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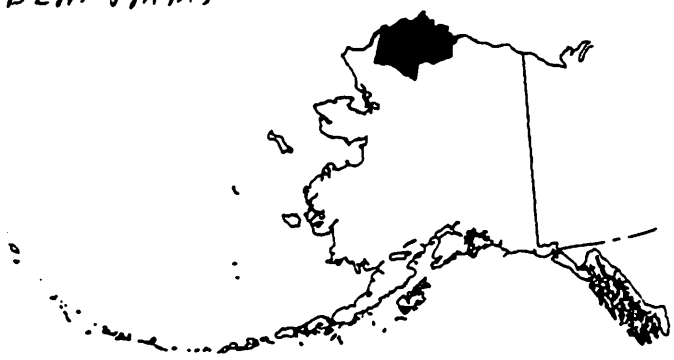

OCS Study
MMS 97-0013

NPR-A Symposium

PROCEEDINGS

Science, Traditional Knowledge, and the Resources of the Northeast Planning Area of the National Petroleum Reserve - Alaska

April 16-18, 1997
Anchorage, Alaska

Sponsored by:

Bureau of Land Management
and

MMS

Minerals Management Service

OCS Study MMS 97-0013

NPR-A SYMPOSIUM PROCEEDINGS

Science, Traditional Knowledge, and the Resources of the Northeast Planning Area of the National Petroleum Reserve-Alaska

April 16-18, 1997
Anchorage, Alaska

Prepared for:

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PREFACE

Symposium Objective: The Bureau of Land Management (BLM), assisted by the Minerals Management Service (MMS), is in the process of developing an Integrated Activity Plan/Environmental Impact Statement (IAP/EIS) for the Northeast Planning Area of the National Petroleum Reserve-Alaska (NPR-A). These lands and the entire North Slope of Alaska have been the subject of extensive research on their rich biological and mineral resources. The area has also been home for Native peoples living off the lands for millennia.

This symposium brings together leading experts on the land's resources and their uses by Natives and newcomers. The guest speakers and the discussion which we encourage among those in attendance will help BLM and MMS better understand the important wildlife, subsistence uses, and archaeological and paleontological resources of the planning area. Because some special-interest groups, the public in general, and State and Federal agencies have concerns regarding oil and gas exploration and development in the NPR-A, which is a possible result of the IAP/EIS, the symposium will focus special attention on oil and gas activities and their potential impacts on resources.

The BLM and MMS are happy to welcome the public to attend and participate in this symposium. The symposium is focused on providing the authors of the IAP/EIS with the best knowledge the assembled experts can provide. To do that in the time available, special priority will be given to addressing the authors' questions. All those attending, however, are invited to share their traditional knowledge of the resources of the planning area or direct the IAP/EIS writers' attention to additional scientific sources of information.

TYPICAL NORTH SLOPE OIL AND GAS OPERATIONS

Session Co-chairs: Rance Wall, Acting Regional Director, MMS; and Greg Swank, Acting State Pipeline Coordinator, Joint Pipeline Office

ON-SHORE GEOPHYSICAL (SEISMIC) EXPLORATION

SHAWN RICE
WESTERN GEOPHYSICAL COMPANY
DENVER, CO

INTRODUCTION

First of all, I want to thank the MMS for inviting us here and giving the us the opportunity to share with you a little bit about what we do and how we do it. My name is Shawn Rice, I am an area manager for Western Geophysical, responsible for our land operations in Alaska, Canada, and the Western U.S.

I have been asked to speak to you about the seismic business, specifically the equipment and technologies we are currently utilizing. I am sure that a number of you are familiar with the seismic industry and generally how we operate on the North Slope, so I will try not to bore you, however, over the past couple of years we have deployed some new equipment and new technologies that have helped to improve our efficiency in the field as well as the quality of the data we collect, and I hope you will find it of some interest.

SURVEYING

First let's discuss surveying and surveying techniques. Once a project has been planned and after the permits have been secured, this is actually the first stage of field work that goes into acquiring seismic data in the field.

Traditionally, we surveyed with Theodolites and EDM's, tying to existing tri-stations to ground truth our survey. This method, while effective, was labor intensive, and the overall accuracy and repeatability was always difficult to determine.

Approximately three years ago we introduced global positioning system (GPS) surveying techniques into our operations. After the normal learning curve that goes with any new technology we have fully integrated this satellite survey methodology onto our field crews as the primary positioning solution.

With differential corrections applied we are able to survey with subcentimeter accuracy at rates that were unheard of even three years ago. Additionally, we have been able to tie any existing control and infrastructure (wells, pipelines, etc.) to properly ground truth our surveys and to allow the geoscientists to correlate all existing seismic and well data accurately to a location on the surface.

This increased accuracy also allows us to go back and reoccupy a location later with a greater degree of confidence in the accuracy of our positioning. We do not have to go out and locate a permanent marker (tri-station) and then traverse to the position we want. We can simply call up the coordinates, and drive to the location. This has saved a lot of time in the field, as well as travel across the tundra.

RECORDING EQUIPMENT

Acquisition recording systems have become increasingly sophisticated over the last several years. The technology has developed significantly and the applications for the technology have kept pace in the field.

We are currently utilizing state-of-the-art 24-bit digital telemetry recording systems. These systems are capable of recording in excess of 2000 channels simultaneously. The systems consist of a set of central electronics which are housed in the recording truck, commonly referred to as the "dog house." From here the ground electronics are deployed in either 2-D or 3-D configurations, depending upon the job.

Most of the current systems utilize a multi-channel box configuration. A number of individual channels (commonly 6 or 8) are recorded into a single box and then the information is converted to digital signal in the box and transmitted to the recording truck where it is recorded to magnetic tape.

The electronics in the recording truck allow us to quality control (QC) the data in near real time to assure that the quality and integrity of the product is maintained according to the client's specifications.

The geophones utilized today are appear to be fundamentally the same as what has been used for a number of years, with the exception that the sensitivity of the elements has been improved.

On the North Slope we find it is more efficient to power these systems by utilizing what is referred to as "power down the line." Effectively, we place a 12-V battery on line approximately every 40 stations that provides the power necessary to run the electronics in the boxes, and to transmit the data to the recorder. In warmer climates, a smaller battery, with a solar panel can be plugged directly into each box, eliminating the need for the additional power cable.

The question could be asked as to how this compares to previously utilized systems. Prior to the 24-bit revolution, the majority of the recording systems available were 15 or 16-bit analog or digital telemetry systems. These systems were more cumbersome and not able to record near as many active channels. A thousand channels would be pushing the limits of the older systems. So, how does this help us? The North Slope provides many significant challenges to the geophysicists and geologists that are working the seismic data, including permafrost and near surface statics due to the many ice lakes, and varying tundra conditions.

The improvements in the systems being used today allow us to gather more data simultaneously allowing us to derive better statistics. These elements, when used in conjunction with the improved processing techniques and algorithms have allowed us to recover more of the earth response from deeper in the spectrum. This has had positive impact in tough data areas and areas where the geoscientists need better resolution.

ROLLING STOCK

Now let's review some of the vehicles that we use on the North Slope. We are currently utilizing many of the same types of vehicles we have for a number of years, as they have proved to be valued work horses in the Arctic. Our recording trucks are mounted on Chieftains. These are articulating tracked vehicles that allow us to get around very effectively on the open tundra.

Survey Units are typically Nodwell 110's (surveyor style). Again these are tracked style units that have are extremely dependable, which is very important as our surveyors tend to be out away from the crew for extended periods of time during the day, and have to depend upon their vehicle to get them around with little or no assistance. While we have not changed the

design of these units in quite some time, we have moved towards cleaner-burning, more fuel efficient engines.

Next, we have a variety of Cable Trucks that are used depending upon the number of crews we are running and where we are running them. First, there are the Nodwell style cable trucks. These units are the same carrier as the survey units, but with a different bed. They have proved to be extremely reliable and effective.

Next we have several makes of buggy-style cable trucks, including Rolligons and Deltas. These have been particularly effective when utilized on a 3-D program, or when we are working offshore on the ice. They are faster, quieter, and require less maintenance than the tracked units. Unfortunately, they sometimes require that we plow snow ahead of them as they have not gotten around in the deep snow as well as the tracked units.

Finally, we have built and are utilizing for the first time this season, a new style buggy which we think has potential to be a very good unit. We have increased the width of the tires to help reduce the overall ground pressure and to allow the buggies to ride more on top of the snow. It keeps us on rubber tires and gets us away from metal grousser bars associated with the tracked vehicles, helping to reduce the potential for damaging the tundra. As well it also reduces the need for plowing, again in an effort to further protect the tundra from possible damage.

Additionally, we have incorporated a number of features in the cab and cable bed which make the units safer for the occupants, including larger cabs, more windows for increased visibility, simpler controls, seat belts for all occupants, and wider cat walks. And lastly, we attempted to mitigate some of the other environmental concerns by building double walled fuel tanks, better contained hydraulic systems, and hard mounted spill pans. While we have experienced some start up pains with these units, overall, we are satisfied that these units will be good models for us to build upon as we continue our work on the North Slope.

SOURCE UNITS

We typically employ the Vibroseis method for acquiring seismic data on the North Slope. The Vibroseis trucks are designed and built to be able to produce a specific bandwidth of frequencies over a specified time and to do so in a very repeatable and consistent fashion. This is accomplished through a series of electronics that are controlled from the recording truck via a radio signal. The electronics in each vibrator controls a hydraulic servo system that controls the movement of the mass, which in turn transmits to the base plate on the ground. The base plate transmits this seismic energy into the ground. We typically run these trucks in groups of 4 or 5 all shaking simultaneously to generate the energy necessary to record the seismic records.

We have several styles of Vibroseis units available to us. The first would be track mounted units. The carriers are similar in style to the cable trucks except that the Vibroseis units have been mounted on the back. Secondly, we have two styles of buggy-mounted vibes. The first of these were built in approximately 1981 and are similar to our Rolligon or Delta II-style cable trucks. While they are quite effective in many cases, they do tend to bog down in deep snow and need to have the snow plowed ahead of them.

The new style AHV vibes are being utilized for the first time this season. They were built with similar concerns as our new style AMV cable trucks, with the wider tires, double walled fuel tanks, drip pans, etc. Again, these are proving to be effective, although like any new equipment in a harsh environment, we are still learning where we can improve upon the design.

SUPPLY VEHICLES

We are utilizing Delta III buggies as supply vehicles for our crews. These are 6-wheel drive articulating buggies that have a 2,500 gallon fuel tank mounted on them with a crane for moving heavy parcels. These units supply fuel, water, groceries, parts, and personnel for the crews.

We experimented with putting the wider tires on one of these units this season, and while it appears to be a viable improvement, we will need to beef up the carrier system (axles, differentials, planetaries, etc.) in order to make them heavy duty enough to deal with the increased stress from the wider tires.

With the overall increase in equipment and crew sizes, we have been forced to run more of these units per crews. Typically, we could handle a 2-D crew with one or two Deltas, and a 3-D crew with two or three Deltas. This season we have been running three to five units consistently to supply the crew working in the National Petroleum Reserve (NPR) due to the distance out from a fuel source. Various ideas are being investigated now and will be implemented during the off season to address this issue prior to next season.

Additional supplies are provided by aircraft when necessary, or when travel distances get so great that supply units cannot reach the crew in a single day.

CAMPS

Our camps are the traditional cat-camp style. They are strings of trailers hooked together and pulled where necessary by Caterpillar tractors. On a 2-D job the camp would consist of 4 primary strings providing all the necessities for survival on the tundra. Each camp is equipped with generators, a kitchen, diner, wash house, recreation room, crew office, survey office, mechanic's shop, geophone and cable repair shop, dry stores, part house, and sleeping quarters. Additionally, there are two fuel sleds (with capacity for 3000 gallons of fuel each), an incinerator, a snow melter for making water, and a steamer unit. These camps can house approximately 60 persons at a time.

A 3-D camp would be similar except that it would have an additional string containing a recreation room, wash house, and sleeping quarters. It is designed to house up to approximately 100 persons at a time.

As the size of the crews, and subsequently the size of the camps has increased over the years, so has the amount of resources required to supply the camps. Average fuel usage has increased to approximately 2,800 to 3,300 gallons/day, depending upon camp configuration. Average water usage is upwards of 2,000 to 3,000 gallons/day.

CONCLUSIONS

So what has this increase in equipment capacity and new technology provided? Why is it significant? In the field, we are able to acquire more data in shorter periods of time. The data we acquire is more accurate and can produce better results for the teams working the data. Current seismic production levels are at an all time high with regard to the amount of data being acquired on a daily basis. The 2-D crews are consistently producing 10% to 20% more data per day when measured in miles recorded. The 3-D crews have been able to record as much as 4 square miles in a single day, compared to 1 or 2 square miles with previous systems. Not only

are we getting more data, but the data we are getting is allowing us to better illuminate the subsurface.

Better recording instruments and deployment equipment has provided us with more flexibility for survey design which can result in better data acquired in the field. The improvement in data quality, coupled with more data (i.e., better statistics), and improved processing techniques and algorithms has allowed the geophysicists and geologists to extract more information from each data set.

This in turn can lead to more accurate interpretations of the seismic data, and when tied with existing geologic and well information, can produce better maps. This in turn should provide more accurate positioning of wells, and hopefully fewer dry holes. Additionally, geoscientists are better able to correlate the seismic data with known reservoir information to better manage the reservoirs.

WHERE ARE WE HEADED?

With a strong move towards 3-D surveys, 2-D has almost become a thing of the past. However, this is not the case in Alaska. Large areas that have been relatively unexplored can be mapped by acquiring large regional grids of 2-D seismic data which provide exploration teams with the information necessary to evaluate the regional geology and the potential hydrocarbon traps.

While 3-D has become the "tool du jour" in the seismic industry, it is primarily being used as a development tool in many cases. Acquiring modern 3-D seismic over existing fields has helped to extend the life of many fields by pinpointing previously untapped hydrocarbon traps. In turn, these surveys have then been extended beyond the boundaries of known production to allow for exploration or exploitation in flank areas, again, providing for previously undiscovered opportunities and cheaper development as a result of new finds close to infrastructure.

Exploration 3-Ds are starting to be acquired on a more regular basis. This would include broadening the parameters to help control the costs, but still allowing for delineation of the primary targets. Once potential anomalies are identified, site specific, in-fill surveys can be conducted and data volumes can be merged to produce a more detailed subsurface map which would allow for potential development of the prospect.

And lastly, some of you have probably heard about a "new tool" being utilized today, commonly referred to as "4-D seismic." This technique could also be described as time-lapse seismic monitoring. With improved positioning techniques and improved recording techniques we are able to conduct identical, multiple 3-D surveys over the same area to monitor the changes in the seismic response within the producing horizons. These changes in seismic response can many times be related to the movement of fluids or gas within the reservoir.

This is a tool being utilized in existing fields to help extend field life and manage the hydrocarbon depletion more efficiently, through better drilling programs.

Well, this concludes my presentation. While I have given you a broad brush view of the seismic equipment and techniques we are utilizing, I hope it has helped to enhance your understanding of our industry and the changes we have made with the application of state of the art technologies.

TYPICAL DEVELOPMENT SCENARIO AND PRODUCTION OPERATIONS

MIKE JOYCE
ARCO ALASKA, INC.
ANCHORAGE, AK

I am going to discuss "What kind of data do we need for a typical development? What are some of the typical design options that are feasible under different physical and biological constraints? And then, How fast can it happen?"

There have been a lot of changes in the last ten years. The ones that get the headlines are usually the engineering changes—reservoir management and some of the drilling improvements. All of those changes have been great for our side of the business, and by "our" I mean the critters and habitat side of the business as well.

ALPINE DEVELOPMENT PROJECT

I will be using the Alpine Project as an example. I don't want us to focus on the real fine print on the slides and the data itself on the slides that I am showing, but I want to present them as examples of what we have been able to do. Alpine is the latest and greatest from ARCO but it is typical of Badami and Northstar and some of the other development activities on the North Slope. I want to describe the location of Alpine for those who don't know. Alpine is on the western edge of the Colville River, about 30 miles west of the Kuparuk Field. Alpine is right on the edge of the NPR-A boundary.

BACKGROUND DATA

There has been exploratory drilling in the general area for over a decade, so we have relatively long-term background data. We have relatively good data in both quality and quantity. It wasn't too long ago, mid-1980s, that we were still focusing on mainly qualitative information and just a few parameters. Now we collect multiple years of baseline data. We have a much better understanding of what the habitat types are and how they are different from one another. We have a habitat classification scheme that we have worked out with the agencies that we think is very effective. And probably more important, since the mid-1980s, we have done post-construction and operational monitoring. So we have a better understanding of what the causes and effects are.

As I have said physical surface conditions are one of the major things that you have to understand to protect the environment. Prudhoe/Kuparuk was all up on the tundra. Yes, we crossed the Sagavanirktok and yes, we crossed the Kuparuk, but this is the first time that we actually have production, in fact, the whole project down in a major flood plain. So one of the very first things that we did in 1992 to start our six years of, when I put the slide together it was five years because the permit application did not yet have the 1996 data available, we now have 1996 so it is really now six years of baseline information. Also, there is some historical information on peak discharge flow from the Colville River. Dr. Walker, a geomorphologist from Louisiana State University, started going to the Colville in the late 1950s and has been back almost every year since to collect data.

Sociocultural data is another type of information that we need. Our background information includes a lot on subsistence. The Colville is an important subsistence area. It is an activity that we have not had to deal with in the Prudhoe/Kuparuk area. There are typically not

major subsistence activities in the Prudhoe/Kuparuk areas; but there is in the Colville Delta and, as you know, there is very significant subsistence use in NPR-A, particularly around Teshekpuk.

In the following sections I will try to summarize some characteristics of a typical development project and the time period for its completion.

NO ACCESS ROAD

Alpine is 32 miles away from existing infrastructure. For quite some time, those of us that have been planning and scheduling this project have talked about an eight to ten year period for it to actually come on line. Alpine had some physical constraints to deal with that we have not dealt with in Prudhoe/Kuparuk. Prudhoe/Kuparuk are basically up on the tundra; so it took about five years to explore, delineate, and collect baseline information so that we could feel comfortable about proceeding. Then the design and permitting process is going to take about a year, each; and then two years for construction. So, it will be about nine years before Alpine will be on-line.

REDUCE FOOTPRINT AND CLUSTER NOISY OPERATIONS

We are planning on only two small pads at Alpine; the large one is 12.3 acres and the small one is only 5.5 acres. Our total footprint, including the road between pads, is 114 acres. This reduced footprint of industry operations on wetlands has been highlighted in the press over the last several years. It contrasts greatly with early Prudhoe operations. For those of us who remember, the size of the pad for Prudhoe Drill Site One was 65 acres. We have also clustered the noise-producing operations within this area, in order to reduce the magnitude of effects on wildlife.

NO ROAD, AIRSTRIP ON A WIDE SECTION OF THE PAD ROAD

In order to build a road between Alpine and the existing road system, it would have required a 6,000 ft span across the Colville River. We considered a bridge for a road and pipeline, a suspension bridge, but the cost kept rising from 50 to 60 to 80 million dollars. Alpine's size could not support that kind of cost, so the Alpine team prepared a plan with no bridge and no road connection. The Badami Development Project to the east has also been planned without a road connection, and you will probably hear of other projects in the future without roads, using remote-access alternatives.

There is going to be an ice road at least during construction and probably for the first year or two of operation while there is still a lot of drilling activity. Depending on the permit applications, we plan to be going into a construction phase this coming winter of 1997-1998 with an ice road. And for the next two winters while we are constructing and hauling gravel, we will be operating off of ice roads. When we build ice roads, there are restrictions on tundra travel. We need authorization from the Alaska Department of Natural Resources for tundra travel. We are not allowed to start until the ground is frozen and the snow pack is thick enough.

Air transport is crucial without a road. The airstrip will be a wide section in the road between the two drill pads. The airstrip will be one of the primary stressors to birds. One of the things that we did to reduce the effects was to restrict the airstrip activity during the nesting season. During six to eight weeks in June and July, we have restricted aircraft access into the airstrip to minimize the airstrips disturbance to birds. The restriction has required the drillers and operators to plan differently about their summer activities. So materials will be brought in prior to that restricted use period and stored. The restriction applies to large aircraft that haul all of the

materials that are needed for drilling and maintenance; they will have to be brought in via airplane in the shoulder months or via ice road in the winter. However, personnel access will probably be implemented during all seasons with small aircraft, such as Twin Otters. Small aircraft for personnel and fresh produce will still have access on a limited basis during that period.

PIPELINE BURIED UNDER RIVER

The absence of a bridge meant that the pipeline would be buried under the river. A hole will be drilled horizontally, using directional drilling, so that it passes 100 ft under the river. The pipeline will be double-walled at river crossings, and have a leak detection system.

ZERO DISCHARGES

Zero discharge is now the common practice. As you know, there are no reserve pits designed into the drilling pads now. The drilling wastes are reduced by eliminating a lot of the old water-based formulas. We use less water and recycle the materials, and the component that is still left at the end is injected in a well. So there is no surface disposal. Those materials are injected and the volumes are significantly reduced from what they were in earlier years.

