating new claims was prepared. This report culminates the USBM's program to inventory land use constraints for locatable minerals in Alaska. A parallel report describing various management policies toward leasing the rights to energy minerals was prepared and is awaiting publication. It was found that 24% of the land north of the Arctic Circle is open or open with restrictions to mining.

A prototype version of the computerized KARDEX system incorporating 1988 and 1989 annual labor and location data was finalized and distributed to USBM and Alaska Division of Mining offices in Alaska in 1989. The data base of 2,378 KARDEX numbers contains information on 79,066 individual claims (45,185 state and 33,881 federal) and can be used to cross-reference claim owner, name, KARDEX number, serial number (Alaska Division of Lands and BLM), and location. A description of the system was published as OFR 50-90.

1990

Various quadrangles were digitized and the land-status updated to June 1989 this year.

1991

A project that analyzes the exploration and mining incentives for mining in Alaska versus Canada is in progress. This project will identify and examine those incentives used in Canada and other northern countries, as deemed appropriate, that may have application in Alaska. Work will include an in-depth analysis of the benefits that could be expected. Work will identify any major disincentives that put mineral development in Alaska at a competitive disadvantage with northern countries.

1992

Work for 1992 is unknown for same reasons the projects for 1992 for Minerals Availability are unknown, but the Bureau will be looking for targets of opportunity.'

RESEARCH

The Bureau is attempting to provide solutions to mining, mineral recovery, and environmental problems in Alaska through a number of research efforts and technology transfer. Several research projects are currently being conducted in Alaska, Bureau research centers, or at universities sponsored by the Bureau through the Mineral Institute Program. Minerals research in Alaska includes efforts to improve mining technology, mineral extraction, and environmental aspects of the mineral industry, while considering Alaska's distinctive climatic and geologic condition. This accomplished through: 1) research projects which are administered by one or more of the nine USBM research centers in the lower 48, and 2) by Washington headquarters in the case of university cooperative programs such as the Mineral Institutes. Although funded by the USBM, Mineral Institutes utilize university staff and facilities to conduct their work. The University of Alaska, Fairbanks and University of Mississippi were active in the State in 1989.

Much of the USMB's work involves high-risk, long-range research that promises major improvements. Industry often cannot afford to conduct such research; the nation, however, cannot afford to do without it. Annual funding for projects in Alaska runs approximately \$700,000,

1989

Bulk samples of strategic and critical ores from various parts of Alaska have been sent to the USBM research centers in Albany, Oregon, and Salt Lake City, Utah to characterize the mineralization and determine the best beneficiation techniques for recovery of the minerals. Materials from the Sithylenkat tin deposits and Misheguk Mountain chromite/PGM, and Sheep Mountain, tin, lead, and zinc deposits were processed.

1990-1992

Researchers from the Spokane Research Center are investigating the development of technology for underground mining of deep placers. Another project at the Spokane Research Center is examining aspects of mine closure in arctic and subarctic environments. Reclamation, revegetation, slope stability, groundwater quality, long-term monitoring of mine sites, bonding, and environmental liability are some of the issues which are being examined.

In 1990, a project to evaluate and compare Soviet placer mining technology with placer mining methods used in Alaska was conducted in 1990. This follows an investigation of the placer mining operations in the Soviet Far East during September 1989. A presentation at the Twelfth annual Alaskan Conference on Placer Mining in Fairbanks described the mining methods used in the Soviet Far East. An article describing the 1989 visit to Soviet mining enterprises in the Magadan region was published in the USBM's journal *Miners/s Today*. A review of mining activities and technology in the Soviet Far East was also the subject of talks given at the monthly AMA meeting in Fairbanks, the Western Gold Show in San Francisco, and the SME December luncheon in Anchorage.

The Twin Cities Research Center in Minnesota is working on a project to determine the feasibility of *in situ* mining of deep placer deposits in Alaska.

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MINERAL INSTITUTES

Under the USBM Mineral Institute program, researchers at the University of Mississippi Marine Minerals Technology Center continued to test a new remote-controlled underwater sampling device offshore near Nome and Cape Prince of Wales. Work was done in cooperation with Western Gold Exploration and Mining Company, which provided the vessels for offshore testing. If further work is successful, the tool could replace the cumbersome placer sampling drill that is presently being used, and could significantly reduce the cost of offshore resource assessment work.

Also under the Mineral Institute program, are several projects at the University of Alaska Fairbanks, School of Mineral Engineering. This program receives 2:1 matched funds from the State of Alaska, which, combined with the USBM funds, are used for various faculty and graduate student mini-projects, scholarships, and other appropriate mineral industry activities.

DEPARTMENT OF INTERIOR

FISH AND WILDLIFE SERVICE

Presented by: William Seitz

OIL SPILL DAMAGE ASSESSMENT STUDIES

Oil Spill Impacts to Marine Birds

From late March through mid-October 1989, Alaska fishermen under contract to the Exxon Company and personnel from the U.S. Fish and Wildlife Service (Service), Alaska Department of Fish and Game (ADF&G), National Park Service (NPS), Alaska Department of Environmental Conservation (ADEC), and the International Bird Rescue Center (IBRC) retrieved more than 37,000 dead birds comprising 90 species from Alaskan waters. About 75% of these birds were murrelets and another 12% were comprised of other alcids and seabirds. Most birds (88%) were killed outside of Prince William Sound, and the proportion that were murrelets increased with distance from the spill site. There was little difference in the species composition of birds retrieved from the Barren Islands, Alaska Peninsula, and Kodiak Archipelago. Thus, Service biologists believe that most of the birds retrieved from the Alaska Peninsula and Kodiak Archipelago were killed in the area of the Barren Islands and drifted west with the advancing oil. Proportionately more loons, grebes, cormorants, murrelets, and murrelets were killed by oil than were present in Prince William Sound and the Gulf of Alaska.

Using data obtained from surveys and an experiment with drifting dead birds, biologists tentatively conclude that the birds retrieved represent only 10 to 30% of the actual kill. This is probably the highest mortality of marine birds from oil pollution ever recorded. A thorough search was precluded outside of Prince William Sound because of logistics, geography, and weather. Beyond the effect of immediately reducing breeding populations, the spill will likely have long-term effects on some marine bird populations. For birds that survived oiling, but ingested oil or had nest sites contaminated, breeding success may have been compromised in 1989, and possibly for a number of years to come. Furthermore, oil pollution may have long-term effects on the availability of food such as nearshore benthic prey eaten by seabirds. The toxicological effects of oil pollution on birds and their food is now the focus of long-term studies by the Service and other agencies.

Radio Telemetry Used to Monitor Fate of Rehabilitated Sea Otters in Prince William Sound

Crude oil spilled from the *Exxon Valdez* into Prince William Sound in March 1989 oiled sea otters. Officials set up temporary rehabilitation centers at Valdez, Seward, and Homer to treat sea otters captured by recovery teams in western Prince William Sound and the Gulf of Alaska. Many of these animals were treated, observed in captivity for a short time, and released into Prince William Sound. Service biologists, in cooperation with the Prince William Sound Science Center, implanted radio transmitters into 45 of these treated animals. Their goal was to gain information for guiding the release of the remaining captive otters and evaluating the efficacy of sea otter rehabilitation after exposure to crude oil.

Biologists monitored the activities of the sea otters' implanted radio transmitters continuously. During the first 20 days after the initial release of 21 treated otters, these marked otters were more mobile than untreated, wild-caught sea otters studied in Prince William Sound from 1984 to 1990. All were alive and vigorous after the 20-day period. Tracking of all 45

implanted otters during the first 8 months showed that the sea otters remained highly mobile, By the end of 8 months, 12 of the 45 instrumented otters were dead and 9 were missing. One radio failed. These mortality and missing rates are much higher than those normally seen for adult sea otters in the Sound. The death rate was highest in winter.

This information suggests that, despite the tremendous amount of money and energy directed toward the treatment and care of these animals, workers in the rehabilitation centers were not able to completely rehabilitate oiled otters. Holding wild animals in captivity greatly enhances stress and disease risks. The Service recommends that future policies focus on preventing otters from becoming oiled, rather than trying to treat them after oiling has occurred.

FISHERIES

Yukon River Salmon Genetic Studies Aid international Treaty Negotiations

The U.S. and Canada are now negotiating a treaty concerning allocation of chum and chinook salmon in the U.S. commercial fishery. Chum and chinook salmon harvested by U.S. fishermen in the Lower Yukon River spawn in both US. and Canadian waters. The largest problem facing the negotiators is to determine the proportion of the stocks of these two species each country contributes to the commercial fishery.

in 1987, the Service's Alaska Fish and Wildlife Research Center started a multi-year cooperative effort to characterize chum and chinook salmon stocks in the Yukon River and determine the composition of each stock in the fishery. They are using protein electrophoresis to characterize the stocks; however, they are investigating the use of DNA techniques to discriminate closely-related stocks. Cooperators include the Service's Region 7 (Fisheries Management Services), the ADF&G, and biologists in Canada.

Earlier results revealed the occurrence of a large percentage of U.S. origin, summer-run stocks that were not factored into previous Canadian analyses. The Center's 1990 analyses show the percentage of Canadian origin chum salmon in the US. hawest was 6.5 in 1987 and 11.6 in 1989. If the 1988 and 1990 results are within these ranges, an agreement between the U.S. and Canada on chum allocation should be forthcoming.

The between-year variation for chinook salmon, however, is much greater. The percentage of Canadian origin fish in the U.S. hawest was 80 in 1987 and 46 in 1988. If results for 1989 and 1990 display similar wide variation, an agreement between the two countries will be more difficult.

MARINE MAMMALS

Polar Bears: A Shared Resource with the Soviet Union

Polar bears occur in northwestern and arctic Alaska during the winter months each year. Native hunters hawest some of these bears for subsistence along the northwestern Alaska coastline. Service research biologists have confirmed that these polar bears spend a considerable portion of their lives in Soviet waters adjacent to the Chukotka Peninsula in northeastern Russia. This confirmation led to setting up a cooperative research program with

the Soviet Union. Scientists will investigate the ecology of polar bears that occur in the Bering and Chukchi seas.

The first part of this cooperative research program took place during April 1989 when Soviet biologists visited the Service research project at Barrow, Alaska. The second portion of the program occurred during spring 1990. Three Service biologists spent 6 weeks with their Soviet colleagues on Wrangel Island and along the northern coast of the Chukotka Peninsula in the Soviet arctic capturing and collaring polar bears.

Wrangel Island is unique among the world's areas where female polar bears congregate to enter maternity dens. Only female polar bears that will have cubs enter the over-winter dens, while all other polar bears remain active throughout the winter. About 300 to 600 females annually den on Wrangel, one of the highest densities of polar bear dens in the world. Polar bears that occur in western Alaska use Wrangel and Herald islands and the northern coast of the Chukotka Peninsula,

By placing satellite telemetry collars on females that den on the two Soviet islands and on those found off the western coast of Alaska, biologists hope to determine the areas used by these females. They also will be better able to answer questions about movements, distributions, and population dynamics, and status. The Service will use this information to determine the size of the allowable harvest of polar bears in the Chukchi and Bering seas and the allocation of that harvest between the two countries.

The Soviet and US. biologists captured 61 bears and placed satellite telemetry collars on 22 adult females. Twenty of these females had recently emerged from dens on Wrangel Island and were accompanied by cubs of the year. Biologists saw 40 sows with litters during the capture program. Average litter size was nearly two cubs per litter. They saw three litters with three cubs, normally a rare occurrence among polar bears.

The cooperative polar bear research program between the US and USSR will continue in 1991. Plans call for Soviet biologists to visit the U.S. project in Alaska to learn computer-aided data analysis techniques and to prepare joint publications of the study results.

Beaufort Sea Studies Emphasize Importance of Arctic Refuge for Polar Bear Denning

During the winter of 1988-1989, Service biologists captured and marked 71 polar bears in the Beaufort Sea and equipped them with 27 satellite and 18 conventional radio transmitters. With this large number of radio transmitters, the biologists were able to locate 16 polar bear maternity dens and evidence of 6 others, bringing to over 100 the total recorded during the course of the project. The database now accumulating is providing some exciting information. Only 23% of known polar bear dens have been found on land in Alaska as compared to drifting sea ice, but significantly, these land dens account for 37% of the known polar bear cubs. Seventeen of 19 monitored cubs survived the winter of 1988-1989 suggesting an 89% survival that is higher than the 83% suggested by changes in litter size ratios during the same time period. Data from polar bears in northern Alaska continue to suggest that higher densities of maternity denning polar bears occur in and near the Arctic National Wildlife Refuge and on small barrier islands, than on other land areas of Alaska. In contrast, 80% of denning by bears captured in northwestern Alaska and traced by satellite collars occurs in the Soviet Union.

Movements and Population Assessment of **Pacific Walrus**

Experts believe Pacific walrus populations are declining, but information on population distribution and composition as well as haulout movement patterns is insufficient to allow meaningful interpretation of existing information. This uncertainty combined with the potential for human intrusions to increase in walrus habitat (for example, commercial fisheries and oil and gas exploration and development) and increases in harvest (for example, more mechanized means of harvest and potential increases in demand for walrus tusks due to the ban on elephant ivory) will surely increase conflicts among users and between resource managers.

In 1986, the Service started research to increase the accuracy and precision of the methods used to indicate population status and reduce time lags in management responses to actions affecting the welfare of the walrus population. Ongoing studies include the use of satellite telemetry to collect the behavioral information necessary to understand the overall scope of Pacific walrus movements and to define population bounds. †

Biologists deployed nine satellite transmitters in spring 1990 on male walruses in Bristol Bay. Seven continued operation through late summer. Also, observers stationed at the two main Bristol Bay haulouts monitored walruses, some with transmitters. Their observations revealed that the number and accuracy of telemetry locations depends on the behavior of the individual animal and its proximity to cliffs. Throughout the summer, marked walruses moved back and forth between the haulout beaches at Cape Peirce and Round Island.

Service biologists evaluated adaptive sampling techniques, videography, 35 mm photography, and line transect techniques as methods for walrus population assessments. Service cooperators from the University of Maine developed a comprehensive protocol for the joint US/USSR walrus survey this fall that recommended a combination of an adaptive sampling procedure and systematically spaced line transects. The procedure should reduce variance between 10 and 30%. Airborne video, in most situations, was not an adequate tool for counting walruses. Preliminary analysis of July 1989 aerial surveys on both sides of the Chukchi Sea revealed that most of the walruses seen were either on the main pack ice sheet in U.S. waters or on remnant ice farther south in USSR waters.

Sea Otter Research **Aids Zonal** Management of Sea Otters In Alaska

Sea otters were virtually eliminated from their North American range during the 18th and 19th Centuries. During the last 75 years, with several transplants to southeastern Alaska, sea otters have increased in numbers such that they have re-occupied much of their former range in Alaska. Without otters, many species of invertebrates, including commercially important shellfish, increased in abundance. Concurrently, commercial and recreational fisheries flourished. Re-occupation of sea otters into former habitat has occasionally put sea otters in competition with humans for shellfish resources. The Service has proposed a zonal management plan to address these conflicts and a growing interest by Alaska Natives for harvesting sea otters.

The Service's research program focuses on the collection of sound biological information to support the Service's management efforts. Completed and ongoing studies address all of sea otter ecology: population composition, natality and mortality estimates, mortality causes, movement patterns, physiological condition, and food resources. Future work will address genetic stock identification using DNA analysis. The Service has ongoing studies at Kodiak Island and Prince William Sound; however, the *Exxon Valdez* oil spill emergency has strongly impacted ongoing work because of the reassignment of personnel.

Department of Interior - Fish and Wildlife Service

Biologists recorded a period of unusually high mortality in the late winter/early spring in the Cordova area of Prince William Sound. Preliminary analysis of post-mortem data shows old age may have been the primary cause of death. Overall survival throughout these studies was lower in the Kodiak study area. In Kodiak, changes in otter distributions and an increase in the proportion of reproductive females show a change in population status within the study area. Biologists expect densities and relative distribution to stabilize within a few years. Synchrony in pupping, evident in Prince William Sound, was not observed in Kodiak.

Marine Mammal Management In Alaska

The Service has a legislative mandate to manage three marine mammal species: polar bear, Pacific walrus, and sea otter. The Marine Mammal Protection Act dictates that population must be managed at Optimum Sustainable Population (OSP) levels, the maximum productivity within the habitat's carrying capacity. Presently, Service biologists believe the populations are at near historic high levels: polar bear-3,000 to 5,000; Pacific walrus-234,000 (1985 survey); and sea otter-1 50,000 to 200,000. The Service's management priorities focus on monitoring population levels, Native harvest, and human impacts,

The Pacific walrus population is shared with the USSR. Since 1975, the Service has conducted walrus population surveys jointly with the Soviet Union at 5-year intervals. The latest in 1990 was the first truly cooperative survey. The polar bear population also is shared with the USSR. Service management and research biologists cooperate with the Soviet Union to survey populations and conduct surveys in the Chukchi Sea. The first ever state-wide population survey of Alaska's sea otter population is scheduled in late summer 1991. Some parts of Alaska have not been surveyed for over 25 years.

The Marine Mammal Protection Act allows Native harvest for subsistence and creating/selling articles of handicrafts and clothing (except sea otters), provided harvest is non-wasteful. [n 1988, new tagging regulations went into effect - all Native-killed marine mammals must be marked, tagged, and reported to the Service.

The Service authorizes and monitors incidental take, defined as non-intentional, accidental take. Areas of concern include commercial fishing operations and activities in specific geographic regions, particularly those with oil and gas exploration and development activities. The Service is cooperating with the National Marine Fisheries Service (NMFS) in developing a legislative environmental impact statement and regulations for incidental take in commercial fisheries.

MIGRATORY BIRDS

Eskimo Students Aid Goose Banding Activities

Since 1983, the Service has conducted a major research effort to address the causes of the serious decline in nesting populations of cackling Canada, dusky Canada, emperor, white-fronted, and brant geese. The Service also is identifying and evaluating new threats to these and other populations in Alaska. Management of the populations is hampered by a lack of knowledge on harvest, population size, population structure and population production rate.

Several of the Service's studies use observations of banded geese to help them achieve their objectives dealing with such topics as mortality and distribution. Yupik Eskimos on the Yukon-Kuskokwim Delta used to use funnel traps to catch flightless waterfowl. Although molting

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driies are a method of the past in western Alaska, biologists now use the funnel trap design to capture many waterfowl for research purposes. Although biologists capture geese using the same methods historically used by local residents to gather food, we have a decidedly different goal. Their intent is not to use the geese as food, but to mark them with coded plastic neck collars.