REDUCED GRAVEL AND WATER NEEDS

We need a relatively small quantity of gravel because of the reduced footprint. There is a substantial difference between building a 65 acre pad versus a 5.5 acre pad. There are two possible sources of gravel for Alpine. The Arctic Slope Regional Corporation is permitting a new gravel site that is to the east of the main channel, almost due east of the Village of Nuiqsut. If that is ready, it is the leading candidate for gravel. If that isn't ready, we will probably haul from the Kuparuk material site, most likely at site called 2-F which is on the western end of the field. With regard to water, it is used mainly for drilling, but some is used for the camp. We are fortunate at Alpine that a lake by the processing facility happens to have no fish in it, so it is a suitable source of water.

MONITORING CONSTRUCTION AND OPERATIONS

Monitoring will be done with the Alaska Department of Fish and Game and the U.S. Fish and Wildlife Service. One of the other changes in the last three to five years is that there is much better cooperation on studies between industry and the agencies. They are more involved. We ask for opinions up front and solicit those opinions and incorporate them. We ask them to participate in gathering the monitoring data.

At Alpine we will be monitoring primarily at the air strip beginning this summer and for three additional years, which will carry us through the two years of construction and the first year of operation. We will be monitoring bird activity and behavior around the airstrip, the processing facility, and camp locations. We will also be monitoring fish use and access of two or three of the key water-source lakes. Then we will be doing some additional monitoring of air quality. We are going to start the bird monitoring a year early, so there will be a four-year monitoring program for birds, specific to disturbance from the airstrip and the processing facility. The monitoring will involve review and input from the Dept. of Fish and Game and U.S. Fish and Wildlife Service. If that monitoring shows that something catastrophic is affecting the birds due to aircraft, for example, we will continue to look at ways to modify aircraft activity.

USE OF ICE ROADS AND ICE PADS FOR ALASKAN ARCTIC OIL EXPLORATION PROJECTS

BEEZ HAZEN, P.E.
NORTHERN ENGINEERING & SCIENTIFIC
ANCHORAGE, AK

Modern Alaskan arctic exploration projects are designed to minimize environmental impacts at exploration sites and along access routes to these sites. In recent years, industry has been constructing ice roads, ice airstrips, and ice drilling pads. Previously, gravel roads, airstrips, and drill pads were common. The evolution away from gravel construction is due in part to reducing environmental impact and cost of restoration, and in part to better ice construction technology and development of specialized equipment.

SITE LOCATION, ROUTE PLANNING AND PERMITTING

Once an exploration site has been identified, a series of studies commence to define the best physical location for the ice pad, the best ice-road route to the site, and a realistic overall schedule for the project. This schedule includes front-end activities such as gathering summertime site data. This data is required for the planning, permitting, and execution activities for the project. The execution phase generally includes construction of the ice road, pad and airstrip, mobilization and demobilization of the drilling rig and equipment, drilling and testing of the well, and clean-up activities conducted before and after spring break-up.

ICE ROAD AND PAD CONSTRUCTION

When the field project begins, all-terrain vehicles (ATVs, such as Rolligons) with very low ground pressure are used to transport surveyors to flag the ice road route and the ice exploration pad and begin to pioneer the ice road. Often temporary snow fences (approximately 4-foot high rolled fencing with wooden slats) are erected perpendicular to the prevailing wind direction near the ice pad to capture drifting snow for use in ice construction. These efforts can begin as early as mid-November unless there are rivers along the ice road routes. Occasionally equipment is staged near the project site avoid project delays while river ice thickens naturally or through flooding operations. Generally, however, ice road and pad construction begins during middle to late December when ambient temperatures are cold enough for relatively fast ice road construction and when river ice is thick enough.

ATVs are generally used to construct the first lift of ice roads and pads. This lift is approximately 2 in. thick and 20 ft wide for roads, and 2 in. thick and the full dimensions (e.g., 500 by 500 ft) for pads. It is designed to provide enough support for higher ground pressure bulk water haul trucks, loaders, and graders that are used to build up the roads and pads to design dimensions. The ice thickness build rate ranges between 0.5 to 1.5 inches per day, depending on ambient temperatures, distance from water sources, etc. Incorporating captured or mined snow significantly increases the build rate. Occasionally, ice aggregate trimmed from the surface of nearby freshwater lakes is used as fill to build pads, equipment ramps, and to build-up ice thickness at river crossings. Generally little maintenance of (land-based and offshore grounded) ice roads and pads is needed after construction, except for snow clearance. The cost for typical ice-road construction is approximately $40,000 per mile.

TEMPORARY CUTTINGS STORAGE AREA

At most exploration sites cuttings are stored temporarily in a bermed area of the ice pad. The ice pad is a minimum of 1 ft thick in this area, which provides enough depth to allow for scraping and trimming of the ice surface after cuttings have been transported to Prudhoe for processing. Berms surrounding the cuttings area are generally 3 ft tall. Often the cuttings area is subdivided with shorter berms so loaders can more efficiently empty cuttings bins and not track the wet cuttings around the cuttings area.

WELL CELLAR

The only excavation at modern exploration pads is for the well cellar. Excavations range in size up to approximately 16 ft on a side and up to 10 ft deep. Reserve pits are no longer excavated. During excavation for the cellar, organic material and organic-rich soil (generally the top two to three feet of the excavation) are kept separate from underlying mineral soil. When the cellar is backfilled, the organic material and organic-rich soil is placed at the top of the fill to promote revegetation. Modern cellars often have insulated walls and floors to prevent melting of surrounding permafrost during well drilling. Occasionally, heat is extracted around the top of cellars and under rigs to prevent any melting of the ice pad.

EXTENDED SEASON ICE PADS

Recent BP Exploration (Alaska) (BPXA) projects described by Hazen, et. al., (1994) and by Stanley, et. al., (1996) documented the viability and cost advantages of using extended-season ice pads for exploration projects. At Yukon Gold #1 BPXA built an ice pad during March, covered the ice pad with reusable insulated panels to preserve the ice pad through the summer, and were able to occupy the ice pad and begin drilling nearly two months earlier than a conventional ice exploration pad. Accordingly, BPXA was able to drill two remote exploration wells off separate ice pads during the same winter drilling season. At the second location, Sourdough #2, ambient-air vent tubes were installed in the ice pad to extract heat under the rig and the rig was put on top of insulated panels. These steps were taken to give BPXA the option to leave the rig in place on the ice pad through the summer. Stanley, et. al. (1996), showed that measured ice pad temperatures at the end of drilling were colder than predictions. They concluded the ice pad would have remained frozen under the dormant (stacked) rig through the summer. Schematic designs have been developed to use active refrigeration to preserve the ice pad under a working rig during summer months.

ENVIRONMENTAL IMPACT

Single-season ice pads, ice roads, and ice airstrips melt naturally during spring breakup and leave virtually no trace. Limited, short-term impact does occur at multi-season ice pads, if tundra around the perimeter of the pad thaws and is blocked from sunlight. The documented case presented at the NPR-A Symposium by the author and by Dr. McKendrick, was at BPXA's Yukon Gold #1. Insulated panels covering the ice pad were covered with a white surface fabric. The fabric extended 4 to 6 ft beyond the insulated-panel footprint and was secured/held down by a continuous line of timbers. During spring breakup, as the ice beyond the insulated footprint melted, the timbers were designed to move down and rest upon the tundra surface and thereby cause surface fabric to drape over the pad edges. This was done to minimize thermal erosion of the ice around the insulated footprint. During summer, tundra melted under the timbers, as expected, and was blocked from sunlight. Locally, the tundra consumed its stored nutrients and died. During the NPR-A Symposium, Dr. McKendrick presented a photohistory of the Yukon Gold

#1 perimeter, showing rapid recovery of vegetation. A design has already been developed to minimize perimeter impact.

SUMMARY

Construction of ice roads, ice pads, and ice airstrips is standard practice for modern Alaskan Arctic oil exploration projects. Typically, construction begins during December, the well is drilled during February and March, and the rig is demobilized during April. The ice melts during breakup, leaving virtually no trace of the exploration project. A few extended-season ice pads have been constructed, affording multiple wells in one winter drilling season, and allowing the rig to stay on location through summer months.

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HISTORIC AND PREHISTORIC CULTURAL RESOURCES IN NPR-A

Session Co-chairs: Mike Kunz, BLM, Fairbanks; and Mike Burwell, MMS, Anchorage

REGIONAL CULTURAL HISTORY AND PREHISTORIC SITES: 10,000 B.C. TO 1,500 A.D.

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Northern Alaska's culture history spans more than 10,000 years of human use of the region, encompassing seven major cultural periods recognized by archaeologists. Early in the exploration of the petroleum reserve, finds of fluted points similar to those of the Clovis and Folsom cultures of the midcontinent suggested great antiquity for humans in the arctic, but it was not until the 1990s that numerous radiocarbon dates from the Mesa site demonstrated the presence of a Northern Paleoindian tradition (8,000-12,000 years before present [B.P.]) within NPR-A. The Mesa site and several others in the region contain lanceolate projectile points and other tools similar to those of Paleoindian cultures of the high plains and desert southwest. Another early culture is represented at the Mesa site, the Tunalik site, and at other localities within NPR-A, the American Paleo-Arctic tradition (8,000-10,000 B.P.). This culture, typified by small microblades struck from wedge-shaped cores, is clearly of Siberian derivation. The Northern Archaic tradition (4,000-6,000 B.P.), not well represented within NPR-A, also contains microblade technology, but is most notable for its side-notched projectile points strikingly different from earlier forms. The Arctic Small Tool tradition (ASTt) (1,000-4,800 B.P.), first defined at Etivlik Lake just south of the petroleum reserve, eventually spread from Alaska across the entire North American arctic as far as Greenland. This tradition is thought to represent the earliest of the Eskimo-related cultural periods, as evidenced by the exceptionally well-preserved organic artifacts from later periods of the ASTt. The Northern Maritime tradition (800-1,500 B.P.) encompasses marine-adapted coastal dwellers ancestral to modern Iñupiat, and a second migration of these people across the American arctic about a thousand years ago. The Late Prehistoric (800-175 B.P.) is a period of transition on the coast between northern Maritime peoples and the modern Iñupiat of the Historic period (175 B.P.-Present). In the interior the Late Prehistoric period is typified by large lake-side villages such as the Sikoruk site at Tukuto Lake within NPR-A.

The NPR-A is indeed remote, but is by no means a backwater with little of archaeological interest. All of the northern Alaska cultural periods are represented by sites in the petroleum reserve, and some sites in the region, like the Birnirk and Mesa sites, have achieved international recognition as the type sites for widespread archaeological cultures. It is certain that all periods of the regional cultural sequence are represented within the northeast planning area, though archaeological investigations there have been sparse. The only systematic investigations have been around Teshekpuk Lake. North of Teshekpuk what is known of the archaeological record comes from clearance work related to earlier phases of petroleum exploration. South of Teshekpuk very little archaeological work has been done, especially in the important Pleistocene/Holocene dune field complexes that have high potential for well-preserved ancient sites.

Protection of cultural resources during renewed petroleum exploration and production in the planning area should follow well-established and proven procedures worked out during the 1970s and 1980s phase of exploration (Hall and Gal 1988). Specific recommendations include:

- Ongoing BLM cultural resources inventory within priority areas of NPR-A (authority: E.O. 11593, NHPA Sections 106 & 110).
- Explicit cultural resources protocols for environmental assessments (EAs) should be specified in the environmental impact statement (EIS).
- Complete reconnaissance level inventory should be completed for all lease blocks.

- At least one summer field-season advance notice of locations for all exploration and development activities.

- Cultural resource clearance by qualified professionals required for all drill pads, material sources, air strips, road alignments, river crossings, seismic routes, etc.

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THE MOST SUCCESSFUL HUNTERS: NORTHERN ECONOMY A.D. 400 TO PRESENT

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Ancestors of today's North Slope peoples hunted and fished for almost the entire range of game species available in the North for thousands of years. Around A.D. 400 they achieved an important breakthrough - they reached the stage where they could predictably succeed every year in their hunt for the bowhead whale. Their assurance that they could rely on the whale hunt, at least partly based upon the effectiveness of drag float technology, allowed these people that archaeologists call the Birnirk folk to begin to modify their lifestyle, concentrating more effort and time on the whale hunt. Correspondingly, they had less time for hunting other species.

Starting ca. A.D. 800, whaling was the dominant factor in people's lives. Archaeologists acknowledge this by calling these whalers the Thule folk. Thule people were dependent upon whales for much of their food and fuel. Their confidence in their ability to support themselves may be reflected in their art, which is less intricate than Birnirk art, perhaps showing less uncertainty in relations with the spiritual world. When a small climatic change ca. A.D. 1000 warmed the north enough to allow whale hunting throughout the circumpolar north, Thule people exploded out of northern Alaska and colonized the Canadian Arctic coast and Greenland.

The climate got a little colder ca. A.D. 1200-1400 and whaling became difficult or impossible throughout most of the Thule range. In Alaska, the only place people could predictably rely on access to whales was at and near points of land, where the nearshore leads in spring were always within hiking distance of land. People established large sedentary villages. As village populations grew, there was not enough game (other than whales) available within walking distance. Small satellite communities sprang up, but the residents returned to the main villages for whaling. Another source of raw materials was increased trade. Once the coastal villages were established, their demand for caribou products supported inlanders' specialization in caribou hunting. The cushion provided by trade led to rising population inland throughout the rest of the prehistoric period.

Eventually, there was no room even for satellite communities. Trade along the coast extended as far as it could, into Canada and across to Siberia. Interior trade reached capacity. The strain was reflected in warfare. In 1800, up to 200 people were killed in a battle near Point Hope. Only a generation later, in 1826, the first contact with Westerners took place. By the early 1850s the whale stocks were being affected by Yankee whaling further south, and in a few short years the Yankees themselves became a northern fixture.

The whaling culture that once supported inlanders and coastal dwellers alike suffered numerous grave setbacks well into the early twentieth century. Whales and then walrus stocks were decimated. New diseases were devastating. Through it all, people kept their focus on whaling. Today, Iñupiat whalers again are the pivotal players in a regional economy whose ties extend far off the North Slope. They represent the direct descendants of people who created an incredibly complex and effective technology to hunt the largest game animals in the world in the most extreme environment that humans have successfully settled. In the bell curve of hunter-gatherers, these people were at one extreme end, eating virtually nothing that they did not hunt, creating the most sophisticated hunting culture the world has seen.

The cultural resources of the North Slope represent World-class heritage for all of humanity. These resources range from the oral traditions carried by Elders, to the interior and coastal archaeological sites that once were all bound together in an enormously successful regional economy. We have a great deal to learn about the human condition from these people and from their ancestors' sites. For instance, what are the conditions under which people are motivated to undertake colonization, and what enables them to be successful? What are the effects of choosing sedentarization upon a formerly much more mobile population (first when the large villages were settled, once again when effects of contact with Yankees became strong)?

But all of these resources are endangered. Many Elders have not had the opportunities to pass on their encyclopedic knowledge. Many sites were situated along bodies of water, and almost all of them are eroding. Any additional endangerment or incremental loss at this stage could forever compromise our ability to come to grips with the large unanswered questions of our common human heritage. Many archaeologists and other "data gatherers" have not committed their data to print and this unavailable data is also constantly "eroding."

There is a great need for research that will allow us to further develop the overall context for Eskimo development in the north. This contextualization is needed for the National Petroleum Reserve-Alaska (NPR-A) Environmental Impact Statement (EIS), if the EIS is going to guide future development, and if the EIS is going to guide federal and other efforts at data collection and analysis.

What happens if the Draft EIS is rushed? When will this data be accessed and analyzed? Residents of the North Slope assert ownership over aspects of their cultural heritage. They have created their own rules and regulations for defining significant cultural resources, and these rules are more strict than any analogous state or federal ones. Their point of view and their sensibilities deserve a place in the draft and final EIS, and deserved to be expressed in the procedures that the EIS will mandate for development in the NPR-A. The EIS must also recognize that the people collectively and their regional government, the North Slope Borough, hold some data as proprietary. Methods should be developed to allow North Slope people to review development proposals in light of their traditional knowledge, much of which has not been recorded, or which has been recorded but can only be shared on a case-by-case basis.

To what extent will the EIS establish protocols to include the people's traditional culturally defined interests in the review process? Given the data's sensitive nature, will the EIS provide for local review of traditional cultural interests for each proposed project within the NPR-A? How will sensitive information be protected?

Procedural questions raised here can be resolved with goodwill and a little work. The scientific questions can only be answered by timely research.

RECOMMENDATIONS

- Ongoing BLM cultural resources inventory within priority areas of NPR-A (E.O. 11593, NHPA Sec. 106 & 110.)
- Explicit cultural resources protocols for Environmental Assessments (EA) should be specified in EIS.
- Complete reconnaissance level inventory should be completed for all lease blocks.

- At least one summer field-season advance notice of locations for all exploration and development activities.
- Cultural resource clearance for all drill pads, material sources, air strips, road alignments, river crossing, etc.
- Consultation with cultural resources professionals for protection of sensitive areas along seismic line routes.

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PALEONTOLOGICAL RESOURCES OF THE NPR-A PLANNING AREA: AN OVERVIEW

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As one proceeds from the south to the north in the planning area, the rocks generally change from oldest (Mesozoic) to youngest (Quaternary) in age. The earliest fossil record in the planning area is found in sedimentary rocks assigned to the Late Cretaceous (circa 95 Ma). This marine and terrestrial record is found in the extreme southern portion just southwest of Umiat. The youngest fossils are contained in early Holocene (<10 Ka) age marine sediments directly underlying tundra and found along the courses of rivers and in the banks of thaw lakes. The most diverse and important collections originate along the Colville and Ikpikpuk rivers. Teshekpuk Lake has provided an unusual late Pleistocene mixture of marine and non-marine mammals.

Thus far, the southern third of the Ikpikpuk River and the northern third of the Colville River have produced abundant remains of late Pleistocene (35-10 Ka) mammals including bison, horse, mammoth, various carnivores, and rare insects. Even more abundant remains of marine mollusks and microfossils have been collected from bluffs cut by these two rivers. This sedimentary record of late Quaternary climate and ecosystem changes is vital to understanding the evolution of the Arctic Ocean basin and the impact of humans on Arctic North American ecology.

A ten mile stretch of the Colville River, from the Kikiakrorak River to near Big Bend, has produced the most diverse and voluminous high latitude dinosaur collections in either hemisphere. Over 6,000 skeletal elements representing 10 different taxa have been curated over the last 13 years. Most were contained in a series of concentrations called bone beds. In addition, closely associated mammals, fish, and plants have been collected. This data set, which is dominated by juvenile dinosaurs, is critical to questions of dinosaur development, biogeography and theories attempting to explain the K-T mass extinction. Sites between Uluksrak Bluff and Kikak Creek promise to greatly expand our knowledge of Arctic dinosaur behavior and ecology.

The direct relationship between good exposure of fossils and the most navigable rivers makes these fossil resources especially vulnerable. Any activity that would increase use of the lower Colville or the Ikpikpuk for transport or recreation would put unprecedented pressure on the paleontological resources. The following recommendations are meant to help protect and properly develop the most important of these resources:

1. Protection of fossil sites is best accomplished by establishing a consistent presence. Monies often spent on ranger patrols is better spent on supporting annual research and salvage parties along the Colville River from Uluksrak Bluff to Ocean Point, and along the southeastern shore of Teshekpuk Lake as well as the northern and southern ends of the Ikpikpuk. In addition, a ten mile section of the Colville, from Bluff to within 2 miles of Ocean Point should be added to an extant Special Area.

   Further, a consortium of museums and universities should be formed and encouraged to conduct cooperative research and field courses in the Special Area.

2. Develop a certification program in paleontological field work and site evaluation for rural residents and volunteers from throughout Alaska. Establish a fossil alert and protection network with the University of Alaska and Ilisagvik College as centers.

3. Establish a minimum level of patrol presence that targets areas within those outlined in #1 that do not have an annual research or schooling presence.

4. Expand the present BLM-UA Museum educational outreach program in order to more widely inform the people of Alaska as to the value of protecting their paleontologic heritage.

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NORTH SLOPE VILLAGE SUBSISTENCE AND SOCIO-ECONOMICS

Session Chair: Craig George, Department of Wildlife Management, North Slope Borough, Barrow

NORTH SLOPE SUBSISTENCE HARVESTS AND MAPPING: BARROW AND WAINWRIGHT

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The purpose of this presentation was to 1) identify relevant subsistence research related to the NPR-A area, 2) identify potential conflicts between development of petroleum resources and significant resources in the planning area, and 3) make recommendations as to how such conflicts might be avoided or mitigated.

Stephen R. Braund & Associates (SRB&A) conducted subsistence harvest studies for three years in Barrow (4/1/87 to 3/31/90) and two years in Wainwright (4/1/88 to 3/31/90) for the Minerals Management Service (MMS) and the North Slope Borough (NSB) between 1987 and 1990. The purposes of the study were 1) to collect subsistence harvest data by species for each community that was generalizable to the whole community and 2) to collect mapped harvest sites. As Barrow was too large to interview each of the 3,000 people living in 935 households, the study team used a disproportionate stratified sample. The sampling unit was the household as they are easier to define than extended families and are more efficient to interview than individuals. The final Barrow sample at the end of three years was 101 households or 90 percent of the 112 desired interview households. Due to Wainwright's relatively small population of 502 persons in 128 households, every household in the community was sought for interviews. By the end of the second year, 100 households had participated in the study for two years. Full-time field coordinators resided in each community to interview study households periodically throughout the study. Interviewers recorded harvests by species on the SRB&A Harvest Activity Sheet and mapped each harvest on a 1:250,000 topographical map. Data were processed to produce harvest totals by species and species groups, pounds harvested (total, per capita, and per household), the number of animals harvested, and harvests by month. Mapped data were processed at the NSB GIS. Each individual harvest location was digitized. Data linked with each digitized harvest point included: entry ID, household ID, species harvested, amount harvested (number of animals/fish), usable pounds harvested, date of harvest (month, day, year of harvest), and location of harvest. Products from this study include 1) the North Slope Subsistence Study - Barrow (1987, 1988, & 1989) based on three years of continuous data collection from a stratified random sample of 101 households (5,701 individual harvest records) and 2) the North Slope Subsistence Study - Wainwright (1988 and 1988) based on two years continuous data collection from 100 households (4,593 individual harvest records).