All waterfowl become flightless each summer when they simultaneously molt their flight feathers. They are extremely wary during this time, but if surrounded with enough people or circled by an airplane, biologists can capture them in large numbers. Since 1986, the Service has asked for the help of youths from Chevak to capture molting geese near their village. The Service benefits by getting much needed help, and the student get firsthand experience in the research of the Delta's natural resources.

Each goose we trap receives a metal Service leg band and a yellow plastic neck collar with black digits. The emperor geese receive an additional colored 'leg band. The students hand the trapped geese to the record banders. Service biologists trapped 401 geese in 1990.

Videography Proves Promising for Estimating Brant Populations

Aerial photography is a valuable tool for improving the precision of estimates of waterfowl populations. Other methods include computer-aided counting of photographic images of waterfowl. However, higher costs of equipment and processing images limits application of these technologies over large areas. Recently, the Service evaluated video imagery and microcomputer-based image-processing software to estimate the size of black brant nesting colonies and staging flocks.

Pacific black brant gather in western Alaska in May-June on the coast of the Yukon-Kuskokwim Delta in several dense nesting colonies. They stage in September-October in large flocks at Izembek Lagoon on the Alaska Peninsula. We estimate about 50% of the entire population nests on the Yukon-Kuskokwim Delta. The entire population of black brant stages at Izembek in fall in preparation for migration. Tens of thousands of birds are not uncommon in the lagoon during tidal fluctuations. These high concentrations of brant in well defined areas made sampling with aerial transects possible. The Service's goal was to improve the precision of estimates from the on-the-ground samples in nesting areas and low altitude aerial surveys at the staging area while reducing disturbance of the birds.

To estimate nesting density, biologists mounted a video camera in the belly port of a fixed-wing aircraft. The camera recorded 12 m (39.4 ft) wide strip transects across nesting areas with known nest locations. They recorded video scenes at an altitude of 152 m (500 ft) and ground speed of 130 km/hr (80 m/hr.). Analysis of freeze-frame images on a high resolution (400 lines) video monitor resulted in identification of all known nests. Although images must be analyzed by inspection, estimates of time required to sample colonies and process images showed that this procedure makes annual estimates of brant colony size possible with minimal disturbance and greatly reduced costs compared to other alternatives.

The reflective properties of the plumage of brant under the low-angle sunlight occurring in the fall staging area caused individual birds to appear as white dots in video images of flocks on the dark water of the lagoon. The high contrast between birds and background allows the automated counting of each bird with a microcomputer and a public domain, image processing program (IMAGE).

Department of Interior - Fish and Wildlife Service

Plans call for testing sampling procedures for efficiency and evaluation of a digital camera that will greatly improve image quality,

Model Development to Evaluate the Potential Impact of Aircraft Disturbance of Pacific Black Brant

Service biologists conducted field studies at Izembek Lagoon on the Alaska Peninsula from 1985 to 1988 to quantify the effects of aircraft disturbance and other disturbances on Pacific black brant. Each fall from September to November nearly the entire Pacific Flyway population of 130,000 brant flies to Izembek Lagoon and feeds on eelgrass to accumulate fat reserves for non-stop transoceanic migration to wintering areas as distant as Mexico. Helicopters frequently fly over Izembek Lagoon to support offshore oil exploration activities in the North Aleutian Basin. Brant, Canada geese, and emperor geese interrupt foraging activities and take flight in response to these overflights. These disturbances caused by aircraft overflights may be harmful to brant.

During the four-year study biologists collected information for the development and evaluation of a model to predict the potential impact of disturbance on the energetic requirements of brant. In over 1,900 hours of daylight observations, potential incidental disturbances occurred at 1.07/hr. Aircraft (0.57/hr) and persons on foot (0.08/hr) were the most frequent human-related disturbances, and bald eagles (0.25/hr) the most frequent natural cause. The entire brant flock responded to 48% of all detectable events and took flight in 35%. The brant spent about 2.5% of the total daylight time responding to incidental disturbance events of all types.

Biologists conducted experimental aircraft flights along planned flightlines to determine precisely aircraft altitude and lateral distance to the flock. The percent response by flocks was least with a twin-engine fixed-wing aircraft and greatest for the helicopter. In contrast to fixed-wing aircraft, the response of brant to helicopter overflights did not diminish with increasing altitudes up to 610 m (2,000 ft). The threshold noise level for alert response was 49 decibels and 58 decibels for fright response. The behavioral response of brant and measured noise level both increased as the helicopter flew at greater altitudes at 1.6 km (1 mi) lateral distance.

By integrating information about brant diets, their behavior, distribution and habitat use, Service biologists were able to develop a model to evaluate the potential impact of disturbance on the energetic requirements of brant. For each additional aircraft disturbance that occurred daily throughout the 54-day fall staging period, the predicted total weight gain would be reduced by 7.4 grams - equivalent to the energy spent in 53 minutes or 73 km (46 mi) of migration flight. Biologists predict that with 45 to 50 daily disturbances, brant would not gain any weight at Izembek. The model permits wildlife managers an opportunity to understand the size of disturbance effects in relation to behavioral change and expected weight gain necessary for migration.

Tundra Vole Abundance May Be Related to Nest Success of Cackling Canada Geese

There have been significant reductions in production of Pacific blackbrant, cackling Canada geese, emperor geese, and white-fronted geese in select areas of the Yukon-Kuskokwim Delta in western Alaska. What are the reasons for these declines? Biologists do not know for sure but believe egg gathering and subsistence hunting by Alaska Natives and predation by birds and foxes may be contributing factors. Managers believe fox predation to be the most manageable factor in curbing the decline of brant and cackling geese.

After almost 5 years of field work, Service biologists are better able to quantify the effects of predation on goose nesting success. The Service's research goals address fox food habits, foraging behavior, and home ranges; population dynamics of foxes in key goose nesting areas; and evaluation of techniques for removal of foxes.

Tundra vole abundance (expressed as the number caught per 100 trap nights) decreased greatly in 1990 (2.3/100 trap nights) compared to 1988 (16.5/100 trap night) and 1989 (10.2/100 trap nights). Fecundity (presence of recent reproductive activity) of foxes biologists captured in study areas on the Delta was much lower in 1990 (14%) than previous years (45%). The low vole population, low fecundity of trapped foxes, and poor nest success for cacklers (62% of 85 nests on plots where biologists removed foxes and 58% of 70 nests on plots where biologists did not remove foxes), are consistent with the hypothesis that vole abundance affects nest predation by influencing the distribution and behavior of foxes.

In years with high vole populations such as 1988 and 1989, control of foxes by trapping and opportunistic hunting, which usually does not remove all foxes, can improve nest success of cackling Canada geese. In years when nests are more attractive to foxes (low vole numbers), a more efficient means of control such as a concentrated hunting strategy using snow machines would be necessary to improve nest success.

Bristle-thighed Curlew Status and Demography

Four species of curlews regularly occur in North America: Eskimo, long-billed; bristle-thighed, and the whimbrel. The bristle-thighed curlew is the only species of curlew whose status is completely unknown. Bristle-thighed curlews winter in the island groups of the central and south Pacific Ocean and breed on the Seward Peninsula of Alaska. In 1988, the Service started a major effort to determine the status of the species. Biologists are focusing their field efforts to determine the status of the species. Biologists are focusing their field investigations on life history parameters on the breeding, staging, and wintering grounds. The Service will use the results to develop a comprehensive management plan.

Recent studies suggest that fewer than 10,000 individuals make up the entire population. Few historical data exist with which to assess possible changes in population. Some biologists suggest that either marked population declines or shifts in use of wintering habitat have occurred since the early 1900s. Potential threats to the population include subsistence hunting on the wintering grounds in the northwestern Hawaiian Islands and in Alaska, exposure to contaminants and changes in food resources.

The Service's preliminary analysis of data on the size of breeding populations shows an estimate of about 3,250 pairs. Biologists located 30 pairs on the Seward Peninsula study site this summer and followed the pairs through departure to the staging grounds. About 50% of the 30 pairs successfully fledged young. The 28 birds color-banded during 1989 returned to the study area in 1990. Biologists captured and color-banded an additional 22 adults and 17 juveniles in 1990. Their field crews were able to mark at least one member of each observed pair. A single creche, a rare behavior among shore birds, consisting of a single marked adult and up to 20 juveniles formed on the study area and was followed until its members left the staging grounds in early August.

Cooperative efforts with the Service's Montana Cooperative Wildlife Research Unit in the northwestern Hawaiian Islands resulted in the capture and color-banding of 90 additional curlews. Investigators documented flightless molt in adults and confirmed differential timing of

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migration among age classes. They estimated a population of about 350 birds on the Laysan Islands in September.

Sixth Straight Breeding Failure Recorded for Black-legged Kittiwakes on Middleton Island

Alaska is an important geographic region for seabirds: populations of seabirds number more than 100 million individuals of about 50 species, and another 20 million more of seabirds from the southern hemisphere forage in Alaska waters during summer. Recreational and commercial fisheries, offshore oil and gas development, and oil spills pose significant threats to marine bird populations in Alaska.

The Service has several ongoing research studies that address life history parameters of Alaska seabirds. One of these multi-year studies is underway on Middleton Island in the Gulf of Alaska. The main goal of this effort is to determine adult survival and energetic of black-legged kittiwakes. As background, more than 80 estimates of annual productivity are available from kittiwake colonies seen in Alaska since 1976. There is little or no new recruitment of breeding adults to many of the largest colonies. Adults have died in large numbers during the summer months in some years, and population declines are being observed. The reasons for these declines are not known. Biologists chose Middleton Island because productivity estimates suggest this site is fairly representative of the Gulf of Alaska.

Biologists estimated adult mortality during the winter of 1989-1990 by refighting birds banded on Middleton from 1984 to 1988. Over 100 new adult birds were captured and banded in 1990. Adult over-winter survival is estimated at 93 to 94% over the last 3 years, far exceeding the values known for Atlantic populations of this species. Even these high survival rates cannot offset the chronic reproductive failure that is now occurring. In 1990, biologists saw the sixth straight year of total or near-total breeding failure on Middleton. Failure appears to be related to an inadequate food supply, although predation by a rapidly expanding gull population is the major proximate cause of egg and clutch losses in this colony. Samples collected in 1988 tested negative for the presence of avian influenza virus.

Migratory Bird Management in Alaska

Alaska is a major contributor to the continental waterfowl population. The state supports approximately 15% of the ducks that breed in North America - nearly 40% of the U.S. share of North American breeding ducks. Many of the most valuable breeding areas lie within the 16 national wildlife refuges in Alaska. Depending on the year, up to 60% of the continental population of northern pintails may be present in the summer. On the average, Alaska annually sends in excess of 800,000 geese to wintering grounds that lie mostly in the lower 48 states. They represent 11 different goose populations, including white-fronted geese, Pacific black brant, and several subspecies of Canada geese. Some 15,000 trumpeter swans and about 100,000 tundra swans - major portions of the world populations of both species - use breeding grounds in Alaska. An estimated 100 million seabirds of 66 species - 96% of the seabirds in U.S. waters - inhabit Alaska waters. Most of the important nesting areas used by seabirds in Alaska are on refuge lands.

Much of the Service's effort in managing migratory birds is directed at monitoring and surveying populations. Examples of the types of activities ongoing on several of Alaska refuges include: state-wide waterfowl brood surveys, inventories to investigate tundra swan distribution and population size, a northern pintail banding program, banding and population studies of bristle-thighed curlews, seabird surveys, raptor population studies, and shorebird inventories.

TERRESTRIAL MAMMALS

Timing of Snow Melt Tied to Calving Activity In the Arctic National Wildlife Refuge

The oil industry considers the '1002' area of the coastal plain of the Arctic National Wildlife Refuge (ANWR) in northeastern Alaska the most promising onshore petroleum exploration area in the United States. However, the 1002 area contains important fish and wildlife habitat, including the most frequently used calving and post-calving habitats for the Porcupine Caribou Herd (PCH). In 1989, Service biologists estimated the minimum post-calving population of the PCH to be 178,000 animals. A 5-year baseline report by the Department of the Interior concluded that major impacts to the PCH could occur if a major oil discovery is located and developed in the 1002 area.

In 1982, the Service started several multi-year studies to address the factors accounting for temporal and spatial variation in caribou calf production and survival, and how development might alter these factors. Between 1983 and 1990 biologists studied 305 calving sites of radio-collared caribou cows to determine the factors influencing calving site selection.

Cows selected areas dominated by cottongrass tussocks north of the foothills primarily to reduce exposure to calves to predators and secondarily for access to newly-emerged vegetation. Highest calf mortality occurred in years when snow melt was relatively late and calving occurred closer to the foothills and in Canada. Industrial development of the coastal plain of the refuge could increase calf mortality if calving was displaced south and east of potential development areas.

Muskox Population Expands Westward of the Arctic National Wildlife Refuge

Muskoxen are year-round residents of the coastal plain of the Arctic National Wildlife Refuge (ANWR) and will be present in winter when exploration drilling and construction activities may occur. Even though winter distribution of muskoxen is not well documented, preliminary information collected using satellite telemetry shows that in winter muskoxen remain in relatively localized areas and reduce both activity and movements.

In 1988, Service management and research biologists with cooperation from the Service's Alaska Cooperative Wildlife Research Unit started an investigation of muskox population parameters, seasonal distribution, movements and activity patterns in and around ANWR. The Service will use the information to determine the potential effects of petroleum exploration and development on muskox using the '1002 area of ANWR. Conventional and satellite telemetry plays an important role in the conduct of our research efforts.

Before calving in 1989, biologists saw about 500 muskoxen on the coastal plain between the Colville River in northcentral Alaska and the Firth River in northwestern Canada. In April 1990, they counted 348 muskoxen on the ANWR coastal plain between the Canning River and the Canadian border, compared to 359 animals seen in the same area in 1989. Canadian biologists have seen at least 50 east of the refuge in northwestern Canada. Service biologists counted 122 muskoxen west of the refuge in April 1990. The portion of the population on the refuge coastal plain may be stabilizing -- precalving estimates have numbered 350 during the past 3 years. Population numbers west of the refuge increased rapidly between 1986 and 1987 and again between 1988 and 1989, probably from a westward dispersal from ANWR.

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In 1990, *biologists* classified 5\$ (16%) of 369 animals as calves; they saw 43 calves per 100 cows greater than 2 years of age. Productivity and initial calf survival in 1990 were slightly higher than 1986 and 1989 when they saw only 39 calves per 100 cows. Survival of calves and yearlings from 1989 to 1990 was very high,

DEPARTMENT OF INTERIOR

GEOLOGICAL SURVEY

ARCTIC DATA INITIATIVES

Presented by: Paul D. Brooks

THE ARCTIC ENVIRONMENTAL DATA DIRECTORY

The Arctic Environmental Data Directory (AEDD) is a database that identifies and describes arctic datasets maintained by federal, state, local agencies, and academic institutions in the United States, Canada, and other arctic nations. In May 1988, the U.S. Geological Survey (USGS) established a cooperative program with representatives from the arctic research community to facilitate data management of arctic information. One of the key activities that the USGS has undertaken is membership in the Arctic Environmental Data Directory Working Group, sponsored by the Interagency Arctic Research Policy Committee. The working group is composed of representatives from government agencies and academia, and one of its goals is to facilitate access to arctic data and to improve information dissemination. As a first step, the working group developed the Arctic Environmental Data Directory, which today contains more than 330 references to arctic datasets maintained by the United States and other arctic nations. The directory sets include references to geophysical data as well as ecological, biological, and socioeconomic data for studies related to human interactions with the environment. The directory information is also being shared with the Global Change Master Data Directory to improve access to arctic data by the scientific community.

THE ARCTIC DATA INTERACTIVE CD-ROM

The Arctic Data Interactive (ADI) CD-ROM is a pilot project being developed by the working group to meet the long-term data management goals of the Interagency Arctic Research Policy Committee. The project is designed to provide an integrated information product that will be published by using Compact Disc-Read Only Memory (CD-ROM) technology. The project entails the development of an electronic journal that includes a mix of text, numerics, spatial data, and related software for data analysis. The data are being collected in a standard format to facilitate use with other applications software such as spreadsheets, graphics, and image processing. The design of the interactive prototype is based on hypermedia technology. This technology provides the capability to create associative links between structured and unstructured information that may include data, text, graphics, imagery, and sound. The prototype includes: 1) the Arctic Environmental Data Directory, 2) bibliographic information, 3) full text of research reports and short papers (including illustrations), and 4) arctic datasets.

DATA MANAGEMENT OF AEDD AND ADI

The working group was formed to guide the development of a data directory for the Arctic. Composed of representatives from the United States and Canadian agencies and academia, the working group has been a major catalyst for data management efforts for the Arctic. The Alaska Council on Northern Resources Information Management (CONRIM) supports the development of the Arctic Environmental Data Directory and the Arctic Data Interactive CD-ROM and has officially endorsed the working group's projects and actively supports data acquisition activities in Alaska. In addition, the council has recently established a subcommittee

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to promote the data directory and to encourage participation from member organizations and potential users.

Overall project management of the Arctic Environmental Data Directory is under the auspices of the working group chairman. The Alaska Office of National Mapping Division, U.S. Geological Survey, has operational responsibility for coordinating logistical support for the directory in Alaska. This support includes correspondence, data entry, database management, links with other data directories, and public outreach. The Alaska Office is accomplishing these efforts under a workplan that has been approved by the working group and is also amenable to the CONRIM.

SHORT- AND LONG-TERM GOALS

The short-term goals of the work plan are to establish an ongoing mechanism to acquire new entries for the Arctic Environmental Data Directory. This effort includes the identification and training of personnel to collect, organize, and encode information into the directory database. During the Federal 1991 fiscal year, 100 new dataset entries have been targeted for inclusion in the directory. A workshop, sponsored by CONRIM, is being organized for April 1991 to encourage broad support within the Alaska community for the directory expansion. Activities planned for the short-term encompass developing database access procedures and dissemination of current directory information in various formats including hardcopy listings, online access, CD-ROM, and other computer-related output; establishing a policy to periodically review and update entries in the directory database to ensure the accuracy of the information as well as reviewing and editing current entries as the data are collected and encoded; continuing the collaboration with Canadian sources and working with federal, state, and local agencies in Alaska; developing contacts with other arctic nations and evaluating the progress of the Arctic Data Interactive CD-ROM and identifying future requirements to support the project.