For the three years, Barrow averaged 702,660 pounds per year (or 750 pounds per household or 233 pounds per capita). These figures include all Barrow residents. Iñupiat households harvested 1,200 pounds per year. Barrow residents harvested at least 52 species of mammals, fish, birds, and other resources. Marine mammals comprised 55 percent of Barrow's harvest whereas terrestrial mammals comprised 30 percent, fish represented 11 percent and birds four percent. Ninety-three percent of Barrow's harvest occurred from April to October. Key species included bowhead whales, caribou, walrus and whitefish. Over the two years in Wainwright, harvests averaged 304,047 pounds per year or 2,624 pounds per household or 638 pounds per capita. Wainwright harvested at least 46 species of mammals, fish, birds, and other resources. The species mix was 70 percent marine mammals, 24 percent terrestrial mammals, 5 percent fish, and two percent birds. Key species included bowhead, walrus, and caribou. Eighty-seven percent of Wainwright's harvest occurred form April to September.

The Barrow harvest area (based on the sample households only) was from Peard Bay to the Colville River, offshore over 25 miles, and included extensive inland areas. The Wainwright harvest area was concentrated within a 15 mile radius offshore from Wainwright for marine

mammals although additional harvests extended NE to Peard Bay and SW to Icy Cape. Wainwright hunters ranged inland to the Brooks Range. (Slides of examples of Barrow and Wainwright harvest locations were presented.)

Limitations of the North Slope Subsistence Study included 1) its focus on subsistence harvest sites only and not general use areas or travel areas or hunting areas, and 2) although the sample in Barrow allowed harvest amounts to be generalized to the entire community, the locational data could not be generalized to represent all of Barrow. Thus, this study provided a potentially limited picture of Barrow and Wainwright subsistence.

For this reason, the North Slope Borough Key Informant Mapping Project was conducted in conjunction with the previous study to address two aspects of North Slope subsistence not covered in the earlier study: 1) interviews with Barrow residents who were not in the original sample in order to increase the geographic coverage of harvest areas not in the original sample of 100 households, and 2) interviews that specifically focused on areas where Barrow and Wainwright residents hunted, but not necessarily harvested (overall use area; not just harvest sites).

In Barrow, a total of 59 key informant mapping interviews were conducted (16 in Year 1, 19 in Year 2, and 24 in Year 3). In Wainwright, a total of 20 key informant mapping interviews were conducted. Thus, the total for both communities was 79 map interviews. Preliminary analysis of these mapped data (slides) indicate that:

- Both Wainwright and Barrow harvest extensively within NPR-A
- Barrow harvest areas extend to the Colville River
- Residents make extensive use of rivers and lakes (and surrounding land areas)
- Teshekpuk Lake and the surrounding area is an important use area
- The Meade, Chipp, Ikpikpuk and other rivers are important use areas and travel routes

Potential conflicts between NPR-A development and Barrow hunters could occur related to terrestrial mammals (caribou, furbearers), fish and birds/waterfowl. Recommendations and mitigation measures include:

- Assess the historic importance of the NPR-A project area for subsistence harvests
- Monitor harvests in that area
- Monitor hunters' concerns
- Document harvest changes over time
- Work in conjunction with local communities - involve local residents
- Establish a wildlife/subsistence working group
- Incorporate local suggestions into development/production plans
- If there is any contamination, involve residents in conducting a sampling program to monitor toxicity in harvest
- Disseminate safety and other information to residents

The mapping data currently available includes the following and is available from the North Slope Borough:

Barrow - three years of harvest location data by individual species and harvest amount for sample households (published as 8 x 11.5 maps in MMS & NSB reports)

Wainwright - two years of harvest location data by individual species and harvest amount for all households in Wainwright that participated (published as 8 x 11.5 maps in MMS & NSB reports)

Unfinished mapping data are the North Slope Key Informant Mapping Project data for Barrow and Wainwright that is currently located at the SRB&A offices in Anchorage and includes:

Harvest points (available above)
Travel routes
Hunting areas
Harvest intensity maps
Lifetime community land use boundaries (available from NSB).

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OVERVIEW OF THE NORTH SLOPE BOROUGH SUBSISTENCE HARVEST DOCUMENTATION PROJECT

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INTRODUCTION

The primary objective was to document the harvest of renewable resources and land used by subsistence hunters of the North Slope Borough.

The basic method used was to conduct individual household surveys on a twice yearly basis. Of major importance is determining the total number harvested, by species, for a village for the year. Of similar importance is the documentation of hunting areas.

Reports are completed for the study period of July 1, 1994 through June 30, 1995 for Anaktuvuk Pass and Nuiqsut, Alaska. Data for this period for Atqasuk are in the draft stage, and the data for Barrow are in the early stage of analysis.

The report for Anaktuvuk Pass indicates that caribou is the most important resource to the Nunamiut. The reported number of caribou harvested during the study period was 311. According to local hunters in Anaktuvuk Pass, this is a low number compared to other years of harvest. Sheep, moose, and brown bear each play an important role as supplemental sources of meat when caribou are scarce. The percentage of harvest in edible pounds by category indicates that caribou was 82.5%, fish 4.2%, birds 0.4%, moose and sheep 12.6%, and plant 0.2%. A total of 40 harvest locations or place names were identified during the study period.

The report for Nuiqsut indicates that 29 harvest items were reported to be taken by Nuiqsut hunters during the study period. The subsistence harvest of terrestrial mammals (caribou and moose) accounted for 69% of the edible pounds. A reported total of 249 caribou were harvested by Nuiqsut hunters. Caribou dominated the subsistence harvest in edible pounds with 48%, fish 25%, plants less than 1%, birds 4%, marine mammals 2%, and moose 21%. A total of 44 harvest locations or place names were identified during the study period.

Reporting of the data for Atqasuk is currently in the draft stage and hopefully should be completed by the end of May 1997.

Evaluation of the data for Kaktovik was put on hold until the reports for Atqasuk and Barrow have been completed, due to the fact that Atqasuk and Barrow will be affected by the NPR-A lease sales.

ANAKTUVUK PASS

Eighty-two of the 85 households in Anaktuvuk Pass were surveyed regarding the number of subsistence harvest items that were harvested during the study period of July 1, 1994, to June 30, 1995. Detailed harvest information was collected for all subsistence use

species taken by residents of Anaktuvuk Pass. Our findings show that 22 harvest items were reported as being harvested by Anaktuvuk Pass hunters. The key harvest items were caribou and sheep for terrestrial mammals, grayling for fish, ptarmigan for birds, wolves for furbearers, and salmonberries for vegetation.

During this study period the most important harvest item was caribou, which accounted for 82.5% of the edible pounds of the subsistence harvest. The reported number of caribou harvested during the study year was 311. This is a low number of harvested caribou compared to other years of harvest data. The low level of harvest reflects the poor caribou migrations through Anaktuvuk Pass during the fall (1994) and spring (1995).

Sharing subsistence resources is an important Iñupiat tradition, and as such is commonly practiced by Anaktuvuk Pass hunters. Some examples of this sharing are the community feasts that take place during Thanksgiving and Christmas, where harvest items such as caribou and fish are distributed by successful hunters to community members and visitors. Of the 82 households interviewed, 50 reported that they harvested subsistence resources. The same 50 households also reported that they shared some of their harvest at least once.

All concerned parties must recognize that the data presented here represent harvests during a one year period and based on this limited period of time, one cannot determine the exact level of harvest needed by this village to meet its cultural and nutritional needs.

NUIQSUT

Eighty-two (71 actually interviewed) of the 83 households in Nuiqsut were surveyed regarding the number of subsistence harvest items that were harvested during the study period of July 1, 1994, to June 30, 1995. Detailed harvest information was collected for all subsistence use species taken by residents of Nuiqsut. Our findings show that 29 harvest items were reported as being harvested by Nuiqsut hunters. The key harvest items were caribou and moose for terrestrial mammals, arctic cisco and broad whitefish for fish, geese unidentified and eider unidentified for birds, wolf for furbearers, and salmonberries for vegetation.

During this study period the most important harvest item was caribou, which accounted for 48% of the edible pounds of the subsistence harvest. The reported number of caribou harvested during the study period was 249. Compared to limited data for other years this is a low number of caribou harvested. In speaking with hunters the low level of harvest reflects the long distance they had to travel to harvest caribou. Local hunters expressed their concern regarding the increasing number of muskox and several hunters believe that muskox deter caribou away from hunting areas. Another comment made by Nuiqsut hunters relates to their traditional subsistence land use areas, which have been restricted due to oil and gas exploration and development. For example, areas used ten years ago for hunting and fishing may have restricted access today due to being within development and exploration areas.

Sharing subsistence resources is an important part of the Iñupiat tradition, and as such is commonly practiced by Nuiqsut hunters. Some examples of this sharing are the community feasts that take place during Thanksgiving, Christmas, and Nalukataq (whaling

feast), where harvest items such as whale, caribou, and fish are distributed by successful hunters to community members and visitors. Of the 82 households surveyed (71 actually interviewed), 49 reported that they harvested subsistence resources. The same 49 households also reported that they shared some of their harvest at least once.

All concerned parties must recognize that the data presented here represent harvests during a one year period and due to the lack of an adequate time series one cannot, at this point, determine the exact level of harvest needed by this village to meet its cultural and nutritional needs. It is especially important to recognize that subsistence harvested bowhead whales usually are major contributors to the cultural and nutritional needs of the people of Nuiqsut; however, due to poor hunting conditions no bowhead whales were harvested during this study period.

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NORTH SLOPE VILLAGE SUBSISTENCE AND SOCIO-ECONOMICS[1]

THOMAS NAPAGEAK
ALASKA ESKIMO WHALING COMMISSION
NUIQSUT, AK

My name is Thomas Napageak. I am from the Village of Nuiqsut. Sitting in the back I was just thinking on what I should speak about this morning. Stephen Braund pretty much stated what I would have said about subsistence and the nutritional needs of the Natives.

I was hoping that our right hand man, the legal counsel for Kuukpik Corporation would be here this morning but I haven't seen him yet. But there is another person in the audience who is with the North Slope Borough Planning Dept. Isaac Nukapigak is the Nuiqsut representative to the Planning Dept.

The village is very concerned about how NPR-A will be developed, if it is developed. Our hope has always been that Alpine would be a complete model of what NPR-A development would be like. But I would like to be frank and usually I come right to the point. Up to date, ARCO has not heeded what the community really wants. Accumulated impact effects that would hinder the community and the socioeconomics of the community, how will it be affected through Alpine and presumably NPR-A; these and many others really need to be considered. For instance, Alpine is in a prime area known as wetlands. ARCO is proceeding with Environmental Assessment procedures. The community requested that a proper EIS be done. But they are proceeding with their own Environmental Assessment put together by their own contractors. I know there is a lot of conflict of interest on their part.

When the well runs dry, the Native people of Nuiqsut will still be there. When the oil companies leave with all of the money drained out of our land, we will still be there. If you turn to the history books, when the great Titanic was built, it was supposed to be an unsinkable ship. But on the first voyage, it ran into an iceberg and sank. Now they are talking about 30 miles of pipeline without roads. They are talking about oil spill response. These have hardly been talked about by ARCO to the community. There is so much at stake for this little village that in the Colville Delta. You know I was touched yesterday by the historical sites that were being presented in slides, etc. Down by a village two years ago, seismic exploration was moving rapidly right over two graveyards. Of course, the markers were driftwood and had fallen off. But the graveyards were still visible. However, you can't see everything from a Rolligon or exploration vehicle when the snow is drifting. The graveyards were being run over. When I die I would like to rest peacefully under the ground without any seismic activity running over me.

But these are things that are of importance. Things that need to be evaluated very carefully. I believe the Environmental Assessment is not giving the local community any consideration because the studies are being done by ARCO's contractors. I know that time is running out. I will be here and if you have any questions I will hopefully be able to answer them.

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[1] This is a briefly edited transcript of Mr. Napageak's presentation.

WETLANDS AND THEIR SIGNIFICANCE IN NPR-A

Session Co-chairs: John Payne, BLM, Anchorage; and Tim Jennings, U.S. Army Corps of Engineers, Anchorage

DISTRIBUTION OF HIGH-VALUE WETLAND HABITATS ON A REGIONAL SCALE

DR. FREDRIC REID, RICHARD KEMPKA, AND ROBB MACLEOD
DUCKS UNLIMITED, INC.
RANCHO CORDOVA, CA

The National Petroleum Reserve in Alaska (NPR-A) includes over 9.4 million hectares (23.4 million acres) and is located on the North Slope of Alaska, much of which falls within the Arctic Coastal Plain physiographic province. The Arctic Coastal Plain contains one of the largest and most stable collections of wetlands in North America. The objective of this project was to create an updated and detailed land cover inventory in computer database format for the entire NPR-A. In addition, information on observed spectacled eider locations was related to land cover types. The NPR-A project was split into three phases because of the immense size of the project area and limited field access due to climate and lack of aircraft support infrastructure. These phases were completed in 1995, 1996, and 1997, respectively. The cooperators in this project include BLM-Alaska, Ducks Unlimited, U.S. Fish and Wildlife Service, North Slope Borough, and Pacific Meridian Resources.

Eight Landsat Thematic Mapper (TM) satellite scenes and three SPOT XS satellite scenes were used to classify the NPR-A into land cover categories. An unsupervised clustering or seeding technique was used to determine the location of field sites. A custom field data collection card was used to record field information. After initial on-the-ground sampling, helicopters were utilized to gain access to field sites throughout the project area. Global positioning system (GPS) technology was used both to navigate to preselected sites and record locations of new sites selected in the field. Data were collected on over 1600 field sites during the three year period. A portion (45%) of these field sites were set aside for accuracy assessment.

The results of this classification suggest dominant land cover types at 37.4% dwarf shrub, 23.5% tussock tundra, 6.1% clear water, 5.5% sedge grass meadow, 4.3% turbid water, 4.1% wet tundra, and 3.6% low centered polygons, 3.4% low shrub, 2.4% flooded tundra – nonpattern, 1.8% ice, 1.8% other, 1.5% *Carex aquatillis*, 1.4% sparsely vegetated, 1.4% clouds/shadows, 0.3% dunes/dry sand, 0.3% *Arctophylla fulva*, and 0.1% tall shrub. Analysis of known spectacled eider locations suggest that the spectacled eiders are selecting for *Arctophylla fulva*, *Carex aquatillis*, and flooded tundra non-pattern habitats. The spectacled eiders also appear to be selecting for *Arcotphylla fulva* twice as much as *Carex aquatillis* and flooded tundra non-pattern.

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CORPS OF ENGINEERS' JURISDICTION AND WETLANDS

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CORPS OF ENGINEERS
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The Corps of Engineers (Corps) has jurisdiction over "waters of the United States," which includes wetlands. In navigable waters (Colville River, Beaufort Sea) a permit is required for any structure in, over, or under the water, and for any work in the water. For non-navigable waters and wetlands, a permit is required for placement of dredged or fill material. The Corps determines whether the work area is a water of the U.S., and if it is navigable or not. On land, this is a determination that the site is either wetlands or uplands. The method used by the Corps to identify wetlands is described in the 1987 *Corps of Engineers Wetlands Delineation Manual*. It is a 3-parameter approach that generally requires the presence of wetland vegetation, hydric soils, and wetland hydrology to call a site "wetlands." However, in reality we often don't have direct field information to determine that these three criteria are met. The best information we often have is National Wetlands Inventory (NWI) mapping, aerial photographs, or for the NPR-A, the Landsat imagery interpretation that BLM is developing. The methods rely heavily on vegetation, which is a fairly good indicator of soil conditions.

Experience with NWI mapping and on-the-ground visits on the North Slope show good correlation between the NWI method and the Corps' method of distinguishing wetlands from uplands. An initial look at the NPR-A mapping by Landsat imagery suggests that any of these methods is going to find the majority of NPR-A clearly wetlands and waters of the United States under Corps jurisdiction. Areas that are not as clearly wetlands may have to be looked at on the ground to determine if the Corps has jurisdiction. Examples of the areas that may be uplands are river banks and other steep slopes, pingos, sand dunes, the tops of some high-centered polygons, and the top of some ridges in the southern NPR-A.

The Corps does not regulate a number of exploration activities such as single-season ice roads and pads, seismic work, and tundra travel. Pipelines constructed on VSMs also are not regulated. Activities common in oil development that are regulated include placement of gravel for pads, roads, and airstrips; multi-year ice pads, berms, and reclamation (capping) of reserve pits, development and reclamation of gravel mine sites; and in navigable waters, docks or causeways along the coast, other offshore structures, and buried or drilled pipelines.

EFFECTS OF PETROLEUM SPILLS ON TUNDRA ECOSYSTEMS

M. TORRE JORGENSON
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The prospect of oil development in the National Petroleum Reserve–Alaska (NPRA) has the potential for both economic benefits and ecological damage associated with petroleum contamination. This talk addresses the potential ecological risks from petroleum by discussing the nature of crude oil and refined products, the history of spills on the North Slope, potential ecological effects, cleanup objectives and techniques, case histories of past oil spills, and an overall assessment of the potential risks.

Common contaminants associated with oil development include crude oil, diesel fuel, seawater and brine, drilling waste, and other less common materials such as glycol, methanol, and fire-fighting agents. This talk focuses on crude oil and to a lesser extent diesel fuel. Several generalizations can be made regarding factors affecting the toxicity of petroleum hydrocarbons. Refined products are more toxic than crude oils and toxicity is related to the content of light aromatic fractions. The toxicity of aromatic hydrocarbons increases with increasing molecular weight and is related to aqueous solubility and bioconcentration potential.

Potential ecological effects are as diverse as the number of organisms, making generalizations difficult. To complicate matters effects can occur and be measured at multiple levels of ecological organization: cellular, organismal, population, community, and ecosystem levels. In general, however, potential ecological effects can be subdivided into acute toxicity, chronic toxicity, physical fouling, and damage from cleanup activities.

In responding to a petroleum spill, balancing cleanup objectives can be difficult and contentious. A partial list of objectives includes minimizing oil movement, water contamination, soil infiltration and surface adhesion; minimizing ecological damage by reducing acute and chronic toxicity, wildlife contact, damage from cleanup, and thermokarst potential; minimizing short-term costs and long-term liability; and maximizing safety by minimizing toxic exposure and harm from equipment.

Based on the experience of over 20 years of oilfield operations in the Prudhoe Bay area, several generalizations can be made about the overall potential risks. Crude oil spills are relatively uncommon and minor damage has occurred on only 10's of acres. In contrast, diesel spills historically are more common affecting probably 100's of acres, mostly within gravel pads. Current management techniques, however, have greatly reduced their occurrence. Cleanup techniques currently are very effective at removing oil, although cleanup techniques for remote areas are unproven. Monitoring of past spills on the North Slope indicates that ecological damage is minor and that ecosystems exhibit good potential for recovery from levels of damage associated with oiling and cleanup. Although the potential damage from a major spill can be high, the cumulative effect of damage from oil is much less than for other impacts such as gravel placement and drilling waste management. While the overall risk of major spills is low, prevention efforts must be vigorous and special care must be taken near rivers, streams, and connected waterbodies to minimize the movement of spilled oil over larger areas.

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RECOVERY AND REHABILITATION OF DISTURBED WETLAND SITES

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The most important point to remember is the greatest number of options for tundra revegetation are available when a suitable soil remains on site. Furthermore, wetness and vegetation recovery from damages are positively related. This is true for oil-damaged sites as well as physically-damaged sites. Sites in the Arctic most likely to require the greatest effort and most time to rehabilitate are those where soil has either been removed or seriously altered, such as with chemicals, salts, refined hydrocarbons, etc. The drier the habitat conditions, (such as dry sands and gravel) the more difficult the recovery process. Typically, drained lake basins will naturally revegetate in 25 to 30 years, if a medium texture soil remains. There are sandy lake basins in NPR-A which have been drained for 40 or more years, and they are yet to be recolonized with vegetation. Similar adverse soil and habitat conditions can be found in the Sagavanirktok River delta, near Prudhoe Bay and in western Siberia. Physically, damaged sites across the Alaska Arctic have recolonized naturally where ever suitable soil conditions exist—medium texture and moderate to wet environments.

In Alaska's Arctic regions (and throughout Alaska) the abundance of moist habitats is a great advantage for site rehabilitation and revegetation. The time for recovery of natural tundra species can be either prolonged or shortened, depending on choice of seeded species and fertilizer applications. This selection is most critical for dry to moderately moist habitats. Tundra species recovery on wet and seasonally flooded sites will tolerate more latitude in the choice of seed and fertilizer applied.

Typical recovery by tundra species on sites with suitable soil present resembles the secondary succession theory of *original species composition*, i.e., the pioneers are usually member of the climax community and the relative composition of this mixture changes over time. If no soil is present, such as on a gravel pad, the succession process is akin to primary succession and it mimics the *species relay floristics* theory, i.e., the pioneers are not members of the climax community and disappear as the site conditions change over time. Most of the change in soil involves accumulations of the peat horizon, which increases the water holding capacity of the soil and reduces the annual depth of thaw.

Most of the original research on tundra revegetation was conducted on medium texture mineral soils of intermediate moistness. The research was directed toward controlling soil erosion and was successful in identifying three grass species (*Arctagrostis latifolia*, *Festuca rubra*, and *Poa glauca*) suited to those habitats. Later it was discovered that most of the sites requiring revegetation were not medium textured, intermediately moist soils and erosion was not a major risk. Long-term observations have revealed these recommended grasses often interfere with the reinvasion by plants of the climax communities, and this interference is exacerbated when moderate to high quantities of phosphorus fertilizer were used. Subsequently, it was learned that *Puccinellia arctica* could be seeded to produce a plant cover quickly and it does not appear to interfere with the natural reinvasion by tundra species. On sites where *Puccinellia arctica* was seeded, the recovery of natural species occurred in 10 - 15 years, while sites seeded to a mixture of (*Arctagrostis latifolia*, *Festuca rubra*, and *Poa glauca*) were still dominated by those seeded grasses after 25 years.

Over a hundred species of plants have been identified colonizing gravel fill across the Alaska Arctic. Forbs, shrubs, and half-shrubs are the usual pioneers on gravel in the Arctic. In time they yield to graminoids (sedges and grasses). In tests at Prudhoe Bay where graminoids and forbs were seeded together on gravel fill, mixing as little as 2 inches of silt loam soil into the surface greatly increased the plant cover. The adding of silt favored grasses and mosses over forbs. Standards for evaluating revegetation in the Arctic should be based on trend rather than canopy cover condition classes, if the objective is to restore natural tundra plant composition. Often the species that produce the greatest canopy cover early in the process are less desirable in the long term. The role of mosses in soil development should be included in evaluating revegetation. *Arctophila fulva* colonizes shallow aquatic habitats. *Elymus arenarius* colonizes moist to dry sand, and sedges colonize wet habitats.

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EFFECTS OF WINTER SEISMIC EXPLORATION ON TUNDRA VEGETATION AND SOILS

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INTRODUCTION

Seismic exploration with tracked vehicles and accompanying ski-mounted camps was conducted during the winters of 1984 and 1985 on the coastal plain of the Arctic National Wildlife Refuge (NWR), Alaska. Two thousand kilometers of seismic line were completed. Additional trails were created adjacent to the seismic lines by D-7 Caterpillar tractors pulling ski-mounted trailers (cat-trains) between camps.

The U.S. Fish and Wildlife Service (USFWS) enforced strict regulations and permit stipulations developed to minimize impacts to wildlife and vegetation. Service monitors traveled with the seismic crews and attempted to limit the amount of disturbance from the vehicle traffic. They routed vehicles through less-sensitive vegetation types and areas with greater snow-cover. Winter seismic exploration causes less damage than summer exploration, however, snow cover on the arctic coastal plain is thin and variable and disturbance to tundra vegetation and the soil thermal regime did occur.

METHODS

A program was initiated by the USFWS to study vegetation disturbance, and natural recovery. A primary focus was to investigate the influence of snow depth at the time of exploration on the severity of disturbance in the following summer. Color-infrared aerial photographs were taken of 20% of the trails in 1985 and 1988 and disturbance levels were photo-interpreted at thousands of points. Two hundred randomly selected plots on the trails were visited in 1986, 1989, and 1993 and were rated for disturbance and visibility. About 100 permanent study plots were established to gather detailed information about disturbance and recovery in different vegetation types and at different levels of initial disturbance. Each site had a disturbed plot and an adjacent control plot off of the trail. Plots were rated for disturbance and visibility, photos were taken, and depth to permafrost was measured on and off the trail. At one third of the plots, percent cover of plant species was quantified using point sampling. Track depression and plant nutrient content were sampled at some plots. Plots were evaluated every three years, in 1985, 1988, 1991, and 1994.

RESULTS

The amount of disturbance and recovery depended on snow cover, vehicle type, traffic pattern, and vegetation type. Snow depths of at least 25 cm were required to cause a significant decrease in disturbance. Camp move trails were more disturbed than seismic trails, and after a decade most remaining sites with high levels of disturbance were on camp move trails. This is probably because the ground contact pressure of the Caterpillar tractors used for camp moves (10.5 pounds/square inch (psi)) was more than twice that of the heaviest seismic vehicle (4.5 psi). Multiple vehicles on a single narrow trail caused much more disturbance than dispersed tracks. Trails with low levels of initial disturbance improved over time, while those with medium to high

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levels (approximately 1/4 of trails) recovered more slowly. Trails in shrub-dominated tundra had the slowest rate of recovery. Trails in sedge-dominated tundra had recovered well, except if initial disturbance was high. Depth to permafrost was greater on disturbed sites than on adjacent controls, an effect which persisted through 1994, even for sites at which vegetation appeared to have completely recovered.

This indicates long-term disruption of the soil thermal regime.

CONCLUSIONS

1) Recovery was not complete, a decade after disturbance. The impacts that remained on medium and highly disturbed trails in 1993 and 1994, such as increased thaw depths, trail subsidence, shifts to wetter conditions, distinct ruts, invasion of grasses, and decreases in shrub cover, may easily persist for another decade or more.

2) Our findings that some damage can persist for long periods indicate that efforts should continue to develop technology to decrease the effects of vehicle traffic on tundra. Most of the seismic exploration that currently occurs every winter in northern Alaska is done with vehicles similar to those used in the Arctic NWR. The tractors and ski-mounted trailers used for camps caused the longest-lasting damage.

3) The Arctic NWR has a large amount of information that could be useful for developing stipulations for future seismic exploration on tundra.

SEISMIC STUDY PUBLICATIONS - ARCTIC NATIONAL WILDLIFE REFUGE

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FISH, AND RARE AND SENSITIVE SPECIES

Session Chair: Dennis Tol, BLM, Anchorage

FISH RESOURCES OF NORTHEASTERN NPR-A

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Baseline fishery assessments were conducted on 101 lakes and 14 streams in northeastern NPR-A during 1968 through 1986. These surveys documented the presence of 10 families and 20 species of fish inhabiting the coastal plain between the Ikpikpuk and Colville Rivers. Freshwater and anadromous fish were captured, as well as marine species that rear in river deltas and coastal lakes. The single family Salmonidae accounted for over half of the total species diversity.

Lakes had a mean surface elevation of 114 ft. They ranged from 90 acres to 201,600 acres in surface area and from 3 ft to 70 ft in maximum depth. Seventeen species of fish were captured in 84 of the 101 lakes that were surveyed. Least cisco *Coregonus sardinella* were the most frequently occurring species and were captured in 64% of the lakes. Broad whitefish *Coregonus nasus*, ninespine stickleback *Pungitius pungitius*, and lake trout *Salvelinus namaycush* were captured in 41%, 40% and 27% of the lakes respectively. The remaining species were captured in frequencies ranging from 1% to 15%. Individual lake diversities ranged from no fish in 17 lakes to 11 species in Teshekpuk Lake. The mean and median diversities for lakes having fish was 3 species.

Surveys were conducted in 14 streams between the Ikpikpuk and Colville Rivers. Streams range from 10 mi to 350 mi in total length and averaged 102 mi. All of the streams had fish, and a total of 20 species was captured. Single stream diversities range from 2 to 19 species with the highest diversity found in the Colville River. Thirteen species were captured in the Ikpikpuk River, while all other streams had 7 species or less. Arctic grayling *Thymallus arcticus* were the most widespread species and were captured in all of the streams that were sampled. Least cisco, broad whitefish, and burbot *Lota lota* were captured in nearly half of the streams.

Northeastern NPR-A has the most diverse assemblage of fish found on the North Slope of Alaska. Species diversity tended to be inversely correlated with elevation and distance from the ocean, while it was positively correlated with the size and depth of water body. Lake and stream habitats are relatively homogeneous having little riparian cover, aquatic vegetation, submerged cover, or woody debris. Shoreline contours are typically smooth and there is little variation in substrate type in all but the largest streams. More than half of the species inhabiting NPR-A exploit nearshore-marine or brackish waters for at least part of their life history. This feeding strategy may be a response to limited growth opportunities in fresh water, but it necessitates long and often complex migrations between lakes, streams, and coastal lagoons. Movements are also undertaken seasonally by most species to limited spawning and overwintering habitats since gravel, spring areas, or deep pools are often isolated and far from summer feeding areas.

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EFFECTS OF OIL AND GAS EXPLORATION AND DEVELOPMENT ACTIVITIES ON FISH AND FISH HABITAT

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Several activities associated with oil and gas exploration activities can have effects on fish and fish habitat.

Inadequate cross drainage structures and inadequate maintenance of drainage structures can lead to problems involving erosion and sedimentation of fish habitat, alteration of patterns of overland and confined drainage flow, alteration of wetland habitat, and alteration or restriction of movements of fish. Improperly designed or sized structures can increase maintenance and the need for remedial instream construction activities.

Gravel removal from floodplains can adversely affect fish habitat, water quality, channel morphology, patterns of flow, and increase aufeis formation. Properly designed and reclaimed gravel sites in floodplain habitats can serve as water supply reservoirs and may enhance limited fish winter habitat.

Unregulated water withdrawal from isolated river pools or lakes during winter may stress fish or cause death if an inadequate volume is left. Grounding of river ice during ice road construction may restrict movement of fish.

Solid-fill causeways may alter water quality, sediment transport, and movements of fish. Adequate breaching or elevated causeways can alleviate these problems.

Oil spills, of both crude and refined product, can cause debilitation or death of fish depending on the duration and concentration of the exposure. Tainting of flesh of fish exposed to crude or refined oils may remain detectable by taste for over 30 days following exposure. Minimization of pipeline crossings and adequate setbacks of facilities and pipelines from streams can reduce chances of oil reaching fish habitat.

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SUBSISTENCE AND COMMERCIAL FISHERIES IN THE NPR-A PLANNING AREA

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Over 21 species of freshwater and marine fish are used in the subsistence fisheries of the NPR-A Planning Area (including coastal waters); however, the bulk of the catch is supported by less than 10 species. Within the Planning Area the target species include: broad whitefish *Coregonus nasus*, Arctic cisco *C. autumnalis*, least cisco *C. sardinella*, Arctic grayling *Thymallus arcticus*, burbot *Lota lota*, Dolly Varden *Salvelinus malma*, humpback whitefish *C. pidschian*, lake trout *S. namaycush*, pink salmon *Oncorhynchus gorbuscha*, chum salmon *O. keta*, and Arctic cod *Boreogadus saida*. Some literature indicates large "herring" catches on the North Slope, however, herring is a local (English) term for least cisco, and does not refer to Pacific herring *Clupea harengus*. In most cases, fishing is a family activity which accompanies other harvesting activities. Fish are taken year-round but at least 95% of the harvest takes place from breakup (June) through November. Regarding preparation, in summer most fish are filleted and sun-dried (pifsi) while most of the autumn fish harvest is stored frozen. The subsistence fisheries are concentrated in a few areas within northeastern NPR-A: the Nuiqsut area (lower Colville River, Colville River Delta, Fish Creek), the lower and middle Ikpikpuk River, and the Miguakiak River (drainage from Teshekpuk Lake). Residents from Barrow (and occasionally Atqasuk) fish the Ikpikpuk and Miguakiak River area while Nuiqsut residents and the Helmericks family conduct essentially all of the fishing on the lower Colville River and associated tributaries. The Helmericks family conducts a small commercial fishery which is currently the only registered commercial fishery in the Planning area. In past years, commercial fishing permits have been submitted for the lower Ikpikpuk River.

The three-year average catch for the principal fish species harvested by Barrow residents is as follows: 17,300 broad whitefish, 9,900 grayling and 5,800 least cisco fish per year (S. Braund and Associates 1993). At Nuiqsut, the target species in summer is broad whitefish and, Arctic cisco, least cisco, grayling, burbot and humpback whitefish in autumn (Brower and Opie 1997). In 1985, the estimated harvest of broad whitefish was 3,749 for Nuiqsut and 600 for the Helmericks family (Entrix 1986). The autumn fishery at Nuiqsut (1985-1996) averaged 24,391 Arctic cisco per year (range 6,098 - 46,681) and 7,732 (range 2,321 - 15,854) least cisco. The commercial catch in the Colville Delta has averaged 21,665 Arctic cisco (range 8,958-31,310) and 12,161 (range 6,037-23,040) least cisco per year from 1985 to 1996 (Moulton 1997). In general, fishing success is highest in autumn at fish overwintering sites; this is also when (and where) the bulk of the fish harvest occurs. Future research should concentrate on: obtaining accurate harvest and population estimates for broad whitefish; conducting a survey and inventory of the major lakes within NPR-A; and gathering data on the distribution, movements and the basic life history of the species taken in the subsistence fisheries.

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REVIEW OF RARE AND SENSITIVE VERTEBRATE SPECIES IN THE NATIONAL PETROLEUM RESERVE-ALASKA

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There are 13 vertebrate species that the Alaska Natural Heritage Program (AKNHP) has given state ranks of S1-S3 in the Biological Conservation Database (BCD, co-managed with The Nature Conservancy) that occur in the NPR-A. These ranks are a measure of conservation concern that individual state Heritage Programs and the national Science Division of The Nature Conservancy have assigned to given species (i.e., highest to lowest, S1 to S5). The ranking criteria used by AKNHP for vertebrate species has been modified slightly from the criteria used to rank plants, in that vertebrate ranks are defined in terms of known and potential (sensitivity to) threats to population persistence. Ranks for plants are defined with primary emphasis on number of known occurrences or population size, as well as extirpation threats. Vertebrate species/populations (particularly in Alaska) differ from plants in that vertebrate species often have large distributional ranges and population numbers are rarely known or static. The following are the criteria used for ranking vertebrate species in Alaska:

S1: Critically imperiled (population at level deemed near to extinction).
S2: Imminent threat to population persistence. Acting anthropogenic effects or high risk to stochastic events (or single catastrophic event) due to extreme concentration of global or state population.
S3: Long term threats to population persistence exist. (threats may not yet be affecting population viability). Threats include the following (but not limited to them):
- Overall global rarity.
- Habitat alteration (affecting any part of their ecology).
- Fragility (overall sensitivity to disturbance).
- Pollution threat.
- Exotic predator threat or human-caused increase or distributional change of regional predators.
- Endemic to state.

S4: Apparently secure, information lacking on population threats, but potential sensitivity to anthropogenic activities.
S5: Population demonstrably (very) secure in regard to population persistence.

The 13 species (and their ranks: G = Global ranks, S = AKNHP state ranks, B = known breeding occurrence) identified to be of high conservation concern within the NPR-A are:

	RANK	
Species	Global Ranks	AKNHP State Ranks
Spectacled Eider	G2	S2B*
Steller's Eider	G2	S2S3B**
Black Guillemot	G4	S2B
Buff-breasted Sandpiper	G3	S2B
Red Knot	G4	S2B
White-Rumped Sandpiper	G4	S3B
Bar-Tailed Godwit	G4	S3B

	RANK	
Species	Global Ranks	AKNHP State Ranks
Stilt Sandpiper	G5	S3B
Baird's Sandpiper	G4	S3B
Yellow-Billed Loon	G4	S3B
Bluethroat	G5	S3B
Arctic Peregrine Falcon	G3	S3S4B
Gyrfalcon	G5	S3B

* = Endangered Species Act: Threatened, ** = Endangered Species Act: proposed Threatened

Notably this review has identified 6 shorebirds (2 upland, 2 coastal, 2 inland), 1 guillemot, 1 loon, and 1 passerine species that have little or no information on their habitat use and distributional occurrence within the NPR-A. The NPR-A comprises a significant portion (for 7 species potentially >50%) of the distributional range of these 13 species in Alaska. Three of these 13 species have documented population declines. Ten of these species have been assessed by this review to be vulnerable to significant state population reduction or elimination if significant habitat disturbance occurs within NPR-A. Particularly vulnerable are the Spectacled Eider, Steller's Eider, Black Guillemot, and Buff-breasted Sandpiper.

Rare and sensitive vertebrate species ranked S1-S3, (in the Biological Conservation Database co-managed by Alaska Natural Heritage Program and The Nature Conservancy), occurring within the National Petroleum Reserve-Alaska (NPR-A). A table of factors relevant to the conservation concern of rare and sensitive species occurring in the NPR-A (Y = yes, ? = suspected threats based on species of similar ecology, blank = no/unknown threats). Northern Bioregion delineation from Kessel and Gibson 1978. (contact AKNHP for permission of use).

Species	Declines documented	Vulnerable to sig. state pop. reduction from habitat loss	Endemic to bioregion	Winter area threats	Staging area threats
Spectacled Eider	Y	Y		Y	
Steller's Eider	Y	Y			
Black Guillemot		Y	Y		
Buff-breasted Sandpiper	Y	Y	Y	Y	Y
Red Knot		Y	Y	?	Y
White-rumped Sandpiper		Y	Y	?	Y
Bar-tailed Godwit				?	?
Stilt Sandpiper		Y		?	Y
Baird's Sandpiper				Y	Y
Yellow-billed Loon		Y	Y		
Bluethroat		Y			
Arctic Peregrine Falcon		Y	Y	Y	Y
Gyrfalcon					

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BIRDS

Session Co-chairs: Dr. Joel Hubbard, MMS, Anchorage; and Dr. Dirk Derksen, Alaska Science Center, Biological Resources Division, U.S. Geological Survey, Anchorage

OVERVIEW: NPR-A WATERFOWL IN THE BIG PICTURE

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This presentation is to provide the EIS preparation team and others perspectives on: (1) the waterfowl of NPR-A in a global or hemispheric view; (2) management and conservation programs relevant to NPR-A migratory birds; and (3) the wide variety of stakeholders that have an interest in the birds of NPR-A.

INTERNATIONAL TREATIES

The United States has treaties (conventions) for the protection of migratory birds with Canada (1916), Mexico (1936), Russia (1976), and Japan (1979). These treaties set forth goals of the respective countries to protect and maintain shared stocks of migratory birds, standards of conservation, and mechanisms for coordinating management programs. These treaties differ somewhat in content, particularly in standards of bird habitat conservation, but many species of birds that use NPR-A are covered by one or more of the conventions. For example, conservation of Pacific brant is subject to all four treaties. Brant are particularly important to stakeholders in Canada, Mexico, and the U.S. It is noteworthy that an amendment to the treaty with Canada was negotiated in 1996 and is awaiting ratification in the U.S. Senate. The amendment primarily facilitates management of subsistence hunting in both countries, but also recognizes the importance of migratory bird habitats and long-standing cooperative conservation efforts.

INTERNATIONAL AGREEMENTS

Migratory birds that use NPR-A are subjects of several international agreements. The North American Waterfowl Management Plan (NAWMP) was implemented by the United States and Canada in 1986, and now involves Mexico. The plan was developed to restore continental duck populations, primarily through habitat protection and improvement, as well as to address conservation of black ducks in the east and gaps in information necessary to manage arctic-nesting geese. The plan establishes continental waterfowl population goals, identifies critical needs, and promotes implementation of broad joint ventures to address problems. Among NPR-A bird species, several are highlighted in NAWMP: pintails because of diminished continental numbers, and brant because of their widespread values and fluctuating status.

The Arctic Goose Joint Venture (AGJV) is a program under NAWMP that focuses on problems and information gaps concerning 16 populations of arctic-nesting geese. The AGJV Strategic Plan 1990-1994 identifies management issues and data needs for several Alaska goose populations. For Pacific brant, information on population dynamics and status of breeding population units was given high priority; these are the subjects of several research programs in Canada and the U.S. Harvest monitoring and vulnerability of arctic habitats were considered the most important management issues. Work to delineate and study Midcontinent white-fronted geese was one of the highest continental AGJV needs. These geese nest from northwest Alaska to Hudson Bay, and are the focus of substantial harvest from the arctic to Mexico. A five-year marking program is concluding and will provide insights into population units, regional productivity, and harvest distribution.

The United States and the Russian Federation signed a 1996 agreement on protection of the environment and natural resources. The "Area V" agreement was established to determine important waterfowl ranges, productivity, and adaptation to environmental changes, with emphasis on areas subject to human disturbance. The primary focal species are geese, spectacled eiders,

and Steller's eiders. The agreement sets forth conservation issues of concern and facilitates scientific cooperation between the countries.

Eight polar nations, including the United States, endorsed the Arctic Environmental Protection Strategy (AEPS) to identify problems in arctic ecosystems and develop cooperative action plans. A section of AEPS, Conservation of Arctic Flora and Fauna (CAFF), is accomplished through international working groups addressing a wide variety of topics. One working group is developing a circumpolar conservation strategy for the four eider species. The draft strategy recognizes the importance of eiders to indigenous peoples, and a variety of onshore and at-sea threats to eiders in the north.

FLYWAY MANAGEMENT PLANS

Several NPR-A waterfowl populations are cooperatively managed by federal and state/provincial wildlife agencies through the four North American Flyway Councils. The councils develop management plans that describe population status, identify values to stakeholders across all jurisdictions, enumerate current management problems, and establish agency responsibilities for actions.

Pacific brant are managed under a 1992 plan by the Pacific Flyway Council (11 states), developed with participation by hunting and conservation groups along the Pacific Coast. this plan lists concerns that brant have not increased despite management efforts, that key factors limiting the population need to be determined, and that brant face habitat degradation throughout their range. Stakeholders throughout the flyway are aware of the importance of Izembek Lagoon and Teshekpuk Lake to brant from all breeding areas. Brant support important harvests in western Canada, northern and western Alaska, Puget Sound, and (by U.S. hunters) in Baja California, Mexico.