The long-term goals ensure the viability and longevity of the Arctic Environmental Data Directory project. This effort would be accomplished by building a consortium of active supporters and interested users of arctic information and data, expanding the thematic content of data holdings to include historical and current records, and by coordinating the relationship between the Arctic Environmental Data Directory and other important directories such as the USGS Global Land Information System and the Antarctica Directory.

If you would like more information about the Arctic Environmental Data Directory and Arctic Data Interactive CD-ROM projects, entry forms for submitting your data, or a demonstration of the online database, please contact:

Paul D. Brooks
Arctic Environmental Data Directory Project Manager
U.S. Geological Survey
4320 University Drive
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ACTIVITIES OF THE BRANCH OF ALASKA GEOLOGY

Presented by: Willis White

Arctic research of the U.S. Geological Survey's Branch of Alaskan Geology is focused mostly on three topics:

1. Geologic mapping of the State of Alaska and assessment of its mineral resources.
2. Deep crustal studies along a transect extending from the Gulf of Alaska to the edge of the Arctic Continental margin.
3. Studies of Late Cenozoic climate change.

Geologic mapping is an ongoing project with the objective of producing a complete, modern geologic map of the State of Alaska at a scale of 1:250,000. Mapping completed to date covers approximately 31 % of the State. During the 1991 field season work will concentrate in the Howard Pass and Misheguk Mountain quadrangles in the western Brooks Range; in the Lime Hill quadrangle in the western Alaska Range; and to a lesser extent, in the Seldovia quadrangle on the Kenai Peninsula, and the False Pass-Cold Bay quadrangles on the Alaska Peninsula.

Deep Crustal Studies along the Trans-Alaska Crustal Transect (TACT) involves coordinated geological and geophysical investigations in the vicinity of the Trans-Alaska oil pipeline corridor and its offshore projection across the Pacific and Arctic continental margins. TACT features state-of-the-art seismic refraction and reflection data, detailed structural and petrologic studies, integrated interpretation and synthesis of geologic and geophysical data. The proposed program for the summer of 1991 includes an offshore-onshore seismic survey of the Arctic margin and the completion of geologic investigations in the northern Brooks Range.

Studies of Late Cenozoic climate change are designed to define the details of climatic change in northern Alaska during the last glacial-interglacial cycle, and to determine the response of permafrost and the landscape to these changes. Emphasis is also placed on the warm period at about 9 or 10 ka as a possible analog for conditions expected to result from the increase in green house gases in the atmosphere. Effort is currently directed towards establishing a stratigraphic and chronologic framework for late Cenozoic sediments; a paleoclimatic interpretation of geochemical, paleontological, sedimentological, and stratigraphic data within this framework; and a synthesis of the interpretations into a long-term record of paleoclimate.

In addition, the Alaska Branch is deeply involved in a joint project with the Alaska Division of Geological and Geophysical Surveys, the USSR Academy of Sciences, and the USSR Ministry of Geology to produce combined metallogenic and tectonic maps of Alaska and the Soviet Far East.

NATIONAL MAPPING DIVISION
EARTH RESOURCES OBSERVATION SYSTEMS-ALASKA FIELD OFFICE
ARCTIC RESEARCH

Presented by: Stanton Moll

BASELINE STUDIES FOR MONITORING GLOBAL CLIMATE CHANGE IN THE ARCTIC ENVIRONMENT: A remote sensing-spatial data base approach

The objective of these studies is to establish a long-term (10-year) monitoring program based on remotely sensed and other digital spatial earth science data bases for specific eco-physiographic regions of Alaska in support of global climate change in the arctic and sub-arctic. The monitoring program is designed to support studies and models of earth system processes at landscape, ecosystem and regional scales. Improved site and regional models will result in improved parameter estimates for circumpolar and global climate change models. A major component of the project will focus on research elements associated with the spatial integration of widely varying sources of earth science data and multi-platform, multi-temporal sources of remotely sensed data for land surface characterization.

Establishing a solid baseline of earth science data for arctic, boreal and sub-boreal ecosystems will facilitate investigations and the development of models for regional scale applications. Site specific information will be correlated through collaborative studies with regional and hemispheric level data bases for broadscale extrapolations and predictions.

Establishment of a monitoring program for the arctic and sub-arctic will be accomplished by addressing the following goals:

1. Identifying eight study sites within Alaska that sample unique ecosystems and transition zones where the potential for change in the arctic landscape is greatest.
2. Compile a comprehensive archive of remotely sensed and automated earth science data bases for designated sites.
3. Develop baseline data bases and maps from which to document change in the biological and physical components of the ecosystems under study.
4. Identify and develop data analysis and data integration techniques for detecting and monitoring changes using remote sensing and GIS technology.
5. Establish a program for acquisition and integration of new data from existing and future satellite systems.
6. Utilize GIS technology to develop parametric and non-parametric models to study and predict ecosystem change.
7. Correlate site and eco-region level information with statewide and circumpolar data bases for broad scale predictive modeling.

A key element of the project will include the development of an ecological regionalization map of the arctic and sub-arctic through collaborative efforts with EPA and Environment Canada. The project was initiated in 1989 and will continue through 1999.

RESEARCH PROJECTS ON THE NATIONAL PETROLEUM RESERVE

Presented by: Max Brewer

Several U.S. Geological Survey (USGS) research projects, some of which are still ongoing, were made possible by the recent and earlier exploratory drilling programs on the National Petroleum Reserve in Alaska (NPRA). Some of these are:

Geothermal Studies of Permafrost and Their Use in Predicting Climatic Changes In Arctic Alaska

Temperature measurements through the permafrost zone provide a reproducible history of climate change(s) that have occurred at the permafrost table (top of the permafrost), and been promulgated downward by heat conduction, during the past several centuries. The measurements do not, however, distinguish whether the temperature changes within the permafrost result from changes in air temperature, from changes in precipitation/evaporation, or from modifications of the surface environments. To date, USGS records from more than 50 well sites and test hole locations in the cold (-6 to -1 °C) permafrost in Arctic Alaska indicate an apparent warming of 2 to 4°C during the 80 years preceding about 1940, an apparent cooling in the 1950s, and an apparently even more significant cooling in the well site areas during the 1980s. The latter, however, appears to have resulted, in at least a large measure, because of disruption of the surface in the area of the well sites. Twenty-one of these wells have been so engineered as to allow periodic temperature measurements to be obtained well into the middle of the next century for use in climatic change studies in this region of the Arctic. There remains a continuing need, however, for more definitive studies of the boundary layers (snow, and the tundra/mineral soils of the annually thawed/refrozen layer) in order to bridge the gap between the air temperatures observed and the temperatures measured within the permafrost.

Coastal Erosion

It has long been known that much of the coast of the Beaufort Sea has been eroding at an average rate of approximately one meter per year, although highly variable area to area and year to year because of storm-driven wave action, while the Chukchi Sea coast appears to be reasonably stable. Both coasts are fronted by ice-rich unconsolidated, generally fine-grained sediments. The USGS coastal erosion studies in the Arctic are in recess at present although scheduled to be reactivated in 1994, as part of the National Coastal Geology Program for the 1990s. Concern also has been expressed by various groups, including government, industry, and the public sector, that the hypothesized climatic warming could endanger the oilfield infrastructure along the Beaufort coast and, thus, pose hazards to the environment. While requiring investigation, this concern would appear to be overly emphasized because, were the average air temperatures during the normal 100 days of summer to be increased by 6°C at Prudhoe, the resulting thawing index would approximate that at the inland station of Umiat. There is little evidence of degradation of the permafrost at that location.

Rehabilitation of Oilfield Reserve (Mud) Pits

The USGS has continued studies of the short-term and the longer-term environmental impacts of experimentally designed reserve (mud) pits, and their contents, at exploratory well sites on the NPRA. Reserve pits, originally intended for containment of surplus drilling muds and fluids, including crude oil, in case of well upset or blowout, have over time also become

the depositories of normal well cuttings and drilling muds in order to maintain a neater and more efficient drilling operation. More recently, the disposal of these cuttings and muds has tended to become of paramount importance in the public perception and the containment of blowout fluids has faded even though blowouts, while infrequent, can have very major environmental impacts. While the studies are intended to evaluate the environmental impacts of reserve pits, they also are providing information concerning the migration of brines within near-surface permafrost,

**WATER RESOURCES DIVISION
ARCTIC RESEARCH**

Presented by: Ken Thompson

I recently reviewed the draft Arctic Research Plan that is being circulated for agency input. After reviewing the draft, I see that some agencies wish to include programs in areas as much as 1,000 miles south of the Arctic. In light of this, I suggest that it is appropriate to reiterate the definition of the Arctic, according to the Arctic Research and Policy Act. The Arctic is defined as:

'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.'

Taking this strict definition of the Arctic, the Water Resources Division of the U.S. Geological Survey is conducting only one research effort in the Arctic. That program is a post-operations audit of some of the environmental effects of oil drilling activities in the National Petroleum Reserve. This assessment is being conducted approximately eight years after all drilling activities ceased. Field work was conducted in 1989 and 1990. A report is in preparation, and no further field work is anticipated.

We also have a small (and shrinking) program to collect basic stream-flow data. This program consists of nine stream gages, three of which are funded by the US Army Corps of Engineers. Our gage on Sagavanirktok (Sag) River Tributary, which has been used as an index station by researchers in the Arctic Tundra Long-Term Ecological Research Site, was discontinued this year for lack of \$10,000.00. The outlook for an increase in gages in 1992 is not good, particularly since we have already been notified to expect major cuts in Corps of Engineers funding for stream gages,

To put our stream-gageing program in perspective, I'd like to contrast the density of gageing stations in the Arctic with the density of stations in the rest of the country. The density of gageing stations in the lower 48 states is one gage per 400 square miles. Contrast this with the present density of stations in the Arctic Alaska. We have nine stations in an area of approximately 300,000 square miles, for a density of one station per 33,000 square miles. Clearly, we do not even have enough stations to make statistical inference in ungaged areas. As energy development pushes the need for data on water resources in the Arctic, it appears that the USGS will not be well situated to provide the necessary data.

Department *of Interior* - *Geological* Survey

Over the past year, we have been meeting with climate-change researchers of the University of Alaska, Woods Hole Marine Biology Lab, National Park Service, U.S. Forest Service, Corps of Engineers' Cold Regions Research and Engineering Lab, EPA, and other agencies to evaluate the need for USGS global-change programs in Arctic and sub-Arctic Alaska. Although this effort may ultimately yield new funding, we do not anticipate new research in Arctic hydrology prior to 1993.

DEPARTMENT OF INTERIOR
MINERALS MANAGEMENT SERVICE
ALASKA OCS REGION - ENVIRONMENTAL STUDIES PROGRAM

Presented by: Cleve Cowles

My talk this morning will include some introductory material on the goals and functioning of the Alaska Region Environmental Studies, which due to its recent emphasis on the Bering, Chukchi and Beaufort Seas, fall almost entirely into at least one politically correct definition of 'Arctic.' I will then summarize our recently completed, ongoing, and planned studies.

As most of you are aware, Minerals Management Service (MMS) is responsible for implementing the congressional mandate embodied in the Outer Continental Shelf Lands Act for developing the nation's offshore energy and mineral resources in an environmentally responsible fashion. Our job is to assess both environmental risks and resource potential, and to make decisions based on the best available scientific and technical information. During the past two decades, MMS has spent more than \$500 million on environmental studies, more than \$230 million in Alaska alone. The studies are designed to provide information necessary to ensure that offshore exploration and development activities pose no unnecessary risk to various resources.

ENVIRONMENTAL STUDIES PROGRAM PURPOSE AND GOALS

The purpose of the Environmental Studies Program is:

1) To establish information needed for prediction, assessment, and management of impacts on the human, marine, and coastal environments which may be affected by OCS oil and gas activities (1978 OCSLA Amendments), 2) enhance the leasing decision process by providing information on the status of the environment pertinent to prediction of potential effects of oil and gas exploration and development, 3) identify the ways and extent that OCS development can potentially effect human, marine, and coastal environment, 4) ensure that information available or being collected in a form useful to the decision making process, 5) provide a basis for future monitoring of post-lease OCS operations.

The major functions of the Environmental Studies Program are: 1) Alaska environmental studies planning, coordination, and execution; 2) environmental studies procurement and contract technical administration; 3) MMS support and interagency coordination. Other activities include: 1) study integration; 2) information transfer, update, and synthesis; and 3) responding to information requests.

The below information summarizes study titles according to various categories. These studies are selected and implemented through the MMS Alaska Region Regional Studies Plan and related planning process. Detailed descriptions of these studies can be found in *Final Alaska Regions/ Studies Plan, Fiscal Years 1991-1992*, a copy of which can be obtained by contacting me.

RECENTLY COMPLETED STUDIES (Fiscal Year 1989- 1990)

Marine and Aquatic Resources

Living Resources:

- 1) Behavior and Energetic of Pacific Black Brant and other Geese in Response to Aircraft Overflights at Izembek Lagoon, Alaska,
- 2) Synthesis of Information of the Effects of Noise and Disturbance on Major Haulout Concentration of Bering Sea Pinnipeds,
- 3) Development of a Method for Monitoring the Productivity, Survivorship, and Recruitment of the Pacific Walrus Population,
- 4) Potential Acoustic Disturbance to Marine Mammals in Alaska,
- 5) Northern Fur Seal Pup Migration in the Bering Sea and north Pacific Ocean.

Endangered Species:

- 1) Development of Visual Matrix Charts which Categorize Research Literature on Endangered Whales,
- 2) Computer Simulation of the Interaction of Endangered Whales with Oil Spills,
- 3) Prediction of the Site-specific Interaction of Acoustic Stimuli and Endangered Whales,
- 4) Simulation Modeling of the Effects of Oil Spills on the Population Dynamics of Key Marine Mammal Species (sea otters, southeast Bering Sea),
- 5) Simulation Modeling of the Effects of Oil Spills on the Population Dynamics of Key Marine Mammal Species.

Oceans and Atmosphere

Pollutant Transport/Physical Oceanography:

- 1) Shoreline Segment Characteristics Handbook for Smear Model Applications,
- 2) Arctic Ocean Buoy Study,
- 3) Integration of Circulation Data, Beaufort Sea,
- 4) Integration of OCSEAP/ISHTAR Data,
- 5) Beaufort Sea Mesoscale Circulation Study.

Department of Interior - Minerals Management Service

Oil Spill Fate and Effects:

- 1) Chemical Quality Assurance Program,
- 2) Performance Analyses, Compatibility, and Simulation Testing of Alaskan OCS Oil-weathering and Transport Models for Use in the Assessment Process.

ONGOING STUDIES (Fiscal Year 1991)

Marine and Aquatic Resources

Living Resources:

- 1) Fisheries Oceanography in areas of Gas and 011 Development Activities in the Arctic: Offshore Chukchi Sea and coastal Beaufort Sea,
- 2) Coastal Fisheries Oceanography of the southern Bering Sea and north Aleutian Basin: Port Moller King Crab and Port Moller Pacific Herring,
- 3) Potential Impacts of Human Activities on Feeding Behavior, Energetics, and Habitats of Moltling Pacific Black Brant in the Teshekpuk Lake Special Area, Alaska,
- 4) Delineation, Faunal Composition, and Repeated Use of Benthic-feeding Areas by Walrus and Endangered Gray Whales in the northeastern Chukchi Sea.

Living Resources (Marine Mammals):

- 1) Use of Satellite Tags to Determine Pelagic Areas Important to Declining Populations of Fur Seals,
- 2) Development of Guidelines for OCS Operations in Polar Bear Habitats.

Endangered Species:

- 1) Effects of Production Activities on Arctic Whales,
- 2) Stable Isotope Analysis of Bowhead Whale Foods and Tissues,
- 3) Comparison of Behavior of Bowhead Whales of the Davis Strait and western Arctic Stocks,
- 4) Application of Satellite Tagging Methods to Large Cetacean Tracking,
- 5) Monitoring the Distribution of Chukchi Whales,
- 6) Baseline Method to Evaluate Chemo-biological Interactions involving Cetacea,
- 7) Bowhead Whale Book.

Federal Arctic Research Information Workshop

Environmental Monitoring:

- 1) Monitoring and Evaluating Effects on Seabird Colonies in Potential Gas and Oil Development Areas,
- 2) Acquisition and Curation of Alaskan Marine Mammal Tissues for Determining Levels of Contaminants Associated with Offshore Gas and Oil Development,
- 3) Monitoring Hydrocarbons and Trace Metals in Beaufort Sea Sediments and Organisms,
- 4) Monitoring Beaufort Sea Waterfowl and Marine Birds/Determining Use of Kasegaluk Lagoon by Marine Birds and Mammals,
- 5) Monitoring the Distribution of Chukchi Whales,
- 6) MMS Bowhead Whale Aerial Survey Project (Beaufort Sea).

Oceans and Atmosphere

Pollutant Transport/Physical Oceanography:

- 1) Circulation and Cross-shelf Transport and Exchange along the Bering Sea Continental-shelf Edge ,
- 2) Circulation and Trajectory Model.

Mapping and Data Management:

- 1) Remote Sensing, Data Acquisition and Analysis,
- 2) Environmental Data Support,
- 3) Alaskan Logistics Support,
- 4) Information-update Meetings and Report Publication.

Interagency Coordination of Federal Research

interagency Agreements:

- 1) NOAA Outer Continental Shelf Environmental Assessment Program,
- 2) National Marine Fisheries Service,
- 3) Fish and Wildlife Service

PLANNED STUDIES FOR FISCAL YEAR 1992 (New Starts)

- 1) Remote-sensing Data Acquisition and Analysis,

- 2) Update-study: Physical Processes and Ecological Characterization of Alaska OCS Areas Needing Information,
- 3) Revision of the Alaska OCS Oil-weathering Model,
- 4) Model Verification: Site-specific Interaction of Acoustic Stimuli,
- 5) Potential Influence of Environmental and Industrial Factors on Bowhead Whale Hunting,
- 6) Importance of Leads to Bowhead Whales.

ALASKA OCS REGION - GEOLOGICAL STUDIES IN THE FEDERAL ARCTIC

Presented by: Roger Klepinger

The Minerals Management Service (MMS) manages the exploration and development of mineral resources on Federal Outer Continental Shelf (OCS) lands. MMS efforts are largely focused on offshore oil and gas exploration and development, but MMS also has the authority to lease OCS lands for ocean mining of hard minerals. The Resource Evaluation office for MMS in Alaska conducts various geologic studies, the work on which is driven by the lease sale process. These geologic studies are conducted by the Resource Evaluation office to assess the mineral potential of the OCS. Resource Evaluation is also responsible for assuring the receipt of a fair and equitable return on OCS lands leased for exploration of resources.

The Alaska MMS office has a large data base of seismic information available for use in mapping and assessing the OCS oil and gas potential. As an example of the data base available, MMS has, in the Chukchi Sea Planning Area, 87,000 line miles of common depth point (CDP) data, and 48,000 line miles in the Beaufort Sea Planning Area. This Alaskan OCS data base is used for geological mapping, preparation of geologic reports, and resource assessment. Copies of the MMS geologic reports for the Chukchi, Beaufort, and Bering Sea planning areas can be acquired from the MMS library.

In the autumn of 1986, the MMS and the U.S. Geological Survey (USGS) jointly launched a national inventory of oil and gas resources. The USGS evaluated the resource potential of onshore areas and State of Alaska waters extending three miles from shore, The MMS was responsible for a similar assessment of offshore areas extending from the 3-mile limit to approximately 200 nautical miles seaward to include the OCS Exclusive Economic Zone (EEZ). Personnel from both agencies met in 1986 and 1987 to review and coordinate the geologic interpretations supporting the assessment. The results of the joint MMS/USGS efforts were published in the report 'Estimates of Undiscovered Conventional Oil and Gas Resources in the United States - A Part of the Nation's Energy Endowment.' A further review and update was conducted by the MMS in 1989 for the January 1990 update. Results of the MMS January 1990 update have not been published, but the resource estimates (shown below) were released in an MMS Focus paper (Table 1).

Future anticipated geological studies include updating the Chukchi Sea and the Beaufort Sea Geological Reports, preparation of a Hope Basin Geologic Report, and other source rock and hydrocarbon generation studies on the Arctic OCS. Also, we were planning for another joint national assessment with the USGS similar to the one begun in 1986. We anticipate a larger

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Table 1. Estimates of undiscovered economically recoverable oil and gas resources in the Alaska OCS Region as of January 1990.

| Planning Area | Conditional Oil (BBO) | | | Conditional Gas (TCF) | | | MP _{hc} * | Risked Mean Oil (BBO) | Risked Mean Gas (TCF) |
|--|-----------------------|-------------|-------------|-----------------------|-------------|-------------|--------------------|-----------------------|-----------------------|
| | 95% Case | Mean Case | 5% Case | 95% Case | Mean Case | 5% Case | | | |
| Arctic Subregion | | | | | | | | | |
| Beaufort Sea | 0.58 | 1.66 | 4.69 | 0.00 | 0.00 | 0.00 | 0.23 | 0.38 | 0.00 |
| Chukchi Sea | 1.19 | 5.96 | 13.10 | 0.00 | 0.00 | 0.00 | 0.23 | 1.36 | 0.00 |
| Hope Basin | 0.20 | 0.50 | 1.44 | 0.00 | 0.00 | 0.00 | <0.01 | Negl | 0.00 |
| Bering Sea subregion | | | | | | | | | |
| Norton Basin | N/A | 0.58 | N/A | 0.00 | 0.00 | 0.00 | 0.01 | Negl | 0.00 |
| Navarin Basin | 0.17 | 1.14 | 4.95 | 0.00 | 0.00 | 0.00 | 0.03 | 0.03 | 0.00 |
| St. George Basin | 0.17 | 0.39 | 0.91 | 0.00 | 0.00 | 0.00 | 0.02 | 0.01 | 0.00 |
| North Aleutian Basin | 0.17 | 0.61 | 2.08 | 0.00 | 0.00 | 0.00 | 0.02 | 0.01 | 0.00 |
| Gulf of Alaska Subregion | | | | | | | | | |
| Shumagin | 0.12 | 0.28 | 0.57 | 0.00 | 0.00 | 0.00 | 0.01 | Negl | 0.00 |
| Kodiak | 0.11 | 0.43 | 0.95 | 0.00 | 0.00 | 0.00 | 0.03 | 0.01 | 0.00 |
| Gulf of Alaska | 0.18 | 0.98 | 2.32 | 0.00 | 0.00 | 0.00 | 0.04 | 0.04 | 0.00 |
| Cook Inlet | 0.14 | 0.17 | 0.26 | 0.00 | 0.00 | 0.00 | 0.01 | Negl | 0.00 |
| TOTAL - Alaska Region | 2.51 | 5.01 | 8.69 | 0.00 | 0.00 | 0.00 | 0.37 | 1.87 | 0.00 |
| <p>* The marginal probability of hydrocarbons. The probability that economically recoverable hydrocarbons exist in the area under study. NOTE: Natural gas is currently considered to be uneconomic in all Alaska planning areas. Estimated resources for St. Matthew Hall, Aleutian Basin, Bowers Basin, and Aleutian Arc are negligible. ABBREVIATIONS: BBO-billion barrels of oil; TCF-trillion cubic feet; Negl-negligible; N/A not available due to insufficient number of data points.</p> | | | | | | | | | |

effort on the next national assessment with more involvement early on with the Association of State Geologists, the National Academy of Sciences, and others for input and suggestions as we step through the process. We plan to complete this new assessment in early 1994.

ALASKA OCS REGION - SOCIAL AND ECONOMIC STUDIES UNIT

Presented by: Don Callaway

The National Environmental Policy Act of 1969 and the Outer Continental Shelf (OCS) Lands Act as amended in 1978 mandate that the Federal Government consider the effects of major federal actions on the human environment. Prior to offshore leasing, an Environmental Impact Statement (EIS) describing the environment and the effects of the proposed lease sale must be prepared. Following the lease sale, monitoring of the environment to assess significant changes must be conducted. To meet the above requirements with respect to the human environment, the Minerals Management Service (MMS) established the Social and Economics Studies Unit (SESU) within the Environmental Studies Program (ESP).

Since 1977 SESU has contracted research in all regions of Alaska and has produced over 150 technical reports that describe and analyze the economic, social and cultural environment. In the two year period 1989- 1990, SESU has published 17 reports. The unit has about a dozen current contracts and plans to procure a large four year survey research effort this fiscal year. SESU employs four general research methodologies in its research contracts:

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1. Modeling and Econometric Analysis:

Often “econometric” and ‘accounting’ models are established to predict employment and population changes for a given deployment scenario,

2. Case Studies:

They provide a great deal of contextual data that can be obtained in no other way:

- a. long term presence in community provides an in depth understanding and in many cases controls for problems such as informant reactivity.
- b. provides a basis to understand the “holistic experience’ against which future judgments and assertions can be tempered.

3. Institution Profile Analysis and **Analysis** of Secondary Source Materials

In approach essentially a compromise between ethnography and survey research:

- a. involves short term visits to communities and interviews with key informants, informants almost exclusively in administrative, service delivery or political positions.
- b. analysis is heavily dependent on secondary source economic and demographic data.

4. Survey Research:

Uses detailed questionnaires and formal sampling techniques to obtain representative and valid local and regional information.

These methodologies are not mutually exclusive and some of the larger contracts employ two or three of these approaches. Using this typology the following is a list of currently completed reports, ongoing research and research proposed for the current fiscal year.

TECHNICAL PUBLICATIONS BY RESEARCH CATEGORY
JANUARY 1989 TO DECEMBER 1990

| Report No. | Title | Published |
|-----------------------------|--|-----------|
| <u>Modeling/Econometric</u> | | |
| TR-134 | Economic and Demographic Systems Analysis - Gulf of Alaska/Cook Inlet Sale 114. ISER (Ail/PB 90-226945/AS) (MMS 89-0076) | 8/89 |
| TR-138 | The Commercial Fishing Industry of the Bering Sea. Northern Economics (AI 5/PB91-121 103/AS) (MMS 90-0026) | 5/90 |
| TR-143 | Alaska Statewide and Regional Economic Systems: Effects of OCS Exploration and Development, 1990. ISER. (A09/PB91-12111 1) (MMS 90-0065) | 9/90 |
| TR-144 | Economic and Demographic Systems Analysis Nome, Alaska. ISER. (A03/PB91-121 129) (MMS 90-0068) | 9/90 |

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| | | |
|--------|--|-------|
| TR-145 | Economic and Demographic Systems Analysis: Unalaska and Cold Bay, Alaska. ISER. (A04/PB91-121 137) (MMS 90-0069) | 9/90 |
| TR-146 | Economic Impacts of the S.S. Glacier Bay Oil Spill. Northern Economics. (MMS 90-0081) | 12/90 |

Case Studies

| | | |
|---------|---|------|
| TR-132 | Village Economics in Rural Alaska. Impact Assessment Inc. (A15/PB 89-189799/AS) (MMS 88-0079) | 1/89 |
| TR-I 39 | Point Lay Case Study. Impact Assessment, Inc. (A99/Pb 90-26937/AS) (MMS 89-0093) | 3/90 |
| TR-I 40 | Point Lay Biographies. Impact Assessment, Inc. (A08/PB 90-227091/AS) (MMS 89-0094) | 3/90 |

Institutional Profile Analysis/Secondary Source Analysis

| | | |
|---------|--|------|
| TR-130 | Kotzebue Sociocultural Monitoring Study. Kevin Waring Associates. (A17/PB 89-189807/AS) (MMS 88-0077) | 1/89 |
| TR-131 | Nome Sociocultural Monitoring Study. Kevin Waring Associates. (A17/PB 90-227109/AS) (MMS 88-0078) | 3/89 |
| TR-137 | Demographic and Employment Analysis of Selected and Vols. 1, II, and III Alaska Rural Communities. Kevin Waring Associates. (E99/PB 90-165887) (MMS 89-0083) | 9/89 |
| TR-I 41 | Northern Institutional Profiles Analysis - Chukchi Sea. Impact Assessment, Inc. (A99/PB91-10551 O/AS) (MMS 90-0022) | 5/90 |
| TR-142 | Northern Institutional Profiles Analysis - Beaufort Sea, Impact Assessment, Inc. (A99/PB91-105403) (MMS 90-0023) | 5/90 |

| | | |
|------------|-------|-----------|
| Report No. | Title | Published |
|------------|-------|-----------|

Survey Research

| | | |
|--------|---|--------|
| TR-133 | North Slope Subsistence Study - Barrow 1987. Stephen R. Braund and Associates. (A06/PB91-1 05569) (MMS 80-0080) | 1 2/88 |
| TR-135 | North Slope Subsistence Study - Barrow 1988. Stephen R. Braund and Associates. (A10/PB91-1 05429/AS) (MMS 89-0077) | 12/89 |
| TR-136 | North Slope Subsistence Study - Wainwright 1988. Stephen R. Braund and Associates. (A07/PB91-1 05437) (MMS 89-0078) | 12/89 |

TECHNOLOGY ASSESSMENT AND RESEARCH (TAR) BRANCH

ARCTIC OIL SPILL RESPONSE RESEARCH

Presented by: Tom Murrell

The Minerals Management Service (MMS) has sponsored numerous Arctic oil spill response research projects since 1978. The MMS was formed in 1982 and prior work was done by the Conservation Division located at the U.S. Geological Survey. In 1979, it was recognized that a cold-weather test facility was needed for testing oil spill response equipment and techniques,

Although by 1980 over 300 devices had been tested at the Environmental Protection Agency (EPA) Oil and Hazardous Material Simulated Environmental Test Tank (OHMSETT) wave tank test facility, none of these devices were actually tested in ice. Some cold weather work began at OHMSETT in the early winter of 1980 with the evaluation of the AMOP boom. This was one of the first boom performance evaluations in the tank. This project resulted in a standard tank test protocol.

A cold weather test of the U.S. Navy's MARCO Class oil spill skimmer was conducted at OHMSETT in 1981. Particular attention was given to modifications of the skimming vessel to optimize recovery of heavy and highly viscous oils in near-freezing and subfreezing temperatures.

MMS in 1981, then the Conservation Division, supported the "hardening" of the OHMSETT facility so that more extensive tests could be conducted in cold weather and in ice. However, complete "hardening" of the OHMSETT facility was not completed until 1983-1984.

The winter of 1983 marked the first full winter test season at OHMSETT. During that winter, a test of the Oil Mop Pollution Control, Ltd. prototype Arctic skimmer was conducted in a range of broken ice concentrations.

In situ burning of oil in ice also began in 1983. *In situ* burning experiments were conducted in 1986 in a 42 square meter burn area in the tank. Ice concentrations were 60 to 75%. Oil removal by burning ranged from 65 to 75% as long as the oil had not become emulsified.

Also, in 1986, an innovative high-speed water jet developed by Environment Canada was evaluated at OHMSETT. This particular system, used to herd oil into a skimmer, holds promise for use in open and light ice conditions. The OHMSETT facility was closed in 1988.

MMS sponsored the Alaska Arctic Offshore Oil Spill Response Technology Workshop in November - December 1988. This was a comprehensive workshop on the state-of-the-art in oil spill response under arctic conditions. Since then, MMS continues an active oil spill response program in conjunction with Environment Canada, the U.S. Coast Guard, the Environmental Protection Agency, the American Petroleum Institute and other agencies and institutions.

TAR Arctic Oil Spill Response Research

The MMS is involved in a number of research projects that are related to arctic conditions,

Department of Interior - Minerals Management Service

Reactivate and Conduct Research at the OHMSETT Test Facility at Leonardo, New Jersey

The only spill response test facility in the United States was closed by the Environmental Protection Agency in 1987-1988. The MMS and Canada jointly sought a replacement facility in Canada. The results indicated that three Canadian test tanks were available to accommodate specific test programs, but none had the capabilities of OHMSETT. Costs for conducting tests of innovative response technologies and procedures in Canada would have been substantially higher than OHMSETT because of necessary facility modifications. Tank testing is used as a full scale evaluation method before field verification is attempted. Tank testing offers an environmentally safe method for tests which otherwise would require the risk of open ocean pollution. Approximately 95% of what is known on response equipment performance has been learned at OHMSETT.

MMS, with cooperative support for the U.S. Coast Guard and Environment Canada, has initiated a major effort to refurbish and reinstate research at the OHMSETT facility. All the major systems at OHMSETT have been repaired. The repair and waterproofing of the tank will be completed by June 1991. MMS will begin operation of this facility in July-August 1991. It is intended to do cold weather testing in ice in the tank.

Optimization of an Innovative High Speed Water Jet Containment Boom for High Currents/Ice Areas

This project will optimize the design of an innovative oil containment boom for high current and ice-infested areas. The boom uses high pressure water jet sprays to herd or direct oil toward skimmers. It is in the final phase of evaluation and has proven effective under currents as high as 3.0 knots and in the presence of ice. In both of these situations, the boom has exceeded the capabilities of other existing technologies. Pump and pressure requirements to operate the high pressure water jets must be optimized and evaluated for maximum efficiency.

Evaluation of an Innovative 'Finnish Oil Skimmer' for Ice-Infested Waters

Current skimmer technology for recovering oil in broken ice conditions is practically nonexistent. However, modifications to existing skimmer systems have improved their efficiencies in cold conditions where ice is not present. This project will cooperatively evaluate the innovative "Finnish Oil Skimmer" in a range of ice conditions and with different oil types. This device makes use of proven ice-handling techniques, efficiently contacting the oils slick with minimal ice movement. The Canadian participation will be a major part of this program.

Development of a Laser-Fluoro Sensor for Detection of Oil In Ice and Open Water

No current remote sensing technology exists to detect oil in ice. The laser-fluoro sensor concept has been under evaluation in the laboratory for two years as part of the joint MMS-Canada research effort. The sensor has been successful in detecting oil in ice under laboratory conditions. Further evaluation is necessary. A 'breadboard' version of this sensor is expected to be flown in late 1991.

Quantify Pollution Trade-offs as a Result of *In situ* Oil Spill Burning

The investigation into *in situ* burning of crude oils began at full scale in 1983 at the OHMSETT facility where a variety of oils were successfully burned. The effects of oil type, water temperature, presence of ice, oil weathering, winds, and degree of emulsification on the burnability of oils were evaluated. Air pollution was subsequently investigated at an intermediate

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scale in the laboratory. Airborne pollutants were quantified and the data were used in conjunction with a sophisticated Department of Defense computer model to predict the behavior and fate of pollutants resulting from the response technique. Results indicate that 50 to 99% of the oil can be removed under open ocean conditions, assuming that the initial slick is thick enough to support combustion (at least 3mm) and that the oil is not extensively emulsified,

Pollutant concentrations will be quantified in larger burns as a preliminary step to field trial verification. Instrumentation and valid sampling protocol have been developed for the field tests. Field tests will begin in 1992.

The results of investigations so far indicate the *in-situ* burning should be considered as a primary response strategy especially in remote areas where logistics play a key role in limiting conventional response capabilities. Oil may be burned in broken ice fields, within fireproof containment booms, or if thick enough, in a unconstrained condition. Evaluation of the capabilities for burning spilled oil *in-situ* in broken ice fields will be part of this project.

Other Related Research Projects

While many of the oil spill research projects MMS is involved in are not strictly arctic research, a lot of the technology which is being developed would have applications in the arctic regions. This is especially true of our cooperative projects with Environment Canada and the U.S. Coast Guard since they both have extensive experience and responsibility in arctic areas,

Related Projects:

- Development of an airborne oil thickness sensor
- Development of nondamaging beachline cleanup techniques
- Chemical treating agent improvements: Nondispersants, Guidelines, Dispersants
- Development of a standard test protocol for offshore containment booms and skimmers
- Development of a portable oil analysis kit
- Investigation into physical behavior of oil

For further information on MMS-related research project, contact John Gregory, Chief of the TAR Branch, Minerals Management Service, 381 Elden Street, Herndon, Virginia 22070-4817.

DEPARTMENT OF INTERIOR
NATIONAL PARK SERVICE
CULTURAL RESOURCES RESEARCH - ALASKA REGION

Presented by: Ted Birkedal

INTRODUCTION

In recognition of the important role that humans have played and continue to play in Alaska's ecological systems, the National Park Service has built a strong program in the social sciences. This emphasis is also in keeping with our service-wide mission as set forth in our *Management Policies* which charges the National Park Service to "preserve and foster appreciation of the cultural resources in its custody through appropriate programs of research, treatment, protection, and interpretation." Traditionally, archeological research has always been a major component of the Service's overall research effort; but ethnographic studies are gaining increased prominence of late in the social science arena. This rising interest reflects the Service's new awareness that almost all park areas are part of the homelands of living Native Americans. The links between particular park areas and Native American groups is often strong and this is especially the case in Alaska where subsistence and other traditional uses of park lands and resources are common, everyday activities for one of the largest Native populations in North America.