Midcontinent White-fronted Geese are managed under a plan by the Central and Mississippi Flyway Councils (23 states), with Alaska as an adjunct member. This plan is currently under revision to provide new direction resulting from continental studies and surveys. North Slope white-fronted geese comprise 10-15% of the growing midcontinent population. These white-fronted geese are highly sought by hunters from the arctic to Texas, Louisiana, and Mexico. Recent marking programs have focused attention on regional populations. Some differential patterns are emerging between tundra nesting birds (North Slope) and interior boreal white-fronts (Koyukuk), in productivity, survival rates, chronology of migration, and harvest impacts.

Eastern Population (EP) Tundra Swans are the subject of a management plan by all four flyway councils. EP tundra swans increased substantially in the past 20 years, but may have begun to decline. EP swans are hunted in four states as well as in arctic Alaska and Canada. Productivity is low in swans, and harvest monitoring is important. The EP Tundra Swan Plan focuses on the need to understand differences in production and survival among breeding areas. The Colville River Delta supports the most dense concentrations of nesting tundra swans on the North Slope, and west Teshekpuk Lake hosts molting aggregations in mid-summer.

REGIONAL AGREEMENTS AND PLANS

The Yukon-Kuskokwim (Y-K) Delta Goose Management Plan has served since 1984 as a catalyst to restore and conserve four goose populations nesting in western Alaska. Seventy-five to eighty percent of Pacific brant nest along the delta coast. Because the Teshekpuk Lake area serves as a common molting area for 20% or more of all pacific brant, a large proportion of those

birds are subadults or failed breeders from the Y-K Delta. This relationship strongly links brant population concerns and interests of stakeholders in northern and western Alaska. The Y-K Delta Goose Management Plan was the first such cooperative effort between agencies, rural Alaskans, and hunters in the lower 48 states. It is viewed as a prototype for future co-management arrangements that focus all affected interests on conservation problems and share responsibilities for solutions. In this respect, the brant of NPR-A are of special interest to many stakeholders and play a unique role in widening management networks.

The Inuvialuit Settlement Agreement established a land and wildlife management system for northwestern Canada, involving native, federal, and territorial participation. The governing board of this settlement has established waterfowl management as a high priority, particularly for brant, white-fronted geese, tundra swans, and snow geese. All of these species are shared with Alaska's North Slope and, except for snow geese, include birds breeding, molting, and staging in NPR-A. The management board has funded an extensive program of waterfowl surveys and harvest data collections to address the concerns and needs of the region's subsistence hunters, and they have a strong interest in Alaska events that may affect resources they use.

SUMMARY

Waterfowl that use NPR-A are continental resources that are of concern to management authorities in four countries and most of the United States. They provide a variety of values and uses to an extensive array of stakeholders throughout North America and along the Pacific Rim. Decisions about land management and petroleum development in NPR-A should be made with full consideration of these stakeholders, the cooperative management programs that are in place and standing commitments to migratory bird conservation.

A DISCUSSION OF GEESE IN THE TESHEKPUK LAKE AREA AND MIGRATORY BIRDS OF THE ARCTIC COASTAL PLAIN

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Aerial surveys of the Arctic Coastal Plain (ACP) have been conducted intermittently since 1977. Emphasis has been on waterfowl and related waterbird species. Initial surveys on the NPR-A were conducted by the author during 1977 and 1978 and resumed on all waterbird habitats on the ACP in 1986. These surveys documented the importance of the ACP to Northern pintail, oldsquaw, scoter, and eider ducks as well as white-fronted geese, tundra swan, and loons. From 1982 to present aerial surveys have also been conducted on selected lakes in the Teshekpuk Lake area. These annual surveys during mid-July have documented the continued use by molting black brant, greater white-fronted geese, Canada geese, and lesser snow geese. These surveys across the Alaskan arctic continue to record the importance of the area to many breeding and molting migratory birds.

The annual survey of molting geese in the Teshekpuk Lake area has documented a 15-year mean of 17,570 black brant, 13,001 Canada geese, 7,024 greater white-fronted geese, and 232 lesser snow geese. Total average goose use for the 199 lake areas surveyed is 37,827 annually. This data emphasizes the importance of the area not only locally, but continentally.

Arctic Coastal Plain survey lines have been positioned to give statistically valid samples that verify the importance of arctic areas to migratory birds. The current 11 year survey has documented an average of 230,000 Northern pintail, 122,000 oldsquaw, 32,000 scaup, 12,000 scoter, and more than 20,000 eider ducks, as well as 105,000 greater white-fronted geese, 8,000 tundra swan, and more than 30,000 loons. Significant proportions of these species habitually use the NPR-A and the Northeast Planning area. It is incumbent that these habitats are identified and their integrity preserved for continued use by all migratory birds.

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IMPORTANT BIRD HABITATS AND POPULATIONS: SHOREBIRDS AND SELECTED WATERFOWL

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SHOREBIRDS

Very little is known about the distribution, abundance, or population trends of shorebirds within the NPR-A planning area. A considerable amount of work has been done in the vicinity of Barrow and in association with the oil development in Prudhoe Bay and Kuparuk Oilfields. These data may be useful in evaluating potential habitat use by various shorebird species.

Recommendation—(1) document general distribution and abundance of shorebirds within the NPR-A.

SNOW GEESE

There are three snow goose colonies in Alaska: a colony on Howe Island within the Sagavanirktok River Delta, a colony on an island in the Kukpowruk River Delta, and a colony within the Ikpikpuk River Delta. ABR Inc. has flown aerial surveys for the North Slope Borough in northwest Alaska since 1992 for nesting and brood-rearing geese. These surveys documented the size and use of the Kukpowruk and Ikpikpuk colonies for the first time. Additionally, scattered pairs of nesting snow geese were located in various locations in northwest Alaska. The Ikpikpuk colony is not used every year depending on water conditions in the spring. All snow goose colonies in Alaska can experience dramatic fluctuations in productivity. The Ikpikpuk colony is immediately adjacent to the NPR-A planning area.

Recommendation—The colony in the Ikpikpuk River Delta may be at risk because of oil exploration or development. Special attention should be given to monitor and provide some type of seasonal or spatial protection to this colony.

BRANT

The ABR, Inc. surveys documented nesting brant within the NPR-A planning area. Small (~50 pairs) colonies were located along the Miguarsak River, connecting Teshekpuk Lake and the Ikpikpuk River, and near the delta of Fish Creek. Additionally, there are scattered pairs of brant nesting within northwest Alaska. Brant are of concern to North Slope residents; brant are an important subsistence resource and the USFWS enforces the no hunting of brant during nesting and molting. Additional pressures on brant on the North Slope due to oil exploration or development may delay removing brant for the enforcement policy and hence reducing access of subsistence hunters to brant.

Recommendation—Provide adequate protection to nesting, brood-rearing, and molting brant within the NPR-A planning area.

KING EIDERS

The number of king eiders migrating past Point Barrow has declined in recent years. Previous migration counts estimated that 800,000 to 1 million eiders passed Barrow and recent

counts estimated about 300,000 to 400,000 king eiders passed. This is of concern because king eiders are an important subsistence resource to many people not only on the North Slope but also in other areas of coastal Alaska. Causes of this decline are unknown. Aerial surveys by the USFWS reveal that some of the highest concentration areas for nesting king eiders on the North Slope occur just southeast of Teshekpuk Lake. Cumulative impacts, from the unknown causes of the population decline, and any possibly impacts from future oil exploration and development, could further reduce the numbers of king eiders.

Recommendation—Document the habitat used by king eiders for nesting and brood-rearing. There are some data available from the aerial surveys and the land cover data collected by Ducks Unlimited and BLM. Evaluate as many cumulative impacts to king eiders as practical.

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THREATS TO THE RECOVERY OF RARE, THREATENED, AND ENDANGERED BIRDS: STELLER'S EIDER

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Steller's eiders were proposed for listing as a threatened species at the same time spectacled eiders were listed under the Endangered Species Act. The listing of Steller's eiders was deferred because of other listing priorities by the USFWS. The Steller's eider may be listed in the near future, perhaps sometime this summer. One reason for the proposal to list Steller's eiders was because they disappeared from the Yukon-Kuskokwim Delta as a breeding bird—an area where they were once described as a common nester. Currently, the only known location in North America where Steller's eiders still nest in any numbers is in the vicinity of Barrow.

Very little is known about the basic biology of Steller's eiders. Thus, the USFWS Northern Alaska Ecological Services Office and the North Slope Borough have been studying the nesting biology of Steller's eiders near Barrow. Steller's eiders do not nest every year at Barrow although they are present. There appears to be a link between the abundance of lemmings and breeding of Steller's eiders. There are several possible reasons: (1) high numbers of lemmings attract nesting snowy owls and jaegers and these birds provide protection to Steller's eiders because they protect their own nests from terrestrial predators such as foxes, (2) the abundance of lemmings provides a vast food base for predators thus reducing the predation pressure on Steller's eiders. Regardless of the reason, Steller's eiders do not nest every year. Therefore relying on aerial surveys to document the presence of nesting Steller's eiders within the NPR-A planning area may not be completely reliable.

Historical nest records indicated that Steller's eiders nested around Teshekpuk Lake as well as near Alaktak, between the Ikpikpuk and Chipp Rivers. Current sightings during aerial surveys conducted by the USFWS and incidental sightings by other researchers indicate that Steller's eiders may nest in areas within the NPR-A including within the planning area.

Recommendation—Document the presence or absence of nesting Steller's eiders within the planning area, especially to the north and west of Teshekpuk Lake.

OTHER RECOMMENDATIONS:

- Little emphasis was given to subsistence uses within the NPR-A planning areas during this symposium. The people living within and adjacent to NPR-A rely on many resources for subsistence. The draft IAP/EIS must not reflect the same emphasis as this symposium but address the impacts to the people who use the North Slope to live and survive.

- The time line for the IAP/EIS is too quick. An adequate job has been done in scoping but more time will be necessary for the development of the alternatives within the EIS. Specifically, there are many data for the NPR-A planning area that are available but have not be analyzed or reported. Some of these data include information on subsistence use, caribou movements and habitat use of waterfowl. The IAP/EIS will not be an adequate document without the inclusion of these data, especially the data on subsistence use.

- Cumulative impacts to local people must be addressed within the IAP/EIS. Impacts to subsistence have to date been assessed on a project by project basis. As oil development

activities begin to surround the village of Nuiqsut, the cumulative impacts need to be assessed and mitigation measures must be taken.

- The State of Alaska has had relatively little involvement in the IAP/EIS planning process to date. Biologists and subsistence specialists within the Department of Fish and Game have a great deal of data and experience within the NPR-A planning area. They need to be much more involved in the development of the IAP/EIS.

- One way to protect important waterfowl and caribou habitat is by deferring areas within the NPR-A planning area. Wildlife refuges or parks are not necessary but important areas could be avoided through seasonal restrictions, directional drilling, or deferring areas completely from surface development.

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SPECTACLED EIDERS: THREATENED SEADUCK ON THE NPR-A

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Endangered Species Act (ESA) Section 7 Consultation Process

When development occurs within the range of threatened or endangered (T&E) species, the agency proposing development is expected to consult with the U.S. Fish and Wildlife Service (USFWS) regarding the activity. The process begins informally with a request for a list of T&E species in the area of interest. If T&E species are present, then informal consultation begins. Should the informal consultation determine that a listed species may be affected by the proposed activity, the action agency prepares a biological assessment of the project. If it is then determined that a listed species is likely to be adversely affected, formal consultation results. During the formal consultation, the USFWS prepares a biological opinion, complete with a list of reasonable and prudent measures that the action agency is bound to adhere to. An incidental take document accompanies the biological opinion, and details how many individuals may be taken as a consequence of the action before consultation is re-initiated. Section 7 consultations on the NPR-A are likely to follow an incremental process, much like the way oil development occurs incrementally.

Because no critical habitat has been designated for spectacled eiders, and will not be designated for Steller's eiders, the USFWS will only be preventing take of individuals. Habitat protection will have to result from Section 404 of the Clean Water Act.

Spectacled Eider Habitat Preferences in the Arctic

Aerial surveys on the NPR-A do not indicate a trend in spectacled eider numbers. Variability in survey estimates can be mostly attributed to survey timing. Estimates for 1993-1996 range from 5821 to 9298, with 13 to 19% Coefficient of Variability (CV) around those estimates.

Kistchinski and Flint's (1974) description of valuable spectacled eider breeding habitat in Russia closely matches our impression of good spectacled eider habitat. In Russia, spectacled eiders perfer to use "Laydas." Laydas are characterized as 2-5 km basins that flood after snowmelt. They are overgrown with *Arctophila fulva* and sedges, with *Hipparus* sp. present as a submerged aquatic. Patches of grass and sedge emergents and small islets and islands are scattered throughout the shallow areas. A deeper water basin is often present, and may be the only part of a Layda that remains wet by the end of the summer. In the NPR-A, we noticed that wetlands most often used by eiders were large (>1 km diameter) emergent wetlands with high shoreline development, vegetated islands and islets, and *Arctophila fulva*. These areas were generally not part of a notable fluvial system.

Threats to Spectacled Eiders Resulting from Human Presence

Lead poisoning has affected spectacled eiders on the Yukon-Kuskokwim Delta and probably is a threat in Russia, but does not appear to be a problem on the North Slope.

Human presence, with its attending piles of trash, tend to support unnaturally high populations of certain predators, such as glaucous gulls and Arctic foxes. High predator populations often means high nest failure rates for waterfowl.

Road dust can alter the ecology of tundra wetlands in several ways. How this may affect spectacled eiders is unknown, but road dust appears to enhance the productivity of some wetlands, and both spectacled and king eiders frequent roadside wetlands in Prudhoe Bay.

Fixed-wing aircraft flown at 150 ft above ground level often cause spectacled and king eiders to flush. Helicopters flown at similar altitudes around Prudhoe Bay do not cause spectacled and king eiders there to flush. Larned observed that spectacled eiders wintering in the Bering Sea were far more tolerant of a helicopter than they were of a fixed-wing aircraft.

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POTENTIAL EFFECTS OF GROUND-RELATED OILFIELD ACTIVITIES ON BIRDS

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Ground activities in northern Alaska oilfields include heavy equipment, light vehicles, boats and pedestrians. Describing their effects on birds requires a discussion of primary structures (gravel pads and roads, pipelines, facilities, and elevated structures) and activities in the oilfields. The degree to which birds will be affected by development depends on a host of biological and physical factors including the species and its sensitivity to disturbance, potential for habituation, environmental conditions such as weather, stage of breeding, as well as physical characteristics of the activity.

Direct and indirect effects of ground-related activities include: (1) long-term habitat loss from gravel extraction and placement; (2) temporary habitat loss from impoundments and persistent accumulations of ice/snow associated with roads and pads; (3) changes in bird use of habitats altered by dust fallout, impoundments, and other habitat modifications; (4) behavioral disturbance of birds from human activities; (5) attraction of birds to project facilities; and (6) injury, mortality, and reduced productivity. An attached bibliography includes primary research investigating the possible effects of oilfield ground activities.

A direct and partially quantifiable effect of oil development will be habitat loss beneath gravel pads, roads, and at quarries. Gravel fill can substantially impact bird habitats in the Arctic because the disturbance is long-term and vegetation recovery is difficult without substantial rehabilitation treatments. Temporary habitat losses will be caused by delayed snowmelt and compaction in the areas underlying proposed ice roads, ice work-pads, and at drifts around facilities. Bird use of habitats adjacent to the roads and pads also will be affected by a number of habitat alterations including dust fallout, impoundments, thermokarst, and contaminants. The magnitude of these impacts will vary depending on the habitat type and hydrologic regime of the site. The disturbance effects of oilfield construction and operations on birds include overt reactions and activity budget effects. Equipment noise, vehicles, pedestrians, and other activities associated with the oilfields result in varying amounts of disturbance near facilities. In general, vehicles are the most common source of oilfield disturbance, but are less disturbing than are humans on foot or natural predators. The level of disturbance increases with traffic rate and the number of large, noisy vehicles. Pedestrian activities can cause severe disturbances to nesting and brood-rearing birds. Indirect effects of disturbance such as noise from facilities or roads may displace birds. Numerous developments such as vehicles, powerlines, and accidental spills, can increase the potential for injury, mortality, and reduced productivity of birds in an oilfield.

In conclusion, the incremental effects of ground activities related to possible oil development in the NPR-A will include: (1) permanent or long-term and temporary habitat loss due to the placement of gravel for roads and pads and ice pads and roads, (2) will change bird use of other habitats if they are physically altered or disturbed, and (3) may increase injury, mortality, and reduced productivity of birds in the area. Mitigation measures can include siting facilities to reduce habitat loss or alteration and avoid important avian habitats, minimizing gravel footprints, proper scheduling of construction activities to reduce disturbance, especially during sensitive stages of bird use, education of field personnel, and restoration of disturbed areas.

Finally, although many of the potential impacts of oilfield developments can be predicted with confidence, oil development in the NPR-A will encounter avian resources not previously or

regularly exposed to development. These resources include species such as the yellow-billed loon and cliff-nesting raptors and sensitive regions or habitats including staging and molting habitats on the coastal plain and tall-riparian shrub habitats on inland rivers. Additional mitigative measures will need to be considered to protect these resources.

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PREDATORS AND SCAVENGERS ATTRACTED TO LOCALES OF HUMAN ACTIVITY

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Certain wildlife species are attracted to locales of human activity because they use anthropogenic food sources or obtain shelter in man-made structures. On the arctic coastal plain of Alaska there are four species that commonly obtain food from human refuse dumps: grizzly bear, arctic fox, common raven, and glaucous gull. Two of these species, the fox and raven, also make use of man-made structures. The appropriate management response depends on the answer to two focal questions. To what extent does predation by these species impact reproductive success and local populations of tundra-nesting birds? Are populations of predators higher as a result of human activity?

IMPACT OF PREDATORS ON WATER BIRDS

Grizzly Bear

Birds and their nests are not a major component of North Slope bear diets (R.T. Shideler, Alaska Department of Fish and Game, pers. comm.), but bears may have locally important impacts on colonially nesting waterfowl. Several instances of bear predation on North Slope brant are documented. In 1992, a bear reduced the number of brant nests on Char Island, Colville River Delta from 125 on 21 June to 10 on 26 June (Fish and Wildlife Service, unpublished); up to half of the approximately 40 brant nests at the CPF-3 colony in the Kuparuk Oil field were destroyed by a bear in 1995 (Fish and Wildlife Service, unpublished), and all (or nearly all) 62 brant nests on Howe Island in 1985 failed due to bear predation (Burgess and Ritchie 1987). A bear was also believed to have been responsible for failure of many of the 85 snow goose nests initiated on an island west of Howe Island in 1991 (Burgess and Rose 1994).

Common Raven

Food habits of ravens on the arctic coastal plain are poorly known, in part because they are a relatively uncommon species there. Ravens have been observed to remove eggs from a greater white-fronted goose nest in the oil fields, as well as carrying eggs (B.A. Anderson, ABR Inc., pers. comm.). Ravens observed to have depredated several Steller's eider nests at Barrow, and were suspected as the cause of additional nest losses (L.T. Quakenbush, University of Alaska, pers. comm.). Nesting ravens are very effective predators on large shorebirds; at Curlew Lake (Yukon Delta NWR), bristle-thighed curlew nest success was very poor, improving only in a year when nesting ravens were absent (B.J. McCaffery, Yukon Delta Nation Wildlife Refuge, pers. comm.). Both observers reported that ravens effectively hunted in pairs.

Glaucous Gull

Anecdotal accounts of gull predation include the Howe Island (Sagavanirktok River Delta, near Prudhoe Bay) snow goose colony, where glaucous gulls were believed to have been responsible for the loss of 10-25% of the nests in several years (Burgess and Rose 1994). Schamel (1974) reported 42% of eider eggs on Egg Island (barrier island west of Prudhoe Bay) were destroyed by glaucous gulls. In the Kuparuk oil field, glaucous gulls were the likely agent

in failure of 11% of brant nests in 1995, and 16-32% in 1996 (T. Obritschkewitsch, University of Alaska, pers. comm.).

In a study of predation on goslings on the Yukon-Kuskokwim Delta, Bowman et al. (1997) estimated that glaucous gulls consumed 15-40% of the goslings of three species of geese (cackling Canada, emperor, greater white-fronted). Experimental removal of mew gulls (a smaller species which is uncommon on the Beaufort Sea coast) at Kigigak Island, Yukon-Kuskokwim Delta, appeared to reverse a decline in nest success of spectacled eiders (B. Grand, Alaska Science Center, pers. comm.). Spectacled eider nest success declined from approximately 73% in 1991 to 18% in 1994. In 1995, approximately 100 mew gulls were removed from a 30 km^2 area surrounding the spectacled eider nesting area, and nest success rebounded to approximately 76%.

Arctic Fox

Anecdotal Evidence

Anecdotal evidence from the North Slope illustrates the potential for arctic foxes to impact productivity of water birds, particularly among colonial nesting species. The Howe Island snow goose colony grew from approximately 50 nests in 1980 to 388 nests in 1995 (Johnson 1994, Johnson and Noel 1996). The number of goslings present during late brood-rearing (obtained primarily from annual banding drives) is a good index of production. Complete nesting failures in 1991, 1992, and 1994 are largely attributable to fox predation during the laying and incubation periods, although weather and disease may also have played a contributing role (Burgess et al. 1994, Burgess and Rose 1994, Johnson and Noel 1996). In 1993, snow goose nest success was high, but all 259 brant nests on Howe Island were destroyed by a fox that arrived on the island in early July, after the snow geese had hatched (S.R. Johnson, LGL Ltd., pers. comm.). In another example of locally catastrophic impact, a fox was observed to have buried approximately 500 common eider eggs over the course of two days, completely eliminating production on a barrier island near Icy Cape, western NPR-A (Quinland and Lehnhausen 1982). It was estimated that the fox would have had to swim at least 150 m to reach the island.