ARCHEOLOGICAL RESEARCH

To make the most effective use of the available archeological dollar, the Service has increasingly emphasized comprehensive planning in deciding which types and levels of studies will yield the most beneficial results and where these studies would be most productively applied in terms of identified park needs. A primary tool in the strategic planning process is the archeological overview and assessment. This synthetic document reviews and evaluates all previous archeological research in the park and its immediate vicinity and recommends future research priorities and directions that logically emerge from the background analysis. Two park-wide overviews and assessments have been published in the past two years, the first for Yukon-Charley Rivers National Preserve and the second for Denali National Park and Preserve. A third, centering of the archeologically-famous Cape Krusenstern National Monument, will be published in late 1991. A fourth, more narrowly-focused document, is in the final stages of production for Skagway in Klondike Gold Rush National Historical Park. Historical archeological research in this turn-of-the-century entrepot to the subarctic and arctic has already generated important new data on how early industrial America managed to 'set up shop' in Alaska within an amazingly brief span of years. Work is now underway on archeological overviews and assessments for Gates of the Arctic National Park and Preserve and Noatak National Preserve and these should be completed by 1992.

Archeological inventory continues to be a dominant research activity of the Service. This stress on survey is understandable in view of the fact that less than 8% of the National Park Service's 54,000,000 acres in Alaska have been subjected to any degree of coverage by trained archeologists. The Service realizes that it cannot adequately manage, protect, or interpret the archeological resources under its charge without a more complete picture of their occurrence, type, significance, and condition. In keeping with its emphasis, a two-volume report on a two-year reconnaissance survey of Cape Krusenstern National Monument has just been published

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and a summary report on over 600 archeological sites located in the course of a four-year survey of Gates of the Arctic National Park and Preserve will soon be made available. A follow-up survey along a portion of the Killik River in Gates of the Arctic was conducted in 1990 and a draft report is now under review for eventual publication. The largest, single inventory effort centers on valid mining claims in Alaska's parks. This ongoing, multi-year survey program continues to add to an unparalleled data base on the history of mining technology and the processes by which industrial America penetrated Alaska's arctic and subarctic wilds. As a side-benefit, the work also greatly assists the National Park Service in the identification of hazardous waste materials located within its jurisdiction.

Because of its conservation mandate, the National Park Service discourages excavation except where subsurface research can clearly be shown to be of benefit to the proper management of the resource. One of the largest such studies, an intensive archeological testing program, was conducted in the Bering Land Bridge National Preserve between 1988 and 1991. The main purpose of the work was to determine the relative significance of a variety of site types that face immediate threats from wind and wave erosion. Stress was placed on a sampling strategy that would capture data that would improve our ability to establish the cultural affiliations of the sites and their chronological placement. The results, scheduled for publication in 1992, will be used to set management priorities and strategies for future mitigative action. Ancillary studies supported by the project led to a dissertation and a masters thesis on coastal geomorphological processes (University of Alaska Fairbanks). Another, more limited testing project in 1990, featured close collaboration among archeologists from Exxon Company, Chugach Alaska Native Regional Corporation, and the National Park Service. The focus of the research was a multi-component prehistoric site in Kenai Fjords National Park. The work was conducted to mitigate the potential adverse effects of oil clean-up activities. Full data recovery excavations were restricted to facility development projects in Katmai National Park and Preserve and the National Park Service headquarters tract in Kotzebue, Alaska. Both excavations revealed important habitational remains and the work in Kotzebue yielded the earliest structure yet documented in the Kotzebue vicinity.

ETHNOARCHEOLOGICAL AND ETHNOGRAPHIC RESEARCH

The Shared Beringian Heritage Program represents a new research thrust; a multi-disciplinary program focussed on bilateral US/USSR studies in ethnography, archeology, historical architecture, geology, ecology, paleogeography and wildlife biology in the Bering Strait area. This multi-phase research program has been stimulated by planning for the proposed Beringian Heritage International Park and will involve close collaboration between cultural and natural scientists in both the United States and the Soviet Union as well as Northern Native peoples from both nations. The first phase of cultural research, to begin in 1991, will initiate ethnographic and ethnoarcheological research centered on an historic village complex that is threatened by severe coastal erosion.

A more traditional National Park Service ethnographic research project is drawing to a close in northwest Alaska. The goal of this study was to produce a regional ethnography that encompasses the three adjacent park areas of Cape Krusenstern National Monument, Noatak National Preserve, and Kobuk Valley National Park. The research is being performed by a team of cultural anthropologists from the University of Alaska Fairbanks, who are under contract to the Service. This three-year project has yielded some unexpected results; the most surprising finding is the high degree of sub-regional variation that prevails in the cultural forms and practices of the region.

Department of *Interior* - National Park Service

The National Park Service has a strong service-wide commitment to ethnographic research. In the Alaska Region we plan to complete major umbrella ethnographies for all the parks within the next two decades. Smaller scale studies are also planned. In fact, we are about to publish a report by an independent ethnographic contractor on the ethnohistory and traditional place names of the Athabaskans who once lived in the Kantishna area of Denali National Park and Preserve. Moreover, as a consequence of recent court rulings which makes the federal government more responsible for subsistence management, the National Park Service is now planning for a whole new additional program of ethnographic research centered on current subsistence practice.

MAPPING AND DATA MANAGEMENT

Alaska Region is continuing development and regular updates of the Alaskan portion of the National Archeological Database (NADB). The system now contains over 5000 bibliographic records on northern archeology and is available to all legitimate users; federal, state, or private. Exxon Company archeologists were among the first users of the system. A separate park-oriented database named the Cultural Sites Inventory (CSI) is now in the final stages of development. When ready, it will allow rapid computerized access to all the National Park Service's archeological site records in Alaska. A similar automated system is now complete and under constant update for the thousands of natural and cultural specimens in the National Park Service's curatorial holdings.

The application of computerized mapping to cultural resource management is in its infancy. Nevertheless, a pilot effort has been made to add archeological site themes to other GIS environmental themes at Cape Krusenstern National Monument, Yukon-Charley Rivers National Preserve, and Lake Clark National Park and Preserve. In addition, we are now engaged in an intensive archeological mapping project of a concentrated archeological site complex located in a high development zone of Katmai National Park and Preserve. The base data, obtained from controlled aerial imagery is being translated to both AUTOCAD and GIS formats.

INTERPRETATION AND PUBLIC EDUCATION

In 1990, the National Park Service spearheaded efforts to celebrate Alaska's first "Archeology Week." This statewide program, involving cooperation among federal, state, native, local, and private agencies and groups is designed to educate the public about the importance of archeological preservation. Outreach programs to school children are a primary component of this program. The Service is also coordinating the event in 1991. In addition, the National Park Service has launched a campaign, utilizing colorful posters and brochures, to discourage archeological looting on federal lands. In addition, the National Park Service will be providing financial and technical assistance to the Smithsonian Institute for the production small-scale "Crossroads of the Continents" exhibit which will bring the story of Northern Native cultural adaptations to rural communities in both the Soviet Union and Alaska. The Smithsonian and the National Park Service have also joined forces in 1991 to put on a week-long course in archeological collections management specifically targeted for Native Alaskans. Another project, tied to the planned Beringian Heritage International Park, will involve the collaborative production of a Russian/English dictionary of archeological terminology. The dictionary should facilitate more accurate communication between U.S. and Soviet scholars working in the north.

EXTERNAL COORDINATION OF FEDERAL RESEARCH

The Archeological Assistance Program of the National Park Service is specifically charged with responsibility for undertaking leadership and coordination of the Federal archeology program in the United States. Among its many activities in this area, is the facilitation of the continued operation of the Alaska Interagency Archeological Group, which includes federal, state, and academic archeologists. The group which meets several times each year is dedicated to the coordination of Alaskan research and management activities. The Archeological Assistance Program also provides technical assistance to other federal agencies. For example, in 1989, it assisted the United States Fish and Wildlife Service with archeological and historical documentation of the World War II National Historic Landmarks in the outer Aleutian Islands. The research involved complex logistic support from the U.S. Navy and a specialized team of National Park Service underwater archeologists. A second phase of this cooperative project is planned for the summer of 1992.

The National Park Service is also working closely with the National Science Foundation to develop a peer review system for its archeological and ethnographic reports, to formulate a system that would match up academic archeologists and anthropologists with research projects in the parks, and to jointly fund projects of great importance to both agencies.

Finally, we have submitted a joint cultural/natural research proposal with the University of Alaska for the future funding of a global environmental change study in Noatak National Preserve. The study features an integrated program of cultural and ecological research.

NATURAL RESOURCES - ALASKA REGION

Presented by: Allan Lovaas

The Alaska National Interest Lands Conservation Act (ANILCA) mandates the National Park Service (NPS) to assure the continuation of geological and biological processes unimpaired by adverse human activity. It also mandates opportunities for a rich variety of recreational activity and consumptive uses, including protection of subsistence ways of life for local, rural residents. Alaska Region areas north of the Arctic Circle include Cape Krusenstern National Monument, Noatak National Preserve, Kobuk Valley National Park, Gates of the Arctic National Park and Preserve, and a portion of Bering Land Bridge National Preserve. Katmai National Park and Preserve lies at the base of, and Aniakchak National Monument and Preserve further along, the Alaska Peninsula. Major glacier systems are included in Denali National Park and Preserve, Lake Clark National Park and Preserve, Kenai Fjords National Park, Wrangell -St. Elias National Park and Preserve, and Glacier Bay National Park and Preserve; and Yukon-Charley Rivers National Preserve brackets a portion of the Yukon River. That leaves only Sitka National Historical Park and Klondike Gold Rush National Historical Park outside the roughly-defined area considered under the Arctic Research and Policy Act; but for the areas south of the Arctic Circle only projects appropriate to the Act are included here.

Because of the small NPS research staff, most projects are cooperative with others, primarily the Alaska Department of Fish and Game (ADF&G), U.S. Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), US. Forest Service (FS), US. Geological Survey (USGS), the University of Alaska (UA), other universities, conservation organizations and private

firms. While we hope to greatly increase our staffing and funding, we anticipate that our program will always depend upon cooperation with others.

In addition to NPS funded research, we encourage use of our areas by independently-funded scientists for environmentally-compatible projects. Some areas, notably Noatak, were established partly to provide opportunities for scientific research.

In order to fulfill ANILCA's mandate, NPS natural resources investigations generally can be classified into three overlapping categories:

1. Research to obtain baseline data about biological and geological resources and processes. These include resource inventories, and basic studies of biology and geology.
2. Monitoring for detection and measurement of changes in resources and processes over time. The many small scale monitoring projects carried out at park level are not included here.
3. Research to determine and evaluate causes of changes, ascertain whether they are natural or anthropogenic, and to provide information for management actions to stop or mitigate undesirable changes or repair their impacts.

MARINE AND AQUATIC RESOURCES

Baseline Projects Completed:

1) Lake fish and their utilization at Gates of the Arctic, with USFWS; 2) the limnology of Surprise Lake in the Aniakchak Caldera, with the Oregon State University Cooperative Park Studies Unit (CPSU); 3) salmon and resident fish and their habitat at Yukon-Charley Rivers, with USFWS; 4) rainbow trout at Lake Clark, with USFWS and ADF&G.

Baseline Projects in Progress:

1) Water resources at Noatak; and Katmai, with USFWS; 2) coastal inventory and monitoring related to the Exxon oil spill at Kenai Fjords and Katmai.

Baseline Projects to Start In FY 1991 or 1992:

1) Coastal resources inventory at Cape Krusenstern; 2) water resources at Gates of the Arctic, with USFWS; 3) river ecology and use at Noatak and Kobuk Valley; 4) fish genetics at Noatak, with ADF&G.

Evaluation of Change Projects Completed:

1) Issues and concerns relative to northern Pacific salmonid enhancement with special reference to the hatchery on the Noatak River, with Arctic Environmental Information and Data Center (UA).

Evaluation of Change Projects to start In FY 1991:

1) Effects of jet boats on salmon and trout egg and fry survival at Katmai and Lake Clark, with USFWS.

TERRESTRIAL BIOLOGY AND ECOLOGY

Baseline Projects in Progress:

1) Predator/prey (wolves, caribou, moose, bear) at Denali, with USFWS; 2) wolves at Gates of the Arctic and Noatak, with ADF&G; 3) caribou at Wrangell-St. Elias, with ADF&G; 4) bears at Noatak, with ADF&G; 5) muskox at Gates of the Arctic, with USFWS; at Bering Land Bridge, with ADF&G; 6) golden eagles at Denali; 7) vegetation inventory at Bering Land Bridge; 8) steppe vegetation at Yukon-Charley Rivers; 9) Dali sheep at Denali, with UA.

Baseline Projects to Start in FY 1991 or 1992:

1) Moose census at Bering Land Bridge, with ADF&G; 2) lynx at Wrangell-St. Elias, with USFWS and ADF&G; 3) lichens at Noatak; 4) vegetation succession at Kenai Fjords, with UA; 5) fire history at Wrangell-St. Elias; 6) wetlands inventory at Yukon-Charley Rivers, with USFWS; 7) bear at Bering Land Bridge, with ADF&G.

Monitoring Projects in Progress:

1) Methodology of Dan sheep censusing at Wrangell-St. Elias, with University of Wyoming, and ADF&G; 2) Dan sheep survey at Yukon-Charley Rivers; 3) vegetation at Katmai; and Glacier Bay, with UA.

Monitoring Projects to Start in FY 1991 or 1992:

1) Methodology of furbearer surveying at Wrangell-St. Elias, with ADF&G, 2) mountain goats at Kenai Fjords.

Evacuation of Change Projects Ongoing:

1) Relationships of bears to the Red Dog Mine at Noatak, with ADF&G; 2) bears/visitors at Katmai; 3) bears/hunting at Aniakchak, with ADF&G and USFWS; 4) merlins/pesticides at Denali, with USFWS; 5) wildlife/road use at Denali; 6) reindeer herding at Bering land Bridge; 7) furbearers/trapping at Gates of the Arctic, with ADF&G; 8) visitor use at Glacier Bay, Denali and Kenai Fjords, with University of Idaho CPSU; 9) fire/wildlife in northwest Alaska, with USFWS.

Evacuation of Change Projects to start in FY 1991 or 1992:

1) Fire/wildlife in Interior Alaska, with USFWS, ADF&G and others; 2) global climate change at Noatak, Bering Land Bridge and Cape Krusenstern, with UA and others; 3) reindeer range evaluation at Bering Land Bridge, with USFWS and UA.

OCEANS AND ATMOSPHERE

Denali, with a Clean Air Act Designation of Class 1, has an Interagency Monitoring of the Protected Environments (IMPROVE) air quality sampling station. The station also serves as an NPS Long-term Trend Site. Visibility is evaluated qualitatively and quantitatively by automatic 35mm cameras. Ozone is averaged hourly, sulphur dioxide concentrations and fine particulate twice weekly, for 24-hour periods. Meteorological data are obtained.

At six areas (Northwest Alaska Group, Bering Land Bridge, Gates of the Arctic, Yukon-Charley Rivers, Wrangell-St. Elias, and Katmai) fine particulate sampling is carried out in cooperation with the University of California at Davis. The purpose is to determine causes of visibility reduction by measuring concentrations of and establishing baselines for airborne particles. Measurements of 24-hour duration are taken twice weekly.

CRYOSPHERE

Completed:

Glacier Workshop, Anchorage, February 5-7, 1991, co-sponsored with USGS, Cold Regions Research and Engineering Laboratory (CRREL), the Geophysical Institute (UA), and others.

Ongoing:

Glacier monitoring at Wrangell-St. Elias, with UA; at Lake Clark, with CRREL.

FY 1992 starts:

Glacier monitoring at several parks following methods determined at the Glacier Workshop.

MAPPING AND DATA MANAGEMENT

The Alaska Regional Office has a geographic information system (GIS). Efforts are focused on building data bases for the field areas. Land cover classifications developed from satellite imagery are in progress slope, aspect and elevation layers are available for every park exceeding 20,000 acres; boundary maps are available for all parks, as are maps of wilderness areas. Many incidental themes have been digitized for individual areas, including such things as wildlife sightings, land status, hydrology, glaciers, etc. Eventually a GIS capability should be developed within each large park area.

EXTERNAL COORDINATION OF FEDERAL RESEARCH

Many instances of NPS cooperation are indicated above. Two additional cooperative efforts of note are: 1) USSR: NPS and Alaska Region are involved in the Beringean Heritage International Park, which will include Bering Land Bridge on the US side with a like area in USSR; 2) Man and the Biosphere (MAB): specifically the High Latitudes Directorate, with all circumpolar nations, Possibly the Noatak Biosphere Reserve will be paired with a similar area in USSR.

DEPARTMENT OF INTERIOR
OFFICE OF ENVIRONMENTAL AFFAIRS
OIL POLLUTION ACT OF 1990, SECTION 8302:
IMPACT OF POTENTIAL CRUDE OIL SPILLS IN THE ARCTIC OCEAN
ON ALASKAN NATIVES

Presented by: Pamela Ann Bergmann

Section 6302 of the Oil Pollution Act of 1990 (OPA 1990) recognizes that potential sources of oil pollution in the Beaufort and Chukchi Seas include transshipment of Canadian oil via tankers, and exploration, development, production, and transportation activities on Outer Continental Shelf lease areas. The OPA 1990 recognizes that the Beaufort and Chukchi Seas are important to Alaska Natives for subsistence resources, and that an oil spill, if not properly contained and removed, could significantly affect those resources.

The legislation directed the Secretary of the Interior, in consultation with the Governor of Alaska, to conduct a study of the issues of the recovery of damages, contingency plans, and coordinated actions in the event of an oil spill in the Arctic Ocean. The legislation further directed the Secretary of State, in consultation with the Secretary of the Interior, the Secretary of Transportation, and the Governor of Alaska, to then begin negotiations with the Foreign Minister of Canada regarding a treaty dealing with issues associated with the recovery of damages, contingency plans, and coordinated actions in the event of an oil spill in the Arctic Ocean.

The subject report, which is based on existing information, will summarize Alaska Native concerns regarding oil spills, oil-spill cleanup activities, and recovery of damages from oil spills in the Beaufort and Chukchi Seas. The study area is defined as the Canadian and American Beaufort Seas and the Chukchi Sea, and Alaskan Native communities in the North Slope Borough, the Northwest Arctic Borough, and the unincorporated area south of the Northwest Arctic Borough to, and including, Cape Prince of Wales.

The report summarizes the following information: 1) characteristics of the study area's natural and physical environment that are important considerations in oil-spill-contingency planning and oil-spill responses; 2) location and population of Alaskan Native communities in the study area, the subsistence species harvested by study-area residents, the importance of those subsistence resources to the residents, and relevant subsistence laws; 3) existing and planned exploration, development, production, and transportation activities, facilities, and vessels in the study area; 4) environmental evaluation processes for proposed crude-oil exploration, development, production and transportation activities, facilities, and vessels 5) public-sector oil-spill-prevention regulations; 6) existing international, bilateral, national, state, and local contingency plans/coordinated actions related to crude-oil activities, facilities, and vessels in the study area; 7) public- and private-sector oil-spill-contingency-plan requirements; 8) private-sector contingency plans for study area crude-oil activities and facilities; 9) existing Canadian and U.S. oil-spill-response organizations with primary responsibility for responding to an oil spill in the study area; 10) response actions based on four generalized oil-spill scenarios; 11) existing and planned research on oil-spill-prevention and response technologies for the Arctic; and 12) the international, Canadian and U.S. National, and State of Alaska legal regimes that may be available to Alaskan Natives to recover damages for injuries related to the loss use of subsistence resources in the study area arising from an oil-pollution incident. The report then identifies issues and findings related to contingency plans/coordinated actions and the recovery

of damages. Information in the report has been obtained from federal agency representatives in the United States and Canada in addition to state and local agency representatives in Alaska and representatives of Native people in the study area.

Opportunities for public input are being provided in three ways. First, comments on, and information for, the proposed report were requested through a Notice in the November 26, 1990, Federal Register. Second, informational meetings were held in Barrow, Kotzebue, and Shismaref for interested Native representatives. Third, copies of the draft report will be made available to all interested persons. It is anticipated that the draft will be available for public review in July 1991.

**DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
INVOLVEMENT IN ARCTIC/ALASKA RESEARCH**

Presented by: Jawed Hameedi

Rural Transportation Technology Program

This program provides matching funding to state and local government, road personnel (e.g., culvert inspection manual)

Highway Planning and Research (HPR) Funds

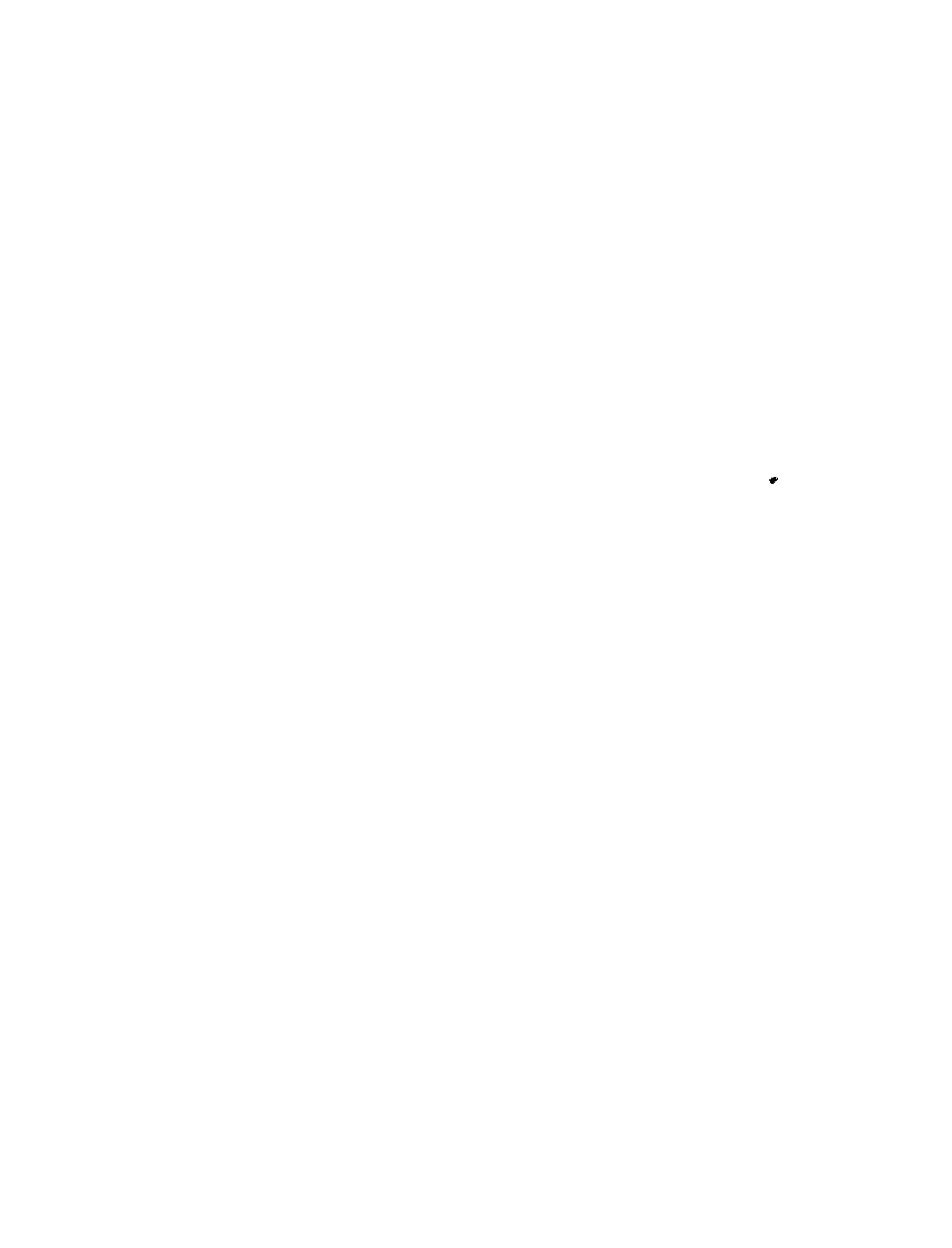
These funds provide for:

- 1) Monitoring of highway deterioration and
- 2) Research on
 - a) Utilization of air ducts to retard melting of permafrost
 - b) Geotextile application (e.g., polypropylene materials, "petromat," etc.) to retard pavement deterioration.

Cooperative funding of stream gaging (State, USGS)

Funding of studies of **grayling** passage through highway culverts during spawning season (State)

Global Positioning Satellite (GPS) is used to locate and install geodetic monuments along the Alaska highway system and at selected airports.



ENVIRONMENTAL PROTECTION AGENCY
CONTAMINATION OF U. S. ARCTIC ECOSYSTEMS BY
LONG-RANGE TRANSPORT OF Atmospheric CONTAMINANTS'

Presented by: Dixon H. Landers

Various kinds of atmospheric pollutants are found in Arctic environments, including organic contaminants, radionuclides, and pollutants associated with fossil fuel combustion, smelting, and industrial development. While some of these contaminants originate in the Arctic itself, most are likely a result of long-range transport from lower latitudes. Recent studies suggest that at least some atmospheric contaminants may be susceptible to poleward redistribution, sequestration, and accumulation as a result of their physical and chemical properties. Thus, contamination of the Arctic may be exacerbated by the tendency of selected contaminants produced at lower latitudes to be transported to polar regions and incorporated into high-latitude food chains.

Although awareness of exotic contaminants in high-latitude food chains is not new, international and regional baseline data are needed to document the magnitude, distribution, and ecosystem effects of this potentially serious global (hemispheric) problem. The United States has given little attention to Arctic studies relative to several other circumpolar nations (e.g., Canada, Sweden). The U.S. Environmental Protection Agency (USEPA) is currently designing regional-scale studies to complement existing site-specific studies and reduce this information gap in the U.S. Arctic. A major focus of this activity will be to ensure compatibility with international studies of Arctic contamination as well as with the USEPA's Environmental Monitoring and Assessment Program (EMAP).

Background

In recent years, there has been an increasing appreciation of the need to know more about arctic environments, both because of their environmental sensitivity, highlighted by their role in global warming scenarios, and because of their potential strategic and economic importance. In the international arena, there are currently several forums for discussion of strategies for protection of the Arctic, including the US/USSR Agreement of Cooperation in the Field of Environmental Protection, in which 6 of 11 technical areas focus significant research on the Arctic (IARPC 1990a), and the eight-nation Consultative Meetings on the Protection of the Arctic (IARPC 1990b).

One aspect of concern is the potential impact of pollutant loadings on arctic food webs. The presence of various contaminants in arctic food chains has been known for over 15 years (Salo and Miettinen 1964, Hanson et al. 1976, Cade et al. 1971, Addison and Smith 1974, Bowes and Jonkel 1975). In contrast to the situation in Canada and the Nordic countries (Wong 1985a, Monitor 1987), however, comparatively little is known about the U.S. Arctic. In part, this may be because the U.S. Arctic occurs entirely within the state of Alaska, which until recently has often been perceived as being conceptually, as well as spatially, removed from mainstream interests of the 'Lower 48.'

¹ Presented at the International Conference on the Role of the Polar Regions in Global Changes, June 11-15, 1990, Fairbanks, Alaska, by Jesse Ford and Dixon Landers (EPA Environmental Research Laboratory, 200 SW 35th St., Corvallis, OR 97333).

Traditionally, the magnitude of food web contamination in the North American Arctic has been assumed to be small relative to more southerly environments. This scenario seems reasonable because in North America most of the larger population centers are located far south of the Arctic Circle, and there is only minor industrialization of the North American Arctic. Thus, the position of the Arctic air mass in North America typically does not intersect likely source regions for atmospheric anthropogenic pollutants (Shaw and Kahlil 1989). This situation is in contrast to Eurasia, where population and industrial centers are generally located 5° to 10° farther north and the polar air masses have lobes that extend farther to the south (Shaw and Kahlil 1989).

Recent work with marine food webs suggests that both the magnitude and the extent of contamination of the North American Arctic may be greater than previously thought (Muir et al. 1988, Norstrom et al. 1988, Bidleman et al. 1989). Less information is available for terrestrial ecosystems of North America (Wong 1985a), with the possible exception of game birds (Wong 1985b). Although there is historical evidence for food chain contamination by both DDT (Cade et al. 1971) and radionuclides (Hanson et al. 1967) there is virtually no recent published information for inland Arctic ecosystems of the United States. The USEPA has therefore initiated a series of research activities that focus on contamination of inland Arctic food chains. This work will focus on terrestrial and inland freshwater ecosystems, with an emphasis on gathering regional scale data on the distribution and potential ecological effects of toxic contaminants.

Potential Sources of Arctic Contamination

Although industrial development in the North American Arctic is minimal, it is now recognized that the concentrations of pollutants in winter air masses even in towns as small as Fairbanks, Alaska can equal or exceed concentrations from temperate latitude cities by two orders of magnitude (Benson 1986). This is due primarily to strong and persistent diurnal surface inversions over snow surfaces (Benson 1986). In addition, sources remote from the Arctic can also be of considerable importance, both from long-range atmospheric transport, and (for marine systems) inflowing Pacific water from the Bering Sea (Hargrave et al. 1989). Riverine inputs may also become important in watersheds large enough to integrate substantial indirect inputs via atmospheric deposition (Hargrave et al. 1989).

Extensive research has been conducted on long-range atmospheric transport, mostly with respect to the phenomenon of arctic haze. Arctic haze is a generic term for spatially well-defined, pollutant-laden aerosols of widespread polar distribution during late winter and early spring (Barrie 1986, Stonehouse 1986, Shaw and Khalil 1989). Haze development is thought to be fed both by episodic injection of a broad spectrum of anthropogenic contaminants from warmer air masses to the south (Rahn and Lowenthal 1984, Lowenthal and Rahn 1985, Barrie 1986), and by direct emissions to the polar airmass within the industrialized Arctic. The pollutant content of Arctic hazes increases throughout the long, dark polar winter, primarily due to lack of removal processes (Barrie 1986). Concentrations peak around April and then nearly disappear throughout the Arctic basin in summer (Shaw and Kahlil 1989). Little is known about the processes involved in the transition from polluted winter air to cleaner summer air (Shaw and Kahlil 1989). One possibility is that late spring atmospheric warming and associated air turbulence may increase rates of direct and indirect deposition, providing a pathway for transfer of contaminants to snow-covered terrestrial and marine landscapes.

It has recently been determined that specific 'brown snow' events appear to be related to a second source of long-range atmospheric transport (Welch et al. 1991). The fine particulates

associated with these events are rich in semivolatile organic pollutants and are believed to originate at least in part in Asia (Welch et al. 1991).

Current Status of USEPA Research on Contamination of Arctic Ecosystems by Long-range Atmospheric Transport

Research by the EPA on the potential ecosystem consequences of Arctic contamination by long-range atmospheric transport began in early 1990. A small workshop of U.S. and Canadian experts with longstanding research experience in one or more aspects of this problem was convened to help identify and prioritize contaminants of concern and the types of environmental samples that could be used as passive 'collectors' of atmospheric disposition. The workshop proceedings have been summarized by Nash (in press), and recommendations from the workshop have guided development of research efforts to date.

The primary goals of our current pilot work are to 1) investigate the technical and logistic constraints affecting the use of various recommended types of environmental samples (lichens, mosses, lake sediments, snow) in the U.S. Arctic and 2) provide preliminary information on contaminant levels in the U.S. Arctic.

Pilot field work initiated during the 1990 field season examined the use of lichens and mosses as passive collectors of atmospheric deposition. Lichen and moss taxa likely to be widely distributed across a variety of habitats in the U.S. Arctic were identified and sampled at 21 locations across the northern foothills of the Brooks Range (Figure 1).

The Arctic foothills were chosen as the primary locus for 1990 study sites, because removal processes from polluted air masses may be accelerated as arctic haze encounters vertical obstruction, such as mountain ranges, during periods of southward flow (Shaw 1990),

Sixteen initial target taxa were selected for study, based on several criteria:

- Broad circumpolar distribution
- Likely frequent occurrence and high abundance in the study area of interest
- Ease of identification (ideally, eliminating the need for using chemical tests and dissecting or compound microscopes in the field)
- Representation of a range of growth forms that may influence scavenging efficiency and/or retention
- Representation in other similar studies worldwide

Of the taxa originally identified, 10 were collected for analysis at one or more sites and four (two mosses: *Hylocomium splendens* and *Racomitrium lanuginosum*, and two lichens: *Cetraria cucullata* and *Masonahlea richarsonii*) were studied in detail.

Sampling, storage, and handling techniques appropriate to the extremely remote nature of the collection sites were devised and tested. Samples are currently being analyzed for a suite of heavy metals, trace elements, and organochlorines by the USEPA's Environmental Monitoring and Systems Laboratory in Cincinnati, Ohio. Selected samples are also being analyzed for radionuclides. Findings from this laboratory work may influence the selection of target species taxa for contaminant monitoring. Results from this pilot study will be reported in the open literature upon completion of the analyses.

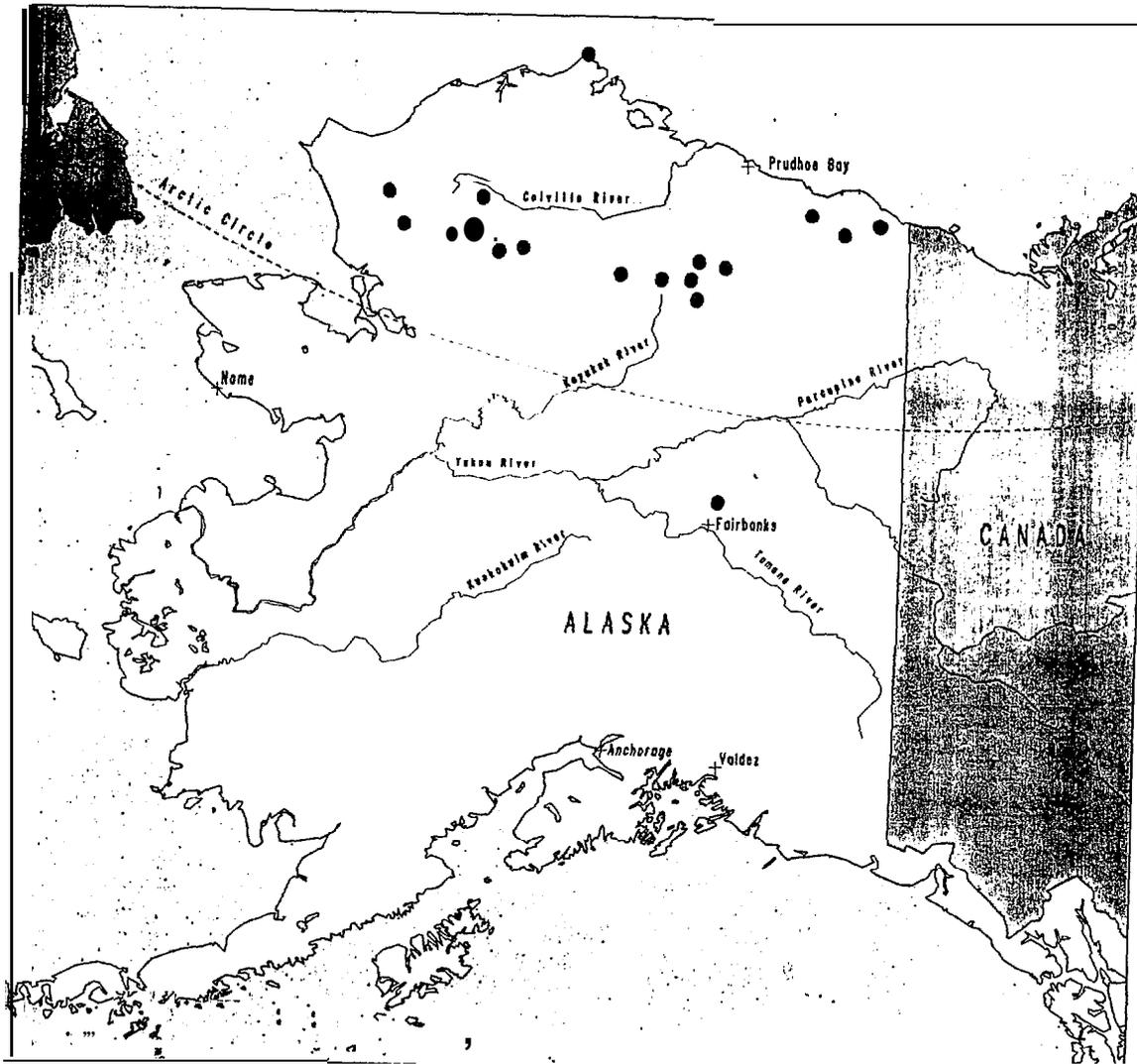


Figure 1. Distribution of sites sampled for lichens and mosses during the 1990 pilot field study. Of 21 field sites, two pairs were closely co-located and thus each appear as a single dot on this map,

Summary

Contamination of Arctic ecosystems is an issue of growing international concern. The US. Environmental Protection Agency has initiated research to provide preliminary information on the status and extent of contamination of U.S. Arctic ecosystems due to long range atmospheric transport.