Correlation Between Nest Success and Population Levels

The extent to which predation influences nest success of tundra-nesting birds, and ultimately population levels is a topic of continuing research, particularly in the Russian arctic. A series of papers (Summers 1986, Summers and Underhill 1987, Syroechkivski et al. 1991, Underhill et al. 1993) has correlated nest success of brant and shorebirds with fox predation pressure, mediated by the abundance of lemmings. According to their model, nest success is high only when lemming abundance is high; prey-switching by foxes and gulls in years of decreasing or low lemming abundance results in low nest success. Although actual data on nest success are scarce, the relationship between lemmings, foxes, and nest success of shorebirds and waterfowl seems to be widely accepted by Russian ornithologists (e.g., Tomkovich and Lebedeva 1996). In northern Alaska, the cyclic nature of both microtine populations and fox activity is less dramatic.

In the Prudhoe Bay area, Troy (TERA 1993) has shown that breeding populations of tundra-nesting shorebirds are correlated with nest success 2 years prior. Most shorebirds breed in their second spring, and the correlation supports the hypothesis that nest success, largely determined by the intensity of predation, is the principle factor influencing short-term population changes.

Although the agents of nest predation are rarely known with certainty, arctic foxes are the most likely predators.

Removal Experiment

Foxes were removed from the vicinity of the Tutakoke River brant colony on the Yukon-Kuskokwim Delta (Anthony et al. 1991) after two years of very low nest success in 1984 (2%), and 1985 (7%). Intensive fox control programs were adopted in 1986-1989, with 52 foxes killed (46 in 1986 and 1987). Nest success increased to a mean of 84% over the four years. This compares with a mean of 54% at a reference colony from which no foxes were removed (excluding 1987, when only one fox was active in the reference area).

PREDATOR POPULATION TRENDS IN THE OIL FIELDS

Grizzly Bear

There is no adequate baseline with which to evaluate pre-development population levels. Bears using anthropogenic foods, principally garbage, were 50-110 lbs heavier than same-aged bears in other North Slope populations (Shideler and Hechtel 1993). It is uncertain whether there has been a population-level effect. Several young bears, accustomed to the oil fields, have been shot at other locations, perhaps negating any potential population increase.

Common Raven

Little information on population trends is available. Because of their nest site requirements, it is evident that ravens were not present as breeding birds on the arctic coastal plain before construction of military and industrial facilities. Ravens nest at Prudhoe Bay, Barrow (since at least 1991), and Lonely, and probably other sites as well. The Christmas Bird Count data for Prudhoe Bay indicates an increase over seven years of observation. Approximately 30-50 individuals are present in mid-winter, a testament to the availability of anthropogenic food.

Glaucous Gull

Glaucous gulls are widely distributed across the arctic coastal plain in very low densities, nesting colonially in river deltas and coastal islands, and in lakes and lake basins (one to a few pairs per site). The largest colonies (30-70 nests) occur on offshore islands, and they generally occur in higher densities along the Beaufort Sea coast, in lagoons and at river mouths. The typical gatherings of several hundred birds at the Prudhoe Bay landfill are clearly unusual concentrations for this region. Although several studies have been conducted which included surveys of the coast and lagoon systems of the Beaufort Sea, it is difficult to compare numbers among locations and years because methods were not consistent. Murphy et al. (1977) noted relatively high numbers of glaucous gull nests within 20 km of the Prudhoe Bay landfill, with a few large colonies on Egg Island, Niakuk Islands, and Sagavanirktok River Delta accounting for the majority. This could be related to the proximity of the landfill, alternatively, to the presence of suitable nesting sites (offshore islands) in favorable foraging areas (river deltas).

Gulls do not remain in the area in winter, so local garbage is not a factor in improving over-winter survival. The extent to which garbage may improve productivity is unknown. There is a tendency for fewer gulls to use the Prudhoe Bay landfill during the nesting season (Murphy et al. 1990). This pattern is very pronounced at Barrow, where counts in the low thousands are typical

in May and August-September, but counts in the low tens are typical in June (R. Suydam, North Slope Borough Department of Wildlife Management, pers. comm.).

Arctic Fox

Studies in the late 1970s (Eberhardt et al. 1983a) indicated that the density of dens at Prudhoe Bay (1 den/12 km^2) was much higher than that of the undeveloped Colville River Delta (1 den/34 km^2). Based on active dens alone (dens containing juveniles), the 1976-1979 mean was 1/42 km^2 for Prudhoe Bay, and 1/151 km^2 for the Colville River Delta. Survival or production of juvenile foxes dropped in both locations in 1977, when lemming densities decreased, but the decrease was less pronounced at Prudhoe Bay. Burgess (1993) found similar den densities in the Prudhoe Bay unit (1/13.4 km^2, natural dens only), significantly higher than the density in undeveloped areas surrounding the oil field (1/72.2 km^2). Productivity (juveniles surviving until late summer) was significantly higher within the Prudhoe Bay unit. Both studies noted use of artificial dens, but Burgess (1993) believed that these were mostly secondary dens, places to which pups were moved after they were born. Both studies noted considerable use of refuse dumps, dumpsters, and unlawful feeding by oil field personnel.

In contrast to the other species discussed, arctic foxes are active in the area in winter. The supplemental food available in the oil fields has the potential to improve over-winter survival, as well as productivity. Little information is available on winter use of the oil fields. Eberhardt et al. (1983b) noted increased concentration of fox activity around developed sites, particularly in fall and early winter, compared with summer use. Up to 23 foxes were captured at a single dump site in seven days. Many foxes dispersed away from the oil fields in the period January - March. Foxes tagged at Prudhoe Bay have been recovered as far as 900 km away, at Banks Island, N.W.T. (Eberhardt and Hanson 1978). The high mobility of the species, and the concentrated use of Prudhoe Bay, suggests that individuals may immigrate into the oil fields in winter.

MANAGEMENT IMPLICATIONS

There is considerable uncertainty regarding the extent to which human activity has elevated the populations of predators in the oil fields. The weight of the evidence, however, points to increased predator activity in the area. While the extent to which these predators may negatively affect water bird productivity in the oil fields is imperfectly understood, there are many examples which illustrate potentially important impacts. The practices which provide these predators with access to anthropogenic food sources are generally prohibited by regulation. State regulations prohibit direct feeding of bears and foxes, and stipulate that solid waste disposal sites be kept inaccessible to wildlife. Some oil and gas lease sales have included language stipulating that "putrescible waste" shall be disposed of in a manner which minimizes attraction of wildlife. Oil company policy of prohibits feeding of wildlife. In spite of these many layers of regulation, problems of hand-feeding and improper waste disposal persist. Enforcement of the regulations is clearly inadequate and must be improved. It is also important to generate better population trend data and to conduct studies on predator-prey relationships in order to clarify the need for management action.

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MAMMALS

Session Chair: Dr. David Yokel, BLM, Fairbanks

MAMMALS OF THE NORTHEASTERN NPR-A

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Very little information exists specific to population status, trends, distribution, or human use of most mammalian species in the northeastern NPR-A. Studies of wolves, wolverines, and bears in the late 1970s and early 1980s concentrated on the calving grounds of the Western Arctic Caribou Herd, well outside the current study area. Wolves, wolverines, and bears occur throughout northeastern NPR-A but are more common in the southernmost part of the current study area, becoming scarce and widely dispersed on the northern coastal plain. Wolves and bears preferentially use major riparian systems where prey such as arctic ground squirrels and moose are most common. Bears may also opportunistically use areas with high abundance of microtine rodents on the coastal plain.

Moose occur year round in the Colville River Special Area. They are most abundant along the southern border of the current study area. Moose disperse farther north during summer and some move into smaller riparian systems as well as the main Colville floodplain. Other than the Colville, only the upper Ikpikpuk River is known to support wintering moose within the study area. Moose populations across the central and western North Slope recently crashed to about 20% of their levels during the mid-1980s. Causes for the decline are unknown, but probably include disease, increased predation, and poor nutrition (exacerbated by severe winter weather and/or excessive insect harassment in summer). Productivity and survival may have improved somewhat during the past year.

Three caribou herds use the northeastern NPR-A, but only the Teshekpuk Lake Herd calves in the study area. In the 1970s and possibly at other times in the past, calving occurred southwest of Teshekpuk Lake, but since about 1980 calving has been concentrated to the east and southeast of the lake. During July Teshekpuk Herd caribou seek relief from insects along the coast from Kogru to Smith Bay and on sand dunes along the Ikpikpuk River and south of Teshekpuk Lake. Fall/spring migrations and winter distribution are highly variable. Some years caribou remain all year in the same areas used for calving and post-calving. In other years, Teshekpuk caribou winter across the North Slope coastal plain from the Colville River to the Chukchi Sea, in the central Brooks Ranges mountains, in the Selawik Basin/Seward Peninsula, or in some combination of these areas. Portions of the Western Arctic and Central Arctic Herds use the current study area seasonally during summer and fall most years. In some winters, caribou from both these herds mix with Teshekpuk caribou in the northern half of the current study area.

The Teshekpuk Herd grew from about 3-4,000 in the late 1970s to nearly 27,000 by 1993. In 1995, the herd numbered just over 25,000. Residents of several North Slope villages hunt Teshekpuk caribou in late summer and throughout winter whenever the herd remains on the slope. Harvest may reach as high as 2,500 in some years. Severe winter storms have sometimes resulted in local die-offs of Teshekpuk caribou on the North Slope.

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CARIBOU AND OIL DEVELOPMENT IN NORTHERN ALASKA: LESSONS FROM THE CENTRAL ARCTIC HERD

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Of the four herds of caribou that inhabit arctic Alaska, only the Central Arctic Herd (CAH) has experienced substantial contact with oil and gas development. This herd ranges from the Brooks Range north to the Beaufort Sea, and from the Colville River (the eastern border of NPR-A) east to the Canning River (the western edge of the Arctic National Wildlife Refuge). The CAH calves and summers on the outer coastal plain, with about half the herd (the western segment) ranging between the Colville and Sagavanirktok rivers (encompassing the oilfields) and the other half (the eastern segment) ranging between the Sagavanirktok and Canning rivers.

Since it was first described as a distinct herd in the mid-1970s, the herd grew from about 5–6,000 caribou to about 23,500 in July 1992, before declining to at least 18,100 by July 1995. In combination with low calf production (particularly by the western segment) in several years in the late 1980s and early 1990s, this decline led to heightened concern about the possible influences of development on caribou demography. It is important to note that, to date, no cause-and-effect relationship has been demonstrated between oil development and the CAH decline (although several lines of inquiry warrant further scrutiny). Nevertheless, because of similarities in distribution and seasonal range use, the lessons learned from the Central Arctic Herd experience are directly relevant for predicting the responses of caribou to oil development within the range of the Teshekpuk Lake Herd (TLH) inhabiting the northeastern NPR-A.

The responses of CAH caribou to oil development are best described in a seasonal context. The two principal seasons when CAH caribou encounter oil development are the calving and insect seasons, which extend from late May to mid-June and from late June to mid-August, respectively. Since calving surveys began in 1978, calving activity by the western segment of the CAH traditionally has been concentrated in the area occupied by the Kuparuk and Milne Point oilfields. By the mid-1980s, studies by the Alaska Department of Fish and Game (ADFG) revealed a localized distributional shift within that area, as cows with newborn calves (which are well-known to be sensitive to humans and other potential predators) tended to avoid areas of human activity; this effect appears to extend 3–4 km from roads during calving. In addition, a shift in the relative distribution of calving activity has been noted since 1987 into areas south and west of the Kuparuk–Milne area (although that area continues to be used by calving caribou). The behavioral sensitivity of cows with young calves is noticeable until the insect season, when harassment by mosquitoes and oestrid (warble and nose-bot) flies during warm, calm weather become the dominant influences on caribou movements and behavior.

Caribou respond to mosquito harassment by aggregating and moving toward the sea coast, where they find relief in the cooler, breezier conditions that prevail there. Oestrid fly harassment tends to fragment groups, with coastal sites offering no special relief; rather, elevated, unvegetated, and shaded sites are selected as relief habitat. Combined harassment by both mosquitoes and oestrids results in the most severe harassment. Caribou moving through oilfields encounter difficulty crossing pipeline–road corridors where high-traffic roads (>15 vehicles/hr) are adjacent to pipelines. Experience and research in the oilfields has led to development of effective mitigation to counter such impacts on movements and behavior. Elevation of pipelines to 1.5 m above ground level, separation of pipelines from roads by ≥100 m, traffic control measures, strategic placement of crossing structures (ramps and higher-than-normal pipe), and careful design and layout of infrastructure all have proven effective.

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Whitten, K.R., and R.D. Cameron. 1980. Nutrient dynamics of caribou forage on Alaska's Arctic Slope. Pages 159-166 *in* Reimers, E., E. Gaare, and S. Skjenneberg, eds., Proc. 2nd Intl. Reindeer/Caribou Symposium, Rrs, Norway.

Whitten, K.R., and R.D. Cameron. 1985. Distribution of calving caribou in relation to the Prudhoe Bay oil field. Pages 35–39 *in* Martell, A.M. and D.E. Russell, eds., Caribou and human activity: Proceedings of the 1st North American Caribou Workshop. Canadian Wildlife Service Publication, Ottawa, Ont.

POLAR BEAR POPULATIONS AND DENNING IN THE BEAUFORT SEA

DR. S.C. AMSTRUP
ALASKA SCIENCE CENTER
BIOLOGICAL RESOURCES DIVISION
U.S. GEOLOGICAL SURVEY
ANCHORAGE, AK

Polar bears (*Ursus maritimus*) occur in most ice-covered seas of the northern hemisphere. In Alaska, their distribution is limited to the Beaufort, Chukchi, and northern Bering Seas. Only in the Beaufort Sea are they truly year-round residents. Mean annual and monthly activity areas ranged from 12,730 km^2 to 596,800 km^2 and 344 km^2 to 11,926 km^2. The Beaufort Sea population occupies a 900,000 km^2 area extending up to 300 km offshore from Cape Bathurst in Canada to Point Hope, Alaska. By mid-summer the most stable ice in the Beaufort Sea is in the central portion between northeastern National Petroleum Reserve-Alaska (NPR-A) and the Canadian border, and bears gravitate toward that area every year. The nearshore area of the northeastern NPR-A is heavily used by polar bears between summer and early winter annually. Although there are no geographic barriers to movement out of the Beaufort Sea, a relatively discrete subpopulation may be maintained by the general pattern of ice formation and ablation. Indeed, animals originally captured along the Beaufort Sea coast spent approximately 25% of their time in the northeastern Chukchi Sea, but animals captured in the Chukchi Sea ventured into the Beaufort Sea only 6% of the time.

The numbers of polar bears in the Beaufort Sea appears to have grown 2% per year through 1992, reaching a population ca. 1,800 animals. Although the number of bears in the Beaufort Sea now appears to be relatively large, it is small in absolute terms. Polar bears live long but reproduce slowly. They give birth in dens of snow and ice constructed by pregnant females in autumn. Of 92 dens occupied by polar bears radiocollared between 1981 and 1992, 48 were on drifting pack ice and 44 were on land or land-fast ice. The proportion of dens on land was increasing ($\underline{P} = 0.029$) in the last half of the study. There was no difference in cub production among bears denning on land and pack ice ($\underline{P} = 0.66$). Mean entry and exit dates were 11 November and 5 April for land dens and 22 November and 26 March for pack-ice dens. Of 35 polar bears that denned along the mainland coast of Alaska and Canada only 4 were located within the bounds of NPR-A. Bears followed to >1 den did not reuse sites and consecutive dens were 20-1,304 km apart. Radio-collared bears were, however, largely faithful to substrate (pack-ice, land, land-fast ice) and the general geographic area of previous dens.

Bears denning on land may be vulnerable to human activities such as hunting and industrial development because altricial neonates cannot leave the den for 3 months post-partum. Excess taking produced a major population decline in the 1950s and 1960s. Hence, managers must be alert to possible changes in human activities, including hunting and habitat alterations that could reduce survival or recruitment. Recovery from perturbations would be slow. For example, the increase in land denning that we observed during the 1980s may have resulted from a decline in hunting in denning areas that began decades earlier. On the other hand, predictable denning chronology and lack of site fidelity, as well as, greater than expected resilience to human activities near dens, indicate that many denned bears exposed to human activities are likely not to be affected in ways that alter their productivity. Also, rigorous adherence to flexible management strategies, including spatial and temporal restrictions on developments, could prevent the potential for many disruptions of dens from being realized.

PUBLICATIONS RELATED TO POLAR BEARS

Amstrup, S.C. 1983. Polar Bear research in Alaska, 1980-1982. Proceedings of the eighth technical workshop of the IUCN Polar Bear Specialists Group. Appendix 5, 18 p. 1196 Gland Switzerland.

Amstrup, S.C. 1984. Masters of the Northern Ice. Alaska. L(11):32-36, 74-77.

Amstrup, S.C. 1986. Polar Bear. Pages 790-804 *in* DiSilvestro, R., ed., Audubon Wildlife Report 1986. The National Audubon Society, New York, N.Y.

Amstrup, S.C. 1986. Research on Polar Bears in Alaska, 1983-1985. Pages 85-115 *in* Proceedings of the ninth working meeting of the IUCN Polar Bear Specialists Group.

Amstrup, S.C. 1987. Marine denning of polar bears in Alaska. Seventh Biennial Conference on the biology of Marine Mammals. Dec. 5-9, 1987. Abstract Only.

Amstrup, S.C. 1987. Telezol is a better drug for capturing free-ranging polar bears. Research Information Bulletin No. 87-110. U.S. Dept. Int. Fish and Wildlife Service. 2 p.

Amstrup, S.C. 1987. The Polar Bear. Pages 58-59 in Bears of Alaska in life and legend. Jeff Rennicke. Roberts Rinehart Inc. Boulder, CO.

Amstrup, S.C. 1991. Research on Polar Bears in Northern Alaska, 1985-1988. *In* Proceedings of the Tenth working meeting of the IUCN Polar Bear Specialists Group, Sochi, USSR. Edited by S.C. Amstrup and O. Wiig. Occas. Pap. IUCN Spec. Surv. Comm. 7:43-53.

Amstrup, S.C. 1991. White Bear: Encounters with the master of the Arctic ice. Book Review. Arctic 44:259-260.

Amstrup, S.C. 1993. Human disturbances of denning polar bears in Alaska. Arctic. 46(3):246-250.

Amstrup, S.C. 1995. Movements, distribution, and population dynamics of polar bears in the Beaufort Sea. Ph.D. Dissertation. University of Alaska Fairbanks, Fairbanks, Alaska. 299 p.

Amstrup, S.C., and J. Beecham. 1976. Activity patterns of radio-collared black bears in Idaho. J. Wildl. Manage. 40(2):340-348.

Amstrup, S.C., and D. DeMaster. 1988. Polar Bear. Pages 39-56 *in* Lentfer, J.W., ed., Selected Marine Mammals of Alaska: Species Accounts with Research and Management Recommendations. Marine Mammal Commission, Washington, D.C.

Amstrup, S.C., and G.M. Durner. 1996. Survival rates of radio-collared polar bears and their dependent young. Can. J. Zool. In Press.

Amstrup, S.C., and C. Gardner. 1994. Polar bear maternity denning in the Beaufort Sea. J. Wildl. Manage. 58(1):1-10.

Amstrup, S.C., G.W. Garner, M.A. Cronin, and J.C. Patton. 1994. Sex identification of polar bears from blood and tissue samples. Can. J. Zool. 71:2174-2177.

Amstrup, S.C., and C.A. Nielsen. 1989. Acute Gastric Dilatation and Volvulus in a free-living polar bear. J. Wildl. Dis. 25(4):601-604.

Amstrup, S.C., and G.M. Durner. 1995. Survival of radio-collared polar bears and their dependent young. Can. J. Zool. 73(7):1312-1322.

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Amstrup, S.C., C. Gardner, K.C. Myers, and F.W. Oehme 1989. Ethylene Glycol (antifreeze) poisoning of a free-ranging polar bear. Vet. Hum. Toxicol. 31:317-319.

Amstrup, S.C., I. Stirling, and J.W. Lentfer. 1986. Past and Present Status of polar Bars in Alaska. Wildl. Soc. Bull. 14(3): 241-254.

Bethke, R., M.K. Taylor, S.C. Amstrup, and F. Messier. 1996. Population delineation of polar bears using satellite collar data. Ecological Applications. In Press.

Bruce, D.S., N.K. Darling, K.J. Seeland, P.R. Oeltgen, S.P. Nilekani, and S.C. Amstrup. 1990. Is the Polar Bear (*Ursus maritimus*) a hibernator?: Continued studies on opioids and hibernation. Pharmacology Biochemistry and Behavior. 35(3):705-711.

Cronin, M.A., S.C. Amstrup, G.W. Garner, and E.R. Vyse. 1991b. Interspecific and intraspecific mitochondrial DNA variation in North American bears (*Ursus*). Can. J. Zool. 69:2985-2992.