Acknowledgements

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Environmental Protection Agency

Worrest, and technical input from cryptogamic botanists W. Denisen (Oregon State University), J. Martin (Tallinn University), T. Moser (NSI), B. Murray (University of Alaska), and S. Pittam (Smithsonian). Preparation of this manuscript has been funded wholly by the US. Environmental Protection Agency under contract DW12931 230 to the U.S.D.A. Forest Service. It has been subjected to Agency review and approved for publication.

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

RESPONSES TO THE SECOND BIENNIAL REVISION OF THE ARCTIC RESEARCH PLAN

Presented by: Gunter Weller

UPPER ATMOSPHERE AND NEAR EARTH SPACE PHYSICS

Accomplishments

NASA's sounding rocket program launched a total of eight missions in Fiscal Year 1990 and one mission thus far in Fiscal Year 1991 to study a variety of atmospheric and space physics phenomena in the science areas of auroral and upper atmospheric physics. Seven additional sounding rocket missions in these scientific areas are planned for the remainder of FY 1991. Of the eight missions in FY 1990, seven were launched from the University of Alaska/NASA Poker Flat Research Range in central Alaska while the last was launched from Norway. The single completed FY 1991 mission was launched from Poker Flat, Alaska. Of the remainder planned for FY 1991, three are scheduled from Poker Flat and four are scheduled to be launched from ESRANGE at Kiruna, Sweden.

PEGSAT, a component of the joint Air Force/NASA Combined Release and Radiation Effects Satellite (CRRES) Program, was launched by a Pegasus launch vehicle in March 1990. PEGSAT carried two barium vapor chemical release canisters which were activated in two experiments over northern Canada to study the electric field structure in and near the visible aurora. A second component of the CRRES Program, the CRRES satellite itself, was launched into orbit by an Atlas-Centaur vehicle in July 1990. During January and February 1991, a series of six barium-vapor and two lithium-vapor releases were made from this satellite. Several of these releases were performed at high altitude, at points along magnetic field lines which thread the auroral regions in the Arctic in order to test various theories of the formation of the aurora. Two of the barium releases appear to have triggered an increase in auroral activity as observed from aircraft observing over northern Canada.

FAST, a small explorer satellite to study the plasma microphysics of the aurora, was approved from a new start in 1990 and is scheduled for launch in 1994.

The MAX-91 U.S. National Campaign to perform coordinated observations of solar and geomagnetic activity during the maximum of the solar cycle under the auspices of the Solar-Terrestrial Energy Program (STEP) was begun in 1990. This program successfully supported observations made from balloons launched in Antarctica.

Objectives for 1992 and 1993

Future objectives include the continuation of NASA's sounding rocket program utilizing ranges at Poker Flat, Alaska, Norway, and Kiruna, Sweden to study aurora and upper atmosphere space physics.

Also planned is the launch of the POLAR spacecraft (a component of NASA's Global Geospace Science (GGS) and the International Solar Terrestrial Physics Programs (ISTP)) in June 1993. POLAR will conduct magnetospheric particles and fields observations with particular attention to the interrelationship between visible aurora and the magnetosphere.

Launching of the WIND satellite (a second component in the GGS and ISTP Programs) is planned in December 1992, to assist in understanding the energy inputs to the magnetosphere from the solar wind.

Participation in the major upgrade of the launch and science support facilities at the Poker Flat Research Range in order to improve NASA's sounding rocket capabilities at that site (NASA, DOD) is also planned.

TROPOSPHERIC AND STRATOSPHERIC CHEMISTRY

Accomplishments

NASA-sponsored researchers reported on the results of the Atmospheric Boundary Layer Experiment-3A at a special session of the American Geophysical Union Symposium, and in a special issue of the *Journal of Geophysical Research*. ABLE-3A was conducted in parts of the Arctic to assess the flux of greenhouse gases including CH₄, NO_x, NO_y, and O₃ between the land surface and the troposphere.

NASA completed a major reprocessing of Nimbus-7 Total Ozone Mapping Spectrometer (TOMS) data. The results identified a drop in stratospheric ozone in the Arctic and mid-to-upper northern latitudes that was more severe than previously reported.

Objectives

A future objective in this study area is to establish the correlation between the chemistry of polar stratospheric clouds in the Arctic and the ozone concentration at northern mid latitudes.

Ongoing and Planned Activities

The second Airborne Arctic Stratospheric Expedition (AASE-II), a six-month program (October 1991 through March 1992) of aircraft data collection for the study of stratospheric chemistry and dynamics will be conducted. AASE-II will cover Arctic and mid-northern latitudes throughout the duration of the Arctic vortex.

The impact of supersonic aircraft transportation on stratospheric chemistry via a program of modeling plus laboratory and field measurements will be evaluated.

It is planned to provide ground-level instrumentation, science teams, and management support of the Network for the Detection of Stratospheric Change (NDSC), which will measure trace gases at sites stationed in Resolute and Alert, Canada; Thule, Greenland; and Kiruna, Sweden. (NASA, NOAA).

Also planned is the launch of the Upper Atmosphere Research Satellite (UARS) (November 1991), and conduct of correlative measurements in the Arctic (UARS makes measurements of stratospheric chemistry in north and south latitudes up to 80° with its limb-observing instruments).

Modeling and data analysis of stratospheric chemistry and ozone dynamics in the Arctic will be supported.

GLACIOLOGY AND HYDROLOGY

Objectives

An objective is to document the cause-and-effect relationships of glaciers to sea ice and global hydrology, including the relationship to world sea level changes and climatic functions, both long term and short term, regional and global, and continue the development of models for glacier mechanisms.

Accomplishments

NASA continued reprocessing Geosat Altimeter data. Results suggest that part of the Greenland ice sheet thickened significantly in the nine-year interval between the Seasat and Geosat altimeter missions.

All components necessary for analysis of the ERS-1 (European Space Agency's First Remote Sensing Mission) Advanced Microwave Instrument (AMI) Synthetic Aperture Radar (SAR) data were delivered to the NASA-sponsored Alaska SAR Facility (ASF) for testing. ERS-1 will launch in 1991, and the ASF will perform processing, archive, and geophysical analysis of these data.

A NASA research announcement was released in 1990 to solicit investigations that will make use of the ASF facilities. Twenty-five investigations were selected that represent a wide range of scientific interests, including studies of the oceans, ice, and land cover in the Arctic.

An ice atlas based on imagery from the Scanning Multichannel Microwave Radiometer was prepared for publication. The atlas covers a nine-year period, from 1978-1987. All digital data associated with the atlas will be archived at the National Snow and Ice Data Center (NSIDC) in Boulder, Colorado,

NASA completed the validation of ice products derived from the Special Sensor Microwave/Imager (SSM/I), and continued to archive these data products in the NSIDC.

Ongoing and Planned Activities

Improvement of the ASF, including upgrades to process, archive, and analyze data from the Japanese ERS-1 SAR will be continued.

An airborne SAR and laser altimeter investigation over Greenland during the summer of 1991, with the goal of applying data from these instruments to a variety of geophysical investigations is planned.

Processing and archiving SSM/I data, and analysis of these data for polar investigations will be continued.

Finish processing of Geosat Altimeter data over ice, processing and analysis of ERS-1 altimeter data over ice.

Support for science teams to continue research and analysis of data and data products derived from the ASF.

ECOSYSTEM STRUCTURE, FUNCTION, AND RESPONSE

Accomplishments

Nasa-supported remote sensing studies led to new and more accurate estimates of methane flux in the North American Arctic tundra.

An experimental plan was developed and sites selected for the Boreal Ecosystem-Atmosphere Study (BOREAS); the experiment sites are in Prince Albert National Park, Saskatchewan and Nelson Home, Manitoba.

Ongoing and Planned Activities

interdisciplinary methane investigations to measure methane flux *in situ* will be continued, and studies to understand microbial process leading to methane flux in the Arctic will be conducted.

Investigations will continue to classify and stratify ground cover types to derive estimates of methane flux, and to use this stratification to develop statistical estimates of flux for the Arctic tundra and taiga.

Radiative transfer models for synthetic aperture radar will be developed to measure structural properties of high latitude forests.

Planning for BOREAS, which will be conducted jointly with several Canadian agencies, will be continued. A solicitation for proposals will be released in late 1991; automated data collection will take place from 1991 through the intensive field campaigns planned for 1994.

NATIONAL SCIENCE FOUNDATION
ARCTIC SCIENCE, ENGINEERING, AND EDUCATION

Presented by: Jerry Brown

The National Science Foundation (NSF) supports research in essentially all scientific disciplines including engineering and education. Proposals are unsolicited and range from small individual research grants to large interdisciplinary programs in disciplines such as oceanography, glaciology, and ecological research.

Essentially all of the NSF funds are devoted to basic science, engineering, and education and related operational, information, and advisory support. In addition to investigations in Alaska and adjacent waters, research is supported in essentially all Arctic-bordered countries. Of the total \$24.1 million expended in Fiscal Year 1990, the Division of Polar Programs input was \$12.3 million. The remainder was awarded from funds in other divisions and programs throughout the Foundation. There were 227 awards to 88 institutions in 32 states and the District of Columbia.

The NSF funding of Arctic research since 1985 is shown in the table below (in thousands of dollars):

| | FY85 | FY86 | FY87 | FY88 | FY89 | FY90 | FY91 (Est.) |
|--|---------------|---------------|---------------|---------------|---------------|---------------|-----------------|
| DPP | 7,947 | 8,005 | 8,095 | 8,211 | 10,175 | 12,310 | 14,500 |
| Other* | 11,482 | 10,143 | 13,801 | 14,906 | 13,549 | 11,778 | 13,000 |
| Total | 19,429 | 18,148 | 21,896 | 23,117 | 23,724 | 24,088 | 27,500 |
| * including Ocean, Earth, Atmospheric, Biological Sciences; Engineering; Education | | | | | | | |

Individual research awards contain their own logistics budgets. Large logistics support such as ship operations, the Polar Ice Coring Office, and an upper atmosphere radar research facility in Greenland are identified separately and amount to 20% of the total NSF annual funding. Each year a complete list of institutions and organizations that received funds is published and is available from the Division of Polar Programs.

The Arctic Research and Policy Act designates the NSF as lead agency and chair agency for the Interagency Arctic Research Policy Committee, and calls for integrated interagency planning and budgetary processes. The Interagency Committee adopted a Statement of Principles for the Conduct of Research in the Arctic and prepared a report on integrated research for the Western Arctic.

The second biennial revision of the U.S. Arctic Research Plan is in preparation: a public review of the draft Plan took place in Anchorage on March 21, 1991. The plan will be submitted to the President by the July 31, 1991 deadline and then published in the journal *Arctic Research of the United States*.

Further information on other agencies' programs is presented in the journal *Arctic Research of the United States*, and the U.S. Arctic Research Plan its biennial revision.

The following two reports summarize major on-going marine and terrestrial activities sponsored by NSF in Alaska.

**ON THE ROLE OF THE NATIONAL SCIENCE FOUNDATION
IN ARCTIC MARINE RESEARCH**

Presented by: Tom Røyer

The National Science Foundation's funding of interdisciplinary, oceanographic research in the western Arctic began in 1975 with a study of Processes and Resources of the Bering Sea Shelf (PROBES). The investigation addressed the marine ecosystem in the southeastern Bering Sea from an interdisciplinary standpoint. That study led to later research programs in ice edge processes, and in the 1980s, the role of fresh water discharge on the Arctic ecosystem. This latter study, ISHTAR (Inner Shelf Transfer and Recycling) which began in 1986, focused on the Yukon River outflow. They found that most of the nutrient flux for the Arctic Ocean is from the region to the west of St. Lawrence Island even though there are relatively large nutrient influxes from the Yukon River. A later aim of this program was to address the interannual nutrient fluxes into the Chukchi Sea.

Many studies of global climate change indicate that high latitudes will have a large amplitude response and thus could serve as an early warning for climate change. One of the goals of the National Science Foundation's Division of Polar Program's (DPP) Arctic System Science (ARCSS) studies is to determine the Arctic response and its role in global climate change. A proposed western Arctic study in ARCSS is the St. Lawrence Island Polynya (SLIP) program. Polynyas are locations where interactions between the atmosphere, ocean, and bottom topography occur. In the western Arctic, shallow water coastal polynyas are generated by wind forcing. For example, the St. Lawrence polynya exists as a result of persistent winter winds. Although polynyas constitute only about 3 to 4 % of the Arctic Ocean area, they are important for air-sea interactions, since up to 50% of the heat transfer can take place in the polynyas. In addition, these are sites of brine formation where deep water masses are created. They are biologically important sites for overwintering mammals and birds. To know the ecosystem better, we need to know the lower trophic levels, that is, a primary production. These studies build on prior knowledge gained in the PROBES, ice edge, and ISHTAR programs. It is important to investigate the interannual changes in the polynyas in order to assess their roles in global climate changes. Remote sensing such as satellite thermal measurements and the new synthetic aperture radar (SAR) will be important in determining the extent of the Arctic ice cover and its variability.

The long presence of NSF-sponsored projects in the Arctic enables the development of data time series that can be used to model changes in the Arctic. For example, a time series of marine conditions for the northern Gulf of Alaska has been constructed because oceanographic cruises have been staged out of Seward, Alaska, for more than 20 years. This allows the measurements to be made as the ship passes through the region. Temperature increases of more than 2°C have been reported over 15 years throughout the upper 250 m of water at the coast. Although this site is not in the Arctic, similar temperature changes apparently occur in the southern Bering Sea. This low frequency phenomenon might be found elsewhere in high latitude regions if we could only get there to measure them.

For improved support of oceanographic studies, the National Science Foundation has funded the development of an arctic research vessel. This work is in conjunction with the Fleet Improvement Committee (FIC) of the University National Laboratory System (UNOLS). The ship

National Science Foundation

design is in response to the science mission requirements to have a ship that is capable of operating in about 3 ft of seasonal ice. The vessel should be capable of carrying 30 scientists for up to 90 days. The conceptual design of this 218 ft, 2400 ton vessel has been completed . (Figure 1). The next stage, a preliminary design, is scheduled to be completed in 1992 with construction starting in 1993. This ice-capable vessel will allow new thrusts into the Arctic Ocean. It should be available to the science community in 1995.

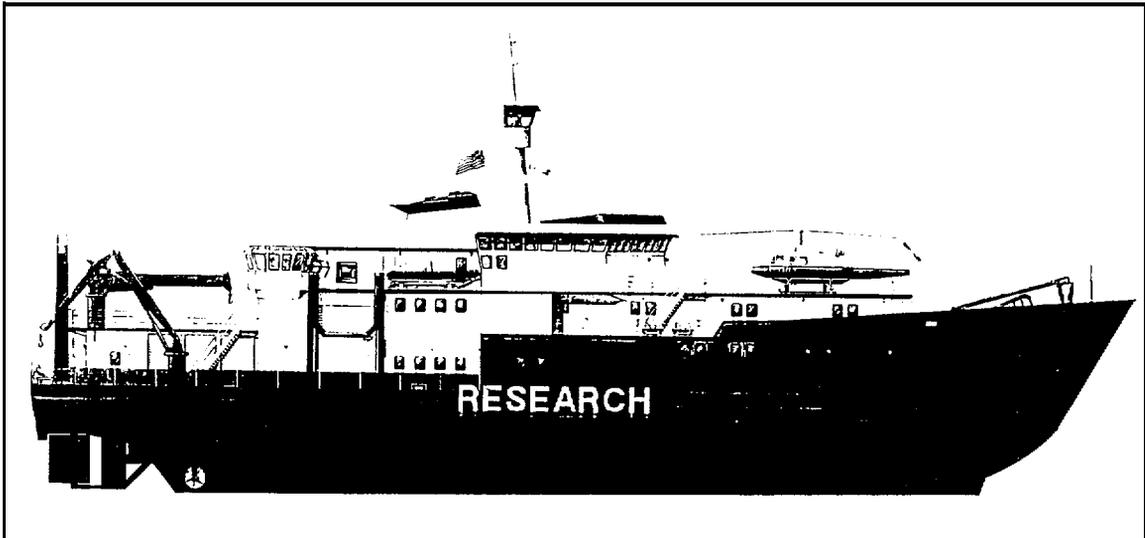


Figure 1. Conceptual design of ice-capable Arctic research vessel by Glosten Associates, Inc. of Seattle with the Institute of Marine Science, University of Alaska, Fairbanks, May 1991.

LONG-TERM ECOLOGICAL RESEARCH SITES IN ALASKA

Presented by: Leslie A. Viereck

The Long-Term Ecological Research (LTER) program is funded by the National Science Foundation's (NSF) Division of Biotic Systems and Resources (BSR). The program was developed by NSF to provide a coordinated network of sites on which long-term ecological experimentation and monitoring could be carried out. In addition to monitoring, each site was encouraged to address research efforts in five core areas: 1) pattern and control of primary production, 2) spatial and temporal distribution of populations selected to represent trophic structure, 3) pattern and control of organic matter accumulation in surface layers and sediments, 4) pattern of inorganic inputs and movements of nutrients through soils, groundwater, and surface waters, and 5) pattern and frequency of disturbance to the research site.

The 18 LTER sites have developed into a coordinated network' through the following: 1) establishment of a network office in Seattle, 2) all sites are electronically connected, 3) establishment of a coordinating committee and several other special committees, 4) LTER workshops, 5) common equipment and software, 6) data catalogue and data sharing, 7) common intersite experiments, 8) all scientist meetings, and 9) a series of LTER publications,

There are two Alaska LTER sites that were established in 1987 and are thus nearing the end of their first five-year cycle of funding. These are the Arctic site at Toolik Lake and Taiga site at Bonanza Creek Experimental Forest.