Durner, G.M., and S.C. Amstrup. 1995. Movements of a polar bear from northern Alaska to northern Greenland. Arctic 48(4):338-341.

Durner, G.M., and S.C. Amstrup. 1996. Mass and body-dimension relationships of polar bears in northern Alaska. Wildlife Society Bulletin 24(3):480-484.

Garner, G.W., S.C. Amstrup, D.C. Douglas, and C.L. Gardner. 1989. Performance and utility of satellite telemetry during field studies of free-ranging polar bears in Alaska. Pages 67-76 *in* Amlaner, C.J. Jr., ed., Proc. Tenth International Symposium on Biotelemetry.

Garner, G.W., S.C. Amstrup, I. Stirling, and S.E. Belikov. 1994. Habitat considerations for polar bears in the north Pacific rim. Trans. N. A. Wildl. and Nat. Res. Conf. 59:111-120.

Fancy, S.G., L.F. Pank, D.C. Douglas, C.H. Curby, G.W. Garner, S.C. Amstrup, and W.L. Regelin. 1988. Development and evaluation of a system for tracking wildlife by satellite. Proc. 2nd International Symp. on Nutrition of Herbivores, Brisbane, Australia.

Fancy, S.G., L.F. Pank, W.L. Regelin, D.C. Douglas, S.C. Amstrup, and G.W. Garner. 1987. Satellite Telemetry: A new tool for wildlife research and management. U.S. Fish and Wildl. Service. Resource. Publ. 172. 54 p.

ATTACHMENT A

RESUMES OF SPEAKERS

In Alphabetical Order

STEVEN CARL AMSTRUP
WILDLIFE BIOLOGIST (RESEARCH)
ALASKA SCIENCE CENTER
BIOLOGICAL RESOURCES DIVISION
U.S. GEOLOGICAL SURVEY
1011 EAST TUDOR RD
ANCHORAGE, AK 99503

EDUCATION:

University of Washington, B. Sc. Forest Resources, 1972 Magna Cum Laude

University of Idaho, M. Sc. Wildlife Mgmt. 1975
Thesis Title: *Activities of Radio-collared Black Bears in Idaho*

University of Alaska Fairbanks, Ph.D. Wildlife Mgmt., 1995
Dissertation Title: *Movements, distribution, and population dynamics of polar bears in the Beaufort Sea.*

AREAS OF EXPERTISE:

- Animal restraint/capture
- Ecology of the north
- Carnivore evolution, ecology and life history
- Mammalian population dynamics

Position (November 1980 to present): Wildlife Biologist (Research), Alaska Science Center, USGS, Biological Resources Division, *(Formerly: Research Division U. S. Fish and Wildlife Service, Alaska Fish and Wildlife Research Center).*

As leader of the Northern Alaska Polar Bear Research, I am responsible for planning conducting and reporting independent research on the general biology, life history, ecology, distribution, and population dynamics of polar bears. I recommend management policies and practices based on research findings. Management policies may be unilateral or international in nature. I correspond and otherwise communicate with other polar researchers world-wide, and consult with foreign researchers regarding the planning and conduction of internationally shared research. I supervise permanent and temporary biological staff also assigned to the polar bear project.

Sample accomplishments: First to successfully use radiotelemetry as a tool to study movements and population dynamics of polar bears. Discovered and documented the significance of marine denning among polar bears of the Beaufort Sea, and mapped the distribution of dens found on land. Determined that polar bears of the Beaufort Sea are shared extensively with our neighbors in Canada. Verified that polar bears, which had been at very low population levels during the 1960s and early 1970s, had increased in number and in frequency of appearance near shore by the middle 1980s. Documented that survival rates of polar bears of polar bears are much higher than previously thought, explaining empirical observations suggesting increasing numbers. Documented that sex of polar bears can be successfully determined, using molecular genetics methods, from only blood or tissue samples.

GREGORY R. BALOGH
WILDLIFE BIOLOGIST
U.S. FISH AND WILDLIFE SERVICE
OFFICE OF ECOLOGICAL SERVICES
1011 E. TUDOR ROAD
ANCHORAGE, Ak 99503

EDUCATION:

Ohio State University, 1981-1989. MS in Wildlife Biology. Thesis topic was control of purple loosestrife in wetlands ; MS in Environmental Biology, focus was remote sensing; BS in Wildlife Management, graduated *cum Laude*.

WORK EXPERIENCE APPLICABLE TO NPR-A:

Botanist/Habitat Classifier, NPR-A satellite mapping project with BLM, 1994-1995.

Observer, Data Analyst, GIS Specialist, North Slope Eider Survey, entire Alaska Arctic Coastal Plain east to Canning River, 1991-1996.

Botanist, Habitat Classifier, North Slope Bird Habitat Project, Colville Delta east to Shaviovik River, 1987-1988.

Crew Leader, North Slope Bird Habitat Project, Shaviovik River Delta, 30 miles east of Prudhoe Bay, 1986.

TERRY BENDOCK
P.O. BOX 3493
SOLDOTNA, AK 99669

EDUCATION:

Bachelor of Science - Biology - University of Alaska, Fairbanks, 1973

PROFESSIONAL EXPERIENCE:

Self Employed, Soldotna, AK (1996-Present) - Commercial Fishing

As vessel owner/operator, supervises all aspects of commercial fishing for salmon, halibut, and cod on F/V Kiska. Duties include operating within the regulatory frameworks established for commercial fishing by the Alaska Department of Fish and Game, National Marine Fisheries Service and U.S. Coast Guard; hiring, training and supervising two to three additional crew persons; and all aspects of maintenance and repair for the vessel and gear.

Alaska Dept. of Fish and Game, Soldotna, AK (1986-1996) - Research Project Leader

Responsible for designing, implementing and reporting on fishery research conducted on the Kenai Peninsula. Directly supervised three full time biologists and up to 6 seasonal fishery technicians. Worked with project biologists to ensure that studies were well designed and conducted within specified time and budget limits.

Principal Research
- Habitat preferences for juvenile chinook salmon in the Kenai River
- Hooking mortality of chinook salmon released in the Kenai River
- Stock composition of chinook salmon harvested in marine fisheries

AK Dept. of Fish and Game, Fairbanks, AK (1974-1986) - North Slope Area Fishery Biologist

Responsible for designing, implementing, and reporting results from fisheries studies conducted on the North Slope of Alaska. Responsible for all management and research activities in the job area including stock assessments, lake and stream inventories, and creel surveys. Supervised one full time biologists and up to 4 seasonal fishery technicians.

Principal Research
- Trans-Alaska pipeline technical evaluation study
- Beaufort sea estuarine fishery study, OCS Principal Investigator
- Fishery surveys of waters within the National Petroleum Reserve, Alaska
- Inventory and cataloging of Arctic area waters.

STEPHEN R. BRAUND
STEPHEN R. BRAUND AND ASSOCIATES
P.O. BOX 1480
ANCHORAGE, AK 99510

Since 1978, Mr. Braund has been principal of Stephen R. Braund & Associates (SRB&A), an anthropological consulting firm specializing in sociocultural, socioeconomic, and subsistence research in Alaska. SRB&A has conducted research in over 120 rural Alaska communities since 1978 as well as in Japan and Canada. Mr. Braund's research background includes collection and analysis of subsistence harvest data and associated mapping of subsistence use areas; assessment of impacts associated with petroleum exploration and development; analyses of the interaction between subsistence and cash economies; and baseline sociocultural and socioeconomic descriptions of rural populations potentially affected by resource development activities. As principal of SRB&A, Braund has directed or participated in over northern 65 research projects. Mr. Braund has a B.A. in Northern Studies and English and an M.A. in Anthropology from the University of Alaska, Fairbanks.

SRB&A has conducted several projects on the North Slope including:

- Beaufort Sea Oil and Gas Development/Northstar Project (1996-97).
- Mapping of Hunting Areas and Travel Routes Based on Interviews with a Selected Group of Subsistence Hunters at Barrow and Wainwright, Alaska (North Slope Borough - 1995-97).
- The North Slope Subsistence Study documenting species, amounts and locations of subsistence harvests for three years in Barrow and two years in Wainwright (Minerals Management Service and the North Slope Borough 1986-93).
- Research associated with the quantification of the subsistence and cultural need for bowheads whales by Alaska Eskimos (1982-94).
- The subsistence portion of the Lisburne Offshore Development Project EIS (1987).
- The Western Arctic Coal Development Project (1985).

HARRY BROWER, JR.
SUBSISTENCE RESEARCH SPECIALIST
DEPARTMENT OF WILDLIFE MANAGEMENT
NORTH SLOPE BOROUGH, BOX 69
BARROW, ALASKA 99723

EMPLOYMENT:

1984-1990 Heavy Equipment Operator, UIC-SKW Construction, Barrow, AK

1991-present Subsistence Research Specialist, Department of Wildlife Management, North Slope Borough, Barrow, AK

COMMITTEE AND COUNCILS:

North Slope Subsistence Regional Advisory Council, Member, 1992 to present.

Alaska Inuvialuit Beluga Whale Committee, Member, 1991 to present.

Rural Alaska Resources Association, Alternate Member, 1991 to present.

Rural Alaska Community Action Program, Alternate Member, 1991 to present.

Indigenous Peoples Council on Marine Mammals, Alternate Member, 1992 to present.

OTHER SIGNIFICANT ACTIVITIES:

Active subsistence hunter for 25 years
Member of the Barrow Whaling Captains Association
Participated in the Harvest Symposium held in Girdwood, Alaska which was sponsored by the Alaska Department of Fish and Game and the Institute of Social and Economic Research, University of Alaska Anchorage
North Slope Borough Employee of the Month, January 1995

ROLAND A. GANGLOFF
CURATOR, EARTH SCIENCE COLLECTIONS
UNIVERSITY OF ALASKA MUSEUM
ASSOCIATE PROFESSOR
DEPARTMENT OF GEOLOGY AND GEOPHYSICS
UNIVERSITY OF ALASKA, FAIRBANKS, AK 99775

EDUCATION:

A.A. Orange Coast Community College, 1958
B.A. University of California at Berkeley, 1961
M.A. in Paleontology, University of California at Berkeley, 1963
Ph.D. in Paleontology, University of California at Berkeley, 1975

RELEVANT EXPERIENCE:

1978 to 1986: excavated and prepared vertebrate fossils from the Green River deposits near Kemmerer, Wyoming.

1987 to 1989: member of joint University of California and University of Alaska excavation and mapping team that worked on Colville River dinosaurs and associated vertebrates.

1990 to present: Principal Investigator of the Arctic Alaska Dinosaur Program. Responsible for curation, funding, research and exploration related to dinosaurs and associated fossils from Ninuluk Bluff to Ocean Point, North Slope of Alaska.

1987 to present: Curator of Earth Science Collections, U.A. Museum. Responsible for all geological and paleontological materials collected in the NPR-A Study Area as per Memorandum of Understanding with Bureau of Land Management.

1992: Co-convener of symposium on Arctic dinosaurs for the first International Symposium on Arctic Margins, Anchorage, Alaska.

1989 to 1997: Engaged in research on collections, and trained in preparation and conservation of dinosaurs at the University of California Museum of Paleontology, the Royal Tyrrell Museum of Palaeontology, Drumheller, Alta., Canada, Museum of the Rockies, Dinosaur National Monument, Utah State Field House of Natural History, Vernal, Utah, the Prehistoric Museum of the College of Eastern Utah and Cleveland-Lloyd Quarry, Price, Utah and the Museum of Western Colorado, Grand Junction, Colorado.

PROFESSIONAL AFFILIATIONS:

Member of : The American Association for the Advancement of Science, Geological Society of America, Paleontological Society, Society of Vertebrate Paleontologists, Society of Sedimentary Geologists, Geological Society of Alaska and Sigma Xi.

JOHN CRAIGHEAD GEORGE
DEPT. OF WILDLIFE MANAGEMENT/NORTH SLOPE BOROUGH
BOX 69
BARROW, AK 99723

EDUCATION:

B.S. Wildlife Management 1977, Utah State University, Logan, UT
M.S. candidate 1996. University of Alaska, Institute of Arctic Biology, Fairbanks, AK

EMPLOYMENT:

Wildlife biologist with North Slope Borough Department of Wildlife Management - July 1982 to present.

International Whaling Commission Scientific Committee - 1985 to present.

SELECTED SCIENTIFIC PUBLICATIONS

George, J.C. 1981. Current procedure for allocating the bowhead whale, *Balaena mysticetus*, by the Eskimo whalers of Barrow, Alaska. Pages 279-803 *in* Albert, T.F., ed., Tissue Structural Studies and Other Investigations on the Biology of Endangered Whales in the Beaufort Sea. Rep. to the Bureau of Land Mgmt. from the Dept. of Veterinary Science, Univ. of Maryland, College Park, MD.

George, J.C., and Kovalsky, R. 1986. Observations on the Kupigruak channel (Colville River) subsistence fishery - October 1985. Rep. to the North Slope Borough, Box 69, Barrow, AK.

George, J.C., and Nageak, B.P. 1986. Observations on the Colville River subsistence fishery at Nuiqsut, Alaska. For the period: 4 July - 1 November 1984. Rep. to the North Slope Borough, Box 69, Barrow, AK.

Carroll, G.M., George, J.C., Lowry, I.F., and Coyle, K.O. 1987. Bowhead whale (*Balaena mysticetus* feeding near Point Barrow, Alaska during the 1985 spring migration. Arctic 40(2):105-110.

George, J.C., Clark, C., Carroll, G.M., and Ellison, W.T. 1989. Observations on the ice-breaking and ice navigation behavior of migrating bowhead whales (*Balaena mysticetus*) near Point Barrow, Alaska. Spring 1985. Arctic 42:24-30.

George, J.C., Philo, I.M., Hazard, K., Withrow, and Carroll, G.M. In Press. Frequency of killer whale (*Orcinus orca*) attacks and ship collisions based on scarring on bowhead whales (*Balaena mysticetus*) of the Bering-Chukchi-Beaufort Seas Stock. Arctic.

Philo, I.M., George, J.C., and Albert, T.F. 1992. Rope entanglement of bowhead whales (*Balaena mysticetus*). Marine Mammal Science 8(3): 306-311.

Zeh, J.E., George, J.C., Raftery, A.E., and Carroll, G.M. 1991. Rate of increase, 1977-1988, of bowhead whales (*Balaena mysticetus*) estimated from ice-based census data. Mar. Mammal Sci. 7:105-22.

Zeh, J.F., Clark, C.W., George, J.C., Withrow, D., Carroll, G.M., and Koski, W.R. 1993. Chapter 11. Current population size and dynamics. *In*: Burns, J.J. and J.J. Montague, eds., The Bowhead Whale. Allen Press, Lawrence, KS.

Zeh, J.F., George, J.C., and Suydam, R. 1994. Rate of increase, 1978-1993, of bowhead whales (*Balaena mysticetus*). Paper SC/46/AS12 presented to the IWC Scientific Committee.

JANET JORGENSON
U.S. FISH AND WILDLIFE SERVICE
FAIRBANKS, AK 99701

Janet Jorgenson has a master's degree in plant ecology and has worked on vegetation studies and monitoring for the Arctic National Wildlife Refuge for 9 years. Projects include vegetation classification and mapping, caribou forage studies, rare plant surveys, establishment of long-term ecological monitoring plots, and studies of vegetation and soil disturbance from seismic vehicle traffic and from recreational camping use.

M. TORRE JORGENSON
SENIOR SCIENTIST
ABR, INC.
P.O. BOX 80410
FAIRBANKS, AK 99709

EXPERTISE: Terrain Analysis, Plant Ecology, Soil Science, Ecological Restoration, Bioremediation

EDUCATION: B.S., Geography, Biology, 1978. University of Minnesota, Duluth.
M.S., Land Resources Management, 1986. University of Alaska, Fairbanks.
Thesis: *Biophysical factors influencing the geographic variability of soil heat flux: Implications for terrain sensitivity.*

PROFILE:

Torre's work has focused on the pattern and process of terrestrial ecosystems and he has broad interests in plant ecology, pedology, surficial geology, and meteorology. He has been involved with studies of tundra, taiga, and coastal ecosystems in Alaska since 1980. His studies have involved baseline investigations of natural ecosystems, ecological land surveys, responses of permafrost terrain to disturbance, and rates and methods of recovery of disturbed terrain. He has conducted projects throughout Alaska, including the Colville River Delta, Prudhoe Bay, Copper River Delta, Yukon–Kuskokwim Delta, Kachemak Bay, Tanana Valley, Kandik Basin, Arctic National Wildlife Refuge, and in northwestern Alaska. He has conducted numerous studies involving damage assessments, contaminants, and bioremediation in tundra and taiga ecosystems. He has worked on seven oil spills on the North Slope of Alaska and on the Komi spill in Russia.

SELECTED PROJECTS

Co-Principal Investigator, Assessing damage from hydrocarbons and cleanup operations after crude oil spills in arctic Alaska (1995–96).

Technical Advisor, Ecological land survey and oil cleanup advise for Komi oil spill, Russia (1995).

Co-Principal Investigator, Assessment of biological effects of a fuel spill along the Alaska Railroad, interior Alaska (1990–91).

Co-Principal Investigator, Site assessment, risk assessment, and remedial planning for Itkillik exploratory well site (1994–95).

Principal Investigator, Bioremediation of hydrocarbon contamination of S.E. Eileen well site, Prudhoe Bay Oilfield (1990–93).

Principal Investigator, Oil spill bioremediation and tundra restoration at Drill Site 2-U, Kuparuk Oilfield (1989–91).

RICHARD KEMPKA
DUCKS UNLIMITED, INC.
3074 GOLD CANAL DRIVE
RANCHO CORDOVA, CA 95670

EDUCATION:

M.A. Geography/Remote Sensing – Indiana State University

EXPERIENCE:

Over eight years experience in management of GIS and remote sensing projects in arctic and alpine environments. Experience includes all aspects of data acquisition, field sampling, database design, image processing, advanced enhancement techniques, and GIS modeling. Mr. Kempka is currently managing projects in California, Oregon, Washington, and Alaska. Among these projects, change detection efforts will contribute to ongoing management of boreal forest areas.

RODNEY J. KING
MIGRATORY BIRD MANAGEMENT
U.S. FISH AND WILDLIFE SERVICE
1412 AIRPORT WAY
FAIRBANKS, AK 99701

EDUCATION:

B.S. in Wildlife Management, Utah State University, Logan, UT 1969.

EXPERIENCE:

Various waterfowl management positions with the U.S. Fish and Wildlife Service from 1969 to 1975 including Woodworth Waterfowl Research Station, Woodworth, ND; J. Clark Salyer National Wildlife Refuge; Bowdoin-UL Bend National Wildlife Refuge, Malta, MT; Benton Lake National Wildlife Refuge, Black Eagle, MT as waterfowl ascertainment biologist for western Montana; Ecological Services, Billings, MT.

Transferred to Wildlife Biologist, Copper River Delta, Chugach National Forest, Cordova, AK in 1975 and back to U.S. Fish and Wildlife Service in 1977 as Wildlife Biologist/Pilot, Migratory Bird Management, Anchorage, AK. Current position in Fairbanks, AK since 1980 to present as Project Leader/Wildlife Biologist/Pilot to conduct surveys for various waterbird species throughout Alaska with intermittent temporary assignments to conduct similar surveys in Canada, western United States, and Mexico. As part of the collection of aerial surveys interpretation and reporting of such surveys in the form of annual reports and presentations of data at various professional conferences.

Conducted the aerial surveys, analyzed data, and reported it in various forms:

1. Migratory bird surveys of NPR-A (1977-78).

2. Aerial surveys on the Arctic Coastal Plain of Alaska from Pt. Lay on the west to the Canada border on the east (1986-96).

3. Aerial surveys for molting geese in the Teshekpuk Lake area (1982-1996).

4. Band greater white-fronted geese, Canada geese, and brant in the Teshekpuk Lake area in 1977-78 and the Arctic Coastal Plain 1990-95.

5. Aerial surveys for waterfowl from Teshekpuk Lake area along the western coast of Alaska to Bethel intermittently 1977 to 1990.

BRIAN E. LAWHEAD
ABR, INC.
P.O. BOX 80410
FAIRBANKS, ALASKA 99709

EXPERTISE: Environmental Impact Assessment, NEPA Documentation, Wildlife Biology

EDUCATION:

B.S., Biological Science, 1975. Cornell University, Ithaca, New York.
M.S., Wildlife Management, 1983. University of Alaska, Fairbanks.
Thesis: *Wolf den site characteristics in the Nelchina Basin, Alaska.*

PROFILE:

Brian has been active in both terrestrial and marine biological studies in Alaska since 1975. As a research biologist for ABR since 1982, he authored or reviewed a variety of environmental assessments and impact statements. He heads ABR's environmental impact assessment program, and recently has managed several large, interdisciplinary environmental impact studies and a variety of specialized environmental analyses.

SELECTED PROJECTS:

Project Leader, Alpine Development Project Environmental Evaluation. Managed interdisciplinary team summarizing information on hydrology, geomorphology, vegetation and wetlands, wildlife, and threatened and endangered species for preparation of NEPA compliance document (1995–1997).

Project Scientist, Colville River Delta Wildlife Studies. Project leader for predevelopment baseline studies of caribou, foxes, and other mammals (1995–96).

Principal Investigator, Endicott Environmental Monitoring Program, Caribou Study (1987–90).

Principal Investigator and Senior Research Biologist, Central Arctic Caribou Herd Studies. Designed and supervised studies to document distribution and movements of caribou during the calving season and to delineate the extent of calving grounds (1996, 1993, 1987, 1984); designed and supervised a study of caribou movements and behavior in an area of drill site expansion in the northwest Kuparuk Oilfield (1991–92); supervised and coauthored a literature review and synthesis to investigate the potential risks to caribou of exposure to toxic substances in North Slope drilling muds (1991–92); designed and supervised an intensive study of the behavioral responses of caribou to Kuparuk Oilfield facilities and activities (1988); wrote an environmental assessment identifying the potential effects of Amerada Hess's proposed North Star development on caribou (1985); served as technical advisor for the development of a computer video program to visually depict radio-telemetry data in temporal sequence, and for the production of a video-taped presentation of caribou movement data (1984); supervised a study to collect pre-pipeline-construction data on caribou movement patterns in the western Kuparuk Oilfield, for use in planning mitigative measures (1984); supervised an intensive radio-telemetry study of caribou distribution and movements on the central Arctic Coastal Plain (1983); participated in a study of the effects of pipelines and roads on caribou movements in the western Prudhoe Bay Oilfield (1982).

PHILIP D. MARTIN
U.S. FISH AND WILDLIFE SERVICE
1412 AIRPORT WAY
FAIRBANKS, AK 99701

EDUCATION:

M.S., Zoology, University of Alaska, Fairbanks, Alaska
B.A., Biology, Antioch College, Yellow Springs, Ohio

EXPERIENCE:

1990 - present **Biologist, U.S. Fish and Wildlife Service.** Prepare agency comments on development proposals involving wetlands, particularly for North Slope oil and gas projects. Evaluate impacts of proposed oil and gas projects on wildlife and habitat. Participate in negotiations with agencies and project proponents regarding appropriate mitigation measures. Conducted studies of shorebird breeding biology and habitat associations, brant brood-rearing behavior, and habitat associations of birds using taiga palustrine wetlands.

1988 - 1990 **Research Associate and Instructor, University of Alaska, Fairbanks.** Co-investigator in a population monitoring study of seabirds on St.Matthew Island, central Bering Sea. Supervised field work, analyzed data, completed report. Coordinated laboratory instruction in introductory biology class, including supervision of up to eight teaching assistants.

1982 - 1984 **Biologist, LGL Ecological Research Associates.** Intermittent employment. Conducted shipboard pelagic bird censuses, conducted literature review, and participated in studies of development effects on arctic-nesting birds, especially shorebirds.

1988 - 1984 **Museum Assistant, University of Alaska Museum.**

1983 **Biologist, FALCO.** Conducted surveys, and studied reproductive success and food habits of seabirds on St. Matthew Island.

1981 **Student Assistant, Institute of Arctic Biology.** Directed vegetation mapping project in boreal forest habitats, Healy, Alaska.

1979 - 1981 **Graduate Research Assistant, University of Alaska.** Designed and conducted a two-year research program to determine how invertebrate prey base relates to habitat use by arctic nesting shorebirds and longspurs.

1978 **Biological Technician, U.S. Fish and Wildlife Service.** Field studies on wetland use by waterbirds in the National Petroleum Reserve, Alaska.

1977 **Volunteer Biologist, Manomet Bird Observatory.** Performed shipboard surveys of marine birds on Atlantic coast between New England and North Carolina.

PHILIP D. MARTIN CONT.

REPORTS AND PUBLICATIONS

Martin, P.D., and Moitoret, C.S. 1981. Bird populations and habitat use, Canning River Delta, Alaska. Unpubl. Report prepared for Arctic National Wildlife Refuge, U.S. Fish and Wildlife Service, Fairbanks. v.p.

Martin, P.D. 1983. Bird use of tundra habitats at Canning River Delta, Alaska. Unpubl. M.S. Thesis, University of Alaska, Fairbanks. 117 pp.

Martin, P.D. In press. Effects of the Exxon Valdez oil spill on migrant shorebirds using rocky intertidal habitats of Prince William Sound, Alaska, during spring 1989. Exxon Valdez oil spill State/Federal natural resource damage assessment. Final report (Bird Study Number 12). U.S. Fish and Wildlife Service, Anchorage, Alaska. 54 pp. plus appendices.

Moitoret, C.S., Walker, T.R., and Martin, R.D. 1996. Predevelopment surveys of nesting birds at two sites in the Kuparuk Oilfield, Alaska, 1988-1992. U.S. Fish and Wildlife Service. Northern Alaska Ecological Services, Fairbanks, Alaska. Technical Report NAES-TR-96-02. 104 pp.

Murphy, E.C., Cooper, B.A., Martin, P.D., Johnson, C.B., Lawhead, B.E., Springer, A.M., and Thomas, D.L. 1987. The population status of seabirds on St. Matthew and Hall Islands, 1985 and 1986. Final report prepared for Minerals Management Service, Anchorage, Alaska. 154 pp.

Norton, D.W., Senner, S.E., Gill, R.E., Jr., Martin, P.D., Wright, J.M., and Fukuyama, A.K. 1990. Shorebirds and herring roe in Prince William Sound, Alaska. Am. Birds. 44(3):367-371:508.

JAY D. MCKENDRICK
PROFESSOR OF AGRONOMY
UNIVERSITY OF ALASKA FAIRBANKS
AGRICULTURAL & FORESTRY EXPERIMENT STATION
PALMER RESEARCH CENTER
533 EAST FIREWEED
PALMER, AK 99645

ACADEMIC BACKGROUND:

1. University of Idaho B.S. 1963 (soil & plant science)
2. University of Idaho M.S. 1966 (range management)
3. Kansas State University Ph.D. 1971 (range management & plant ecology)

EMPLOYMENT HISTORY:

Research Associate, University of Idaho, Moscow, Idaho (1965-67)
Research Associate, Kansas State University, Manhattan, KS (1967-71)
Turf Agronomist, D.W. Newcomers, Inc., Kansas City, MO (1971)
Faculty Member, University of Alaska Fairbanks (1972- present)

PERTINENT ALASKA AND/OR ARCTIC PROJECTS:

Reclamation of Land Damaged by Oil Spills. (1972 - 1974)
Tundra Rehabilitation Research. (1972 - 1974)
Applying Remote Sensing Technology for Developing Regulations for Off-Road Vehicle Use for a Selected Portion of the Alyeska Pipeline Route. (1975 - 1976)
Compilation of Cold-Climate Oil-Spill Research and Technology. (1975 - 1977)
Mineral Nutrient Studies on Arctic Tundra. (1975 - 1978)
Musk Ox Range Evaluation. (1978 - 1980)
Sand Dune Revegetation Near Northway, Alaska. (1977 - 1979)
Natural Succession on Placer Mine Spoils of Interior Alaska. (1979)
Coal Mine Reclamation. (1979 - 1982)
Susitna Hydroelectric Project. (1980 - 1982)
Evaluating Vegetation Recovery on Exploration Sites in NPRA. (1983)
Arctophila Revegetation Feasibility Study. (1985 - 1989)
Gravel Pad Vegetation Experiments Arctic Slope Alaska. (1989 - 1999)
Tundra Revegetation in Western Siberia, Tyumen Region. (1991 - ?)
Monitoring Vegetation and Soil Changes on Graveled Tundra. (1992 - 1997)
Stabilizing Sand Cover Over Closed-Out Landfill, Prudhoe Bay, Alaska. (1993-1996)
Evaluating Revegetation of Gravel Cleanup Sites Around Drilling Pads, Prudhoe Bay, Alaska. (1992-1996)
Pad X Flare Pit Closeout Revegetation. (1994-1996)
Revegetation of Abandoned Flare Pits for BP Exploration (Alaska), Inc. (1996)

JAY D. MCKENDRICK CONT.

CURRENT PROJECTS:

Recording Tundra Recovery on Alaska's Oil Exploration Sites National Petroleum Reserve in Alaska. (1996 - 1997)
Long-term Monitoring of Disturbed Sites and Experiments in Prudhoe Bay Oil Field. (1972 - 1999)
Testing North Slope Waste Products for Revegetation of Gravel Pads. (1996-1997)
Handbook on Coal Mining Reclamation in Alaska. (1996-1997)
Badami No 1 Vegetation Monitoring. 1996-1999)
Seeding and Monitoring Recovery of Tundra in Milne Point Oil Field. (1996 - 1997)
Monitoring Revegetation on Sequoia Exploratory Drilling Site for Conoco, Inc. (1996 - 1999)
American Petroleum Institute Unusually Sensitive Area - Ecological Resources Technical Work Group (1996 - 1997)

RICHARD E. REANIER
1807 - 32nd AVENUE
SEATTLE, WA 98122

PROFESSIONAL EXPERIENCE

1989 - Present	President, Reanier & Associates, Environmental Consultants.
1994 - Present	Affiliate Assistant Professor of Anthropology, University of Alaska Fairbanks.
1992 - Present	Editor, *Aurora*. Alaska Anthropological Association Monograph Series.
1989 - Present	Co-Principal Investigator, The Mesa Project: Paleoindian Investigations in Arctic Alaska.
1995 - 1996	Senior Environmental Scientist and Director of Operations, Utah Trust Lands Archaeological Survey
1989 - 1990	Consulting Archaeologist, *EXXON VALDEZ* Cultural Resource Program.
1984 - 1989	Research Technologist, National Science Foundation supported paleoclimatic research. University of Washington.
1983 - 1986	Archaeologist, Gates of the Arctic National Park, Fairbanks, Alaska.
1979 - 1982	Teaching Assistant, Forest Resources, University of Washington.
1981	Geoarchaeologist, Public Archaeology Facility, SUNY Binghamton, New York.
1977 - 1979 &1981	Research Assistant, National Science Foundation supported pedological research, University of Washington.
1979 - 1980	Supervisory Archaeologist, U. S. Fish and Wildlife Service, Anchorage, Alaska.
1976	Archaeologist, Bureau of Land Management, Fairbanks, Alaska.

EDUCATION:

1984 - 1992	Doctor of Philosophy, Anthropology, University of Washington Dissertation: *Refinements to K-means Clustering: Spatial Analysis of the Bateman Site, Arctic Alaska.*
1981 - 1984	Master of Arts, Anthropology, University of Washington
1977 - 1983	Master of Science, Forest Resources, University of Washington Thesis: *The Potential of Gelifluction Deposits at Walker Lake, Brooks Range, Alaska as Sources of Paleoenvironmental Data.*
1972 - 1977	Bachelor of Arts, Anthropology, University of Washington

REFERENCES: Available upon request

FREDRIC REID
DUCKS UNLIMITED, INC.
3074 GOLD CANAL DRIVE
RANCHO CORDOVA, CA 95670

EDUCATION:

Ph.D., M.S. Fisheries and Wildlife/Wetland Ecology – University of Missouri

EXPERIENCE:

Nearly 20 years' experience with wetland and waterbird management, especially on migration and wintering areas. Coordinated biological aspects of multiple GIS projects in Alaska and California. Efforts in boreal forest regions including systematic classification of wetland basins in the Black River/Yukon Flats area, Copper River Delta, riparian areas of Lake Iliamna region, and white-fronted goose habitat analysis in western Alaska. International experience in Canada, Mexico, Sweden, Lithuania, Belarus, and Ukraine.

ROBERT J. RITCHIE
ABR, INC.
P.O. BOX 80410
FAIRBANKS, AK 99709

EDUCATION:

M.S., Natural Resources, University of Alaska, Fairbanks, 1976
B.S., Wildlife Biology, University of California, Davis, 1971

CERTIFICATIONS AND AFFILIATIONS:

Member: Raptor Research Foundation, American Ornithologists' Union, Cooper Ornithology Society
Master Banding Permit

PROFESSIONAL SPECIALTIES:

Aerial Surveys (Bald Eagle, Peregrine Falcon, Northern Goshawk, waterfowl)
Biological evaluations/assessments for TES
Environmental monitoring of impacts of industrial disturbance on raptors and waterfowl

SELECTED PROJECT EXPERIENCE:

Response of Peregrine Falcons to experimental disturbance, Sagavanirktok River-Alyeska Pipeline Service Co. Designed and conducted an intensive study to measure the reactions of falcons to pipeline associated activities.

Bald Eagle and Peregrine Falcon surveys-EXXON Co. USA. Managed helicopter surveys for nesting Bald Eagles and Peregrine Falcons in coastal areas of Prince William Sound, the Kenai Peninsula, and Kodiak Island following the Exxon Valdez oil spill.

Raptor investigation, NPR-A-USFWS. Designed and conducted aerial surveys to delineate important cliff-nesting habitat for raptors in the NPR-A. Four species of cliff-nesting raptors were recorded: Golden Eagles, Peregrine Falcons, Gyrfalcons, and Rough-legged Hawks.

Evaluation of the impacts of low-flying jet aircraft on raptors, interior Alaska-U.S. Air Force and U.S. Fish & Wildlife Service. Managed a program to monitor occupancy and productivity of remote nest sites of raptors, including Bald Eagles, Peregrine Falcons, and goshawks.

Tundra Swan and Brant investigations in the Kuparuk and Prudhoe Bay Oilfields-ARCO Alaska, Inc. Designed and conducted annual surveys to monitor the distribution, abundance and productivity of these species as part of a long-term ecosystem monitoring program.

Waterbird migration and summer use along the proposed Northwest Gas pipeline route-Office Federal Investigator and Northwest Alaska Pipeline Co. Conducted surveys to delineate high-value waterfowl habitat at wetlands along the proposed corridor.

Endicott Environmental Monitoring Program-Army Corps of Engineers and BP Alaska, Inc. Conducted surveys to determine the effects of oil development on the distribution, abundance, productivity, and behavior of nesting and brood-rearing Snow Geese.

ROBERT J. RITCHIE CONT.

Spectacled and Steller's eider surveys, northern Alaska-ARCO Alaska, Inc. and U.S. Fish & Wildlife Service. Conducted ground and aerial surveys for nesting eiders at proposed construction sites near Prudhoe Bay.

OTHER EXPERIENCE AND QUALIFICATIONS:

Project leader or Principal Investigator on >40 projects in Alaska, including 20 years in northern Alaska.

Experienced in capturing, handling, marking, and caring for raptors, waterfowl, and passerines.

Authored or co-authored over 35 presentations, publications, and technical reports on ornithology and wildlife research in Alaska, including disturbance and oilfield effects papers.

THOMAS C. ROTHE
WATERFOWL COORDINATOR
ALASKA DEPT. OF FISH AND GAME
333 RASPBERRY ROAD
ANCHORAGE, AK 99518

Tom Rothe earned a Bachelor of Science degree in Population Dynamics from the University of Wisconsin (1973), including background in environmental impact analysis, environmental law and public policy, and natural resource economics. He received a Master of Science degree in Animal Ecology from Iowa State University (1977) after research work on wetland ecology and behavioral biology of prairie ducks.

Mr. Rothe conducted wetland and waterbird studies in relation to petroleum development on Alaska's North Slope 976-1983 for the U.S. Fish and Wildlife Service. He collaborated in design and field work on basic studies of wetland ecology, habitat associations of waterbirds, and breeding bird densities in the Prudhoe Bay region and in NPR-A. He played an important role in planning and implementing the NPR-A 105(c) studies of birds, including regional surveys of wetland types and bird abundance; descriptions of wetland fauna and seasonal phenology; waterfowl food habits; and molt ecology of geese near Teshekpuk Lake. Mr. Rothe also studied cumulative wetland impacts within the Prudhoe/Kuparuk oilfields and cooperated in design of mitigation measures.

During 1980-83, Mr. Rothe supervised the Office of Special Studies in a program of baseline, pre-development, and mitigation studies for petroleum, mining, and wetland impact activities in northern, southcentral, and southeastern Alaska. This work included baseline studies of waterfowl in the Colville River Delta, with emphasis on tundra swans, white-fronted geese, and yellow-billed loons; studies of sea duck food habits and potential contamination from oil in Port Valdez and from metals near the Quartz Hill molybdenum mine near Ketchikan; and wetland and wildlife inventories in southcentral Alaska. In these capacities, Mr. Rothe has had extensive experience with the petroleum industry and their consultants (TAPS, Prudhoe/Kuparuk, NPR-A, ANGTS), interagency coordination, management of major field studies, and public involvement processes on natural resource issues.

Since 1983, he has been Waterfowl Coordinator for the Alaska Department of Fish and Game, responsible for a wide variety of statewide waterfowl and habitat management programs. He currently serves as the Alaska member of the Pacific Flyway Council's Study Committee and the Council's technical representative to the international Arctic Goose Joint Venture. Mr. Rothe has been involved with flyway-wide and international population management issues for over 15 years and has accumulated extensive knowledge of the biology and management of Alaska's waterfowl and wetland habitats.

GLENN W. SHEEHAN
UIC REAL ESTATE SCIENCE DIVISION
P.O. BOX 577
BARROW, AK 99723

EMPLOYMENT AND APPOINTMENTS

Senior Scientist/Principal Investigator, UIC Real Estate Science Division, Barrow
Executive Director, Barrow Arctic Science Consortium
Faculty Affiliate, Ilisagvik College, Barrow
Arctic Logistics Working Group member, U.S. Arctic Research Commission

EDUCATION:

Ph.D., Anthropology, Bryn Mawr College, 1992: "Proto-Historic Social Organization of the Coastal Whaling Communities of North and Northwest Alaska"
M.A., Anthropology, University of Pennsylvania, 1983
A.B., Honors, Villanova University, 1971

RESEARCH/GRANTS:

National Science Foundation (NSF), Office of Polar Programs research grant "Archaeology of the North Alaska Coast: A Settlement Pattern Study," OPP-9321112, 1994-1996
NSF, Emergency supplement, the "frozen child" of Ukkuqsi, Barrow, 1994-1995
NSF, Supplement grant for study of burials at Pingasagruk, Point Franklin, 1995-1996
NSF, Supplemental grant for logistics at Pingasagruk, 1996-1997
Earthwatch grant in support of research at Point Franklin, 1995
NSF research grant BNS 8214594 in support of doctoral research, 1982-1984
National Endowment for the Humanities, Kodiak Island surveys, Alaska, 1983
Frederica de Laguna Research Fund grant, Karluk survey, Kodiak, 1982

SELECTED PUBLICATIONS:

1997 *In the Belly of the Whale-Trade and War in Eskimo Society*. Book. Alaska Anthropological Association Aurora Series.

1995 Whaling Surplus, Trade, War, and the Integration of Prehistoric Northern and Northwestern Alaskan Economies, A.D. 1200-1826. *Hunting the Largest Animals*. A.P. McCartney (Ed.) 185-206. Studies in Whaling No. 3, Occasional Publications No. 36. The Canadian Circumpolar Institute, University of Alberta.

1991 In the Footsteps of the First Settlers. *Fodor's Pacific North Coast*, Allison Hoffman (Ed.) 48-53. New York: Fodor's Travel Publications, Inc. (Reprinted in *Fodor's Seattle and Vancouver*, 1992 and *Fodor's Pacific North Coast*, 1992, *et. Seq.*).

1990 Excavations at Mound 34, *The Utqiagvik Excavations*. Edwin S. Hall, Jr. (Ed.). 2:181-325, 337-353. Barrow: The North Slope Borough Commission on Iñupiat History, Language, and Culture.

1989 In the Belly of the Whale: An Archaeological Ceremonial Center. Archaeology 42:3:52-53, 76.

1989 High Tech Transit. *Archaeology* 42:2:23.

1985 Whaling as an Organizing Focus in Northwestern Alaskan Eskimo Society. In T.D. Price and J.A. Brown (Eds.), *Complexity Among Prehistoric Hunter-Gatherers*, 123-154. New York: Academic Press.

1984 (With S.A. Kaplan and R.H. Jordan) An Eskimo Whaling Outfit from Sledge Island, Alaska. *Expedition* 26:2:16-23.

GLENN W. SHEEHAN CONT.

Selected Papers:

Threatened Sites & Chronology Building: The Arctic Coast of Alaska. Society for American Archaeology Annual Meeting. Memphis. April 1997.

Working Back From What We Think We Know: How Social Relations Were Expressed in War, How Women Hunted Whales. Society of American Archaeology Annual Meeting. New Orleans. April 1996.

House Forms and Construction Techniques at Point Franklin, A North Alaskan Whaling Village. Alaska Anthropological Association Annual Meeting. Fairbanks. April 1996.

Maintaining Ethical Relationships Between Researchers and Native Communities. Invited Lecture to the staff of the National Science Foundation, Arlington, Virginia. April 1995.

Accentuation of Inequality in Eskimo Whaling Societies During Early Contact. Society for American Archaeology Annual Meeting. Toronto. May 1987.

Archaeology at Pingasagruk. Series of lectures to school and community in Wainwright, Alaska. Sponsored by U.S. Fish and Wildlife Service, Anchorage. November 1986.

ROBERT S. SUYDAM
NORTH SLOPE BOROUGH
DEPARTMENT OF WILDLIFE MANAGEMENT
P.O. BOX 69
BARROW, AK 99723

EDUCATION:

B.A.--Environmental Biology (Honors), May 1986, California State University Fresno
M.S.--Biology, August 1995, University of Alaska Fairbanks

POSITIONS:

Wildlife Biologist, North Slope Borough Department of Wildlife Management, Barrow, AK.
May 1990 to Present
Spectacled Eider Recovery Team, U.S. Fish and Wildlife Service, Anchorage, AK.
May 1993 to Present
Contract Biologist, TEVA Biological Consultants, Ridgecrest, CA.
January to April 1990
Graduate Research, University of Alaska Fairbanks, Fairbanks, AK.
June 1988 to December 1989
Biological