Arctic Tundra LTER Site at Toolik Lake

The Toolik Lake LTER site is directed from the Ecosystem Center at the Marine Biological Laboratory at Woods Hole, Massachusetts. There are fifteen investigators from 10 different institutions presently working at the Toolik LTER site. The arctic LTER program at Toolik Lake is designed to build on an extensive research base; to provide core funding for ongoing, long-term experiments; and to link terrestrial, lake, and stream studies. The heart of the program is a series of parallel, whole-ecosystem experiments in lakes, streams, and the major terrestrial ecosystem types. The experiments are of two types: 1) manipulation of herbivores or predators, and 2) manipulations of nutrient availability. The overall goal is to understand and to separate the role of animal consumers versus plant/nutrient responses as controls over terrestrial and aquatic systems. A second major goal is to advance understanding of how mineral nutrients move over the arctic landscape, from terrestrial to aquatic ecosystems. The site is developing a model of nutrient transport in a tundra watershed, combined with the use of stable isotopes as tracers to identify major sources, sinks and pathways of element cycling.

Bonanza Creek LTER Site

The Bonanza Creek LTER site is operated jointly by the University of Alaska and the Institute of Northern Forestry. At present there are seven scientists from the UAF and three from INF working on the project. The studies at the BCEF LTER site deal with successional processes in floodplain (primary) succession following alluvial deposition and in upland (secondary) succession following wildfire. The research is examining the premise that the pattern of succession is determined primarily by the initial soil physical and chemical environment of the site and by the life history traits of component species, and that the rate of successional change is determined by vegetation-caused changes in environment and ecosystem function. Through a set of four corollary hypotheses research is designed to test the central question focusing on important controls of ecosystem structure and function at major turning points in the successional sequences. A series of study sites in various stages of succession are being used to monitor vegetation and environmental changes with succession and to serve as sites for experiments testing the four hypotheses.

SMITHSONIAN INSTITUTION
THE ARCTIC STUDIES CENTER

Presented by Stephen Loring

The Arctic Studies Center was established by Congress in 1988 to create a national program of arctic research and education within the Anthropology Department at the Smithsonian Institution. The Center's mandate includes conducting research in all aspects of arctic anthropology, as well as managing the curation of the Smithsonian's large arctic ethnographic and archeological collections. Among federal agencies the Center is in a unique position to provide expertise on the rich cultural heritage of Alaska and to collaborate with federal agencies, international scholars, and native Alaskans in the management, conservation, and promotion of Alaska's dynamic cultural heritage. The Center is committed to maintaining a highly visible public agenda with the exhibition and publication of arctic materials, and to promoting scientific, scholarly interaction in the form of conferences and seminars. In addition, the Center, through a variety of fellowships and visiting scholar programs afforded by the Smithsonian, provides scholarly opportunities and training in museum anthropology.

The Arctic Studies Center responds to pressing need for northern research and for education addressing the array of public policy issues confronting federal agencies and northern Native interests. There is at present a critical need for anthropological research in the north given the accelerated pace of industrial development, the specter of climate change, and the increased international focus on the resources and peoples of the circumpolar region. The Center envisions developing cooperative relationships with federal agencies and Native organizations by providing expertise as well as research, education, and training opportunities.

While adopting a circumpolar perspective with major international research initiatives in Siberia, Baffin Island, and Labrador, the Arctic Studies Center envisions a particularly strong commitment to Alaska reflecting the long-standing involvement of Smithsonian researchers there. Soon after the Smithsonian was founded in 1846, Spencer Baird sent teams of naturalists into the Yukon Territory and Alaska. This interest helped convince Congress to purchase Alaska in 1867. The subsequent work of a number of Smithsonian ethnographers, including Edward Nelson in southwest Alaska and John Murdoch at Pt. Barrow, resulted in the formation of extensive ethnological collections and publications which are the foundation of Alaskan ethnography. With the work of Ales Hrdlicka and Henry Collins beginning in the late 1920s, the Smithsonian's interests in Alaska were broadened to include pioneering archeological investigations into the origins and dimensions of prehistoric Eskimo culture.

The Alaskan collections at the Smithsonian provide a wealth of opportunities for research into the origins and iconography of Eskimo art, the ethnohistory of the Beringian region, and the cultural adaptations of Alaska's native peoples. In addition to collection research, the Arctic Studies Center can provide access to the impressive archival collections at the Smithsonian, at the National Anthropological Archives, and at the nearby Library of Congress, and the United States National Archives.

Recently, the Smithsonian's involvement with the western arctic has further focused national attention. William Fitzhugh has been instrumental in the revitalization of the Smithsonian's commitment to anthropology in Alaska through the development of a number of public programs that are now under the auspices of the Arctic Studies Center. These include the creation of two major exhibition programs. The first of these, *Innu: Spirit World of the Bering Sea Eskimo* toured the United States and Canada in 1982-1985. A smaller version of the exhibition

was created in order to travel to small museums and culture centers throughout the north (in Alaska, Canada, Greenland, and Europe). *Crossroads of Continents: Cultures of Siberia and Alaska* (1989) is a major exhibition that explores the cultural relationships between the native people on both sides of the Bering Straits. A joint US-Soviet initiative, *Crossroads* has paved the way for a resurgence of international scholarship on the cultures of the North Pacific Rim. The *Crossroads* exhibit is presently on tour in the United States and Canada, It will later travel to the Soviet Union,

Future plans include an exhibition on Beringian Archeology which would travel to small communities in Alaska and Siberia, and the production of a series of films focusing on the history and culture of Arctic peoples. These projects are to be developed in close association with Soviet colleagues and can be expected to further strengthen the international commitments of the program.

The development of an international park in Beringia oilers the potential for additional collaboration between federal agencies including the Arctic Studies Center and their Soviet counterparts. International cooperation is a central tenet of the Arctic Studies Center. In the coming year, Igor Krupnik from the Institute of Ethnography in Moscow, will join the Center as a visiting Siberian ethnologist. And, if funds are made available, the program intends to hire a western Arctic archeologist to develop a new research program in the region.

The Arctic Studies Center expects to take a strong advocacy role in meeting the needs and interests of Native Alaskans in the realm of museum anthropology through Native training programs, collaborative research, and exhibit planning. The Center is committed to maintaining an active, visible agenda of arctic research. The Smithsonian's substantial collections and archival resources are an important Alaskan legacy which the Center hopes will facilitate collaborative, interagency research initiatives.

CLOSING COMMENTS

**CURT MCVEE
SPECIAL ASSISTANT TO THE SECRETARY
DEPARTMENT OF THE INTERIOR**

This workshop has presented a good synopsis or sketch of research and studies conducted or funded by Federal agencies in Alaska. However, the information presented was probably incomplete; undoubtedly there were projects which were not reported. There was not sufficient time to explore specific projects. This was probably frustrating, but I would hope that individuals would follow-up in areas of their special interest.

On the other hand, I felt that the workshop did accomplish its purpose. Research funded by Federal appropriations has been cataloged. The workshop brought together many agencies which identified numerous opportunities for cooperation and coordination. Hopefully, participants picked up new ideas and concepts worthy of future consideration. These new ideas were gathered during the course of listening to the presentations.

The workshop products to be produced include a summary of the presentations and an index or catalog of projects. Speakers were asked to submit abstracts or summaries of their presentations. This information will be used, shared, and I expect it to appear in other reports and publications. I hope that we also initiated interest in research coordination and encourage the development of *ad hoc* committees. There may be some advantages to continue the steering committee, perhaps with some restructuring as a focus to facilitate the interchange of information and coordination between the agencies actively working in Alaska.

Most of the reports were presented by the program managers. This has advantages in that program managers generally have responsibility for coordination and cooperation and if opportunities were identified I think we had people participating who can do something. There is a need for some follow up sessions to address in more depth specific subjects, more involvement of principal investigators in such sessions. Initiatives in this directions should be encouraged.

Thank you all for your participation in the workshop.

APPENDIX A
IARPC Principles Statement

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 timeframe 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, **@ 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.

APPENDIX B

Agenda

FEDERAL ARCTIC RESEARCH INFORMATION WORKSHOP

**March 19-21, 1991
Anchorage Museum of History and Art
Anchorage, Alaska**

Purpose of Workshop: Report on recently completed, ongoing, and planned Federally-funded research in the Arctic (1989-1992); provide information for the biennial revision of the Arctic Research Plan scheduled for submission to the President and the Congress in June 1991.

Tuesday, March 19, 1991

8:30 a.m. Introduction (Curt McVee, DOI; Joy Geiselman, MMS)

8:45 a.m. Session I (Walt Olson, CRREL, chair)

National Science Foundation

Jerry Brown

Tom Royer

Les Viereck

9:45 a.m. Coffee break

10:15 a.m. National Aeronautic and Space Administration

Gunter Weller

11:00 a.m. Smithsonian Institution

Stephen Loring

11:30 a.m. Questions/Discussion

11:45 a.m. Lunch

1:15 p.m. Session II (Joy Geiselman, MMS, chair)

Bureau of Land Management

Gene Tedand

Joe Dygas

Martha Shepard

Tina Huffaker

1:55 p.m. Forest Service
Fred Larson
Les Viereck

2:40 p.m. Coffee break

3:00 p.m. Bureau of Indian Affairs
Ken Pratt

3:15 p.m. Questions/Discussion"

3:30 porn. Session III (Robert Wainwright, CDC, chair)
Alaska Area Native Health Service
David Barrett

3:34 p.m. Center for Disease Control
Robert Wainwright

4:00 p.m. National Institute of Health

4:15 p.m. Questions/Discussion

4:30 p.m. Adjourn

Wednesday, March 20, 1991

8:30 a.m. Session IV (Paul Brooks, USGS, chair)
U.S. Geological Survey
Jim Devine
Max Brewer
Ken Thompson
Will White
Stanton Moll
Paul Brooks

9:15 a.m. Cold Regions Research and Engineering Laboratory
Jerome Johnson

10:00 a.m. Coffee break

10:15 a.m. Department of Energy
Helen McCammon

10:35 a.m. Bureau of Mines
Steven Fechner

10:50 a.m. Soil Conservation Service
Rick McClure
Dave Swanson

11:30 a.m. Lunch

1:00 p.m. U.S. Army Corps of Engineers
Carl Stormer

1:15 p.m. Questions/Discussion

1:30 p.m. Session V (Jawed Hameedi, NOAA, chair)
National Oceanic and Atmospheric Administration:
Oceanography and Marine Assessment
National Marine Fisheries Service
National Weather Service
Jawed Hameedi
Jim Balsiger
Jim Kemper
Mike Crane

3:15 p.m. Coffee break

3:30 p.m. Environmental Protection Agency
Dixon Landers

4:00 p.m. Federal Highway Administration

4:10 p.m. Questions/Discussion

4:15 p.m. Office of Naval Research

4:25 p.m. Questions/Discussion

4:30 p.m. Adjourn

APPENDIX C
Attendee List

FEDERAL ARCTIC RESEARCH INFORMATION WORKSHOP
MARCH 19-21, 1991
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MARCH 19-21, 1991
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APPENDIX D

Acronyms

ACRONYMS

| | | | |
|--------|---|---------|---|
| AAPG | American Association of Petroleum Geologists | EEZ | Exclusive Economic Zone |
| AASE | Airborne Arctic Stratospheric Expedition | EIS | Environmental Impact Statement |
| ACDCP | Alaska Coastal Data Collection Program | EMAP | Environmental Monitoring and Assessment Program |
| ACEC | Area of Critical Environmental Concern | EROS | Earth Resources Observation Systems |
| ADBP | Arctic Drifting Buoy Program | ERS-1 | European Remote Sensing (Satellite) |
| ADE | Alaska District Corps of Engineers | ESI | Environmental Sensitivity Index |
| ADEC | Alaska Dept. of Environmental Conservation | ESP | Environmental Studies Program (MMS) |
| ADF&G | Alaska Dept. of Fish and Game | FAS | Fetal Alcohol Syndrome |
| ADI | Arctic Data Interactive CDROM | FCDIS | Fairbanks Command and Data Acquisition Station |
| AEDD | Arctic Environmental Data Directory | FIC | Fleet Improvement Committee (UNOLS) |
| AEIDC | Arctic Environmental Information and Data Center | FNOC | Fleet Numerical Oceanography Center |
| AFGWC | Air Force Global Weather Central | FWS | Fish and Wildlife Service |
| AFOC | Alaska Field Operations Center (Bureau of Mines) | GGG | Global Geospace Science |
| AFSL | Alaska Forestry Sciences Laboratory | GIS | Geographic Information Systems |
| AGASP | Arctic Gas and Aerosol Sampling Program | GMCC | Geophysical Monitoring for Climatic Change |
| AIP | Arctic Investigations Program | GOES | Geostationary Operational Environmental Satellite |
| AMI | Advanced Microwave Instrument | GPS | Global Positioning Satellite |
| AMMTAP | Alaska Marine Mammal Tissue Archival Project | HazMat | Hazardous Materials Response Branch |
| AMSU | Advanced Microwave Sensing Unit | HIPAS | High-powered Auroral Study |
| ANILCA | Alaska National Interest Lands Conservation Act | HPR | Highway Planning and Research |
| ANCSA | Alaska Native Claims Settlement Act | IBRC | International Bird Rescue Center |
| ANWR | Arctic National Wildlife Refuge | IHS | Indian Health Service |
| AORIS | Arctic and Offshore Research Information System | IMPROVE | Interagency Monitoring of the Protected Environments |
| ARO | Army Research Office | INF | Institute of Northern Forestry |
| ARCSS | Arctic System Science | ISHTAR | Inner Shelf Transport and Recycling |
| ASF | Alaska SAR Facility | ISPTP | International Solar-Terrestrial Physics Program |
| AVHRR | Advanced Very High Resolution Radiometer | JIC | Joint Ice Center |
| BCEF | Bonanza Creek Experimental Forest | ILTER | Long Term Ecological Research Program |
| BIA | Bureau of Indian Affairs | MAB | Man and the Biosphere |
| BLM | Bureau of Land Management | MAS | Minerals Availability System |
| BOREAS | Boreal Ecosystem Atmosphere Study | MCS | Mining Coat Service |
| BSR | Division of Biotic Systems and Resources (NSF) | MILS | Mineral Industry Location System |
| CDC | Centers for Disease Control | MMS | Minerals Management Service |
| CDP | Common Depth Point | MSRC | Marine Spill Response Cooperative |
| CDROM | Compact Disk Read Only Memory | NADB | National Archeological Database |
| CEHIC | Center for Environmental Health and Injury Control | NASA | National Aeronautics and Space Administration |
| CERC | Corps of Engineers Coastal Engineering Research Center | NCDC | National Climatic Data Center |
| CES | Cost Estimation System (USBM) | NDSC | Network for the Detection of Stratospheric Change |
| CFDC | National Coastal Field Data Collection Program | NECOP | Nutrient Enhanced Coastal Ocean Productivity |
| CMAS | Computer Mapping and Analysis System | NESDIS | National Environmental Satellite, Data, and Information Service |
| CMDL | Climate and Monitoring Diagnostics Laboratory | NGDC | National Geophysical Data Center |
| CNES | Centre National d'Etude Spatiale | NIOSH | National Institute for Occupational Safety and Health |
| COE | Corps of Engineers | NMD | National Mapping Division |
| COMPAS | Coastal Ocean Management, Planning, and Assessment System | NMFS | National Marine Fisheries Service |
| CONRIM | Council on Northern Resources Information Management | NOAA | National Oceanic and Atmospheric Administration |
| CPCRW | Caribou-Poker Creeks Research Watershed | NODC | National Oceanographic Data Center |
| CRDI | Copper River Delta Institute | NPRA | National Petroleum Reserve in Alaska |
| CRREL | Cold Regions Research and Engineering Laboratory | NPS | National Park Service |
| CRRES | Combined Release and Radiation Effects Satellite | NS&T | National Status and Trends Program |
| CSI | Cultural Sites Inventory | NSF | National Science Foundation |
| DCFROF | Discounted Cash Flow Rate of Return | NSIDC | National Snow and Ice Data Center |
| DFO | Department of Fisheries and Oceans (Canada) | NTOF | National Traumatic Occupational Fatality System |
| DMSP | Defense Meteorological Satellite Program | NWS | National Weather Service |
| DOD | Department of Defense | OAR | Oceanic and Atmospheric Research |
| DOE | Department of Energy | OCS | Outer Continental Shelf |
| DOI | Department of the Interior | OCSEAP | Outer Continental Shelf Environmental Assessment Program |
| DOMSAT | Polar Domestic Satellite | OCSLA | Outer Continental Shelf Lands Act |
| DOT | Department of Transportation | OHMSETT | Oil and Hazardous Material Simulated Environmental Test Tank |
| DOT/PF | Department of Transportation/Public Facilities | OMA | Oceanography and Marine Assessment |
| DPP | Division of Polar Programs (NSF) | | |
| DSR | Division of Safety Research | | |

| | |
|--------|---|
| ONR | Office of Naval Research |
| OPA | Oil Pollution Act |
| OSP | Optimum Sustainable Population |
| PCH | Porcupine Caribou Herd |
| PGM | Platinum Group Metals |
| PMEL | Pacific Marine Environmental Laboratory |
| PNW | Pacific Northwest Research Station |
| PRESTO | Probabilistic Resource Estimates-Offshore |
| PROBES | Processes and Resources of the Bering Sea Shelf |
| RAWS | Remote Automatic Weather System |
| REE | Rare Earth Elements |
| RMV | Recoverable Metal Value |
| SAR | Synthetic Aperture Radar |
| SCM | Strategic and Critical Minerals |
| SOS | Soil Conservation Service |
| SEL | Space Environment Laboratory |
| SEMS | Seafloor Earthquake Measurement system |
| SESU | Social and Economic Studies Unit (MMS) |
| SFSL | Seattle Forestry Sciences Laboratory |
| SLIP | St. Lawrence Island Polynya |
| SSM/I | Special Sensor Microwave/Imager |
| STEP | Solar Terrestrial Energy Program |
| TACT | TransAlaska Crustal Transect |
| TAR | Technology Assessment and Research (MMS) |
| UAA | University of Alaska Anchorage |
| UARS | Upper Atmosphere Research Satellite |
| UNOLS | University National Laboratory System |
| USAF | United States Air Force |
| USBM | US. Bureau of Mines |
| USEPA | U.S. Environmental Protection Agency |
| USFWS | U.S. Fish and Wildlife Service |
| USGS | U.S. Geological Survey |
| VLBI | Very-long-based Interferometry |
| WFOC | Weetern Field Operation Center (USBM) |

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interest of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. Administration.

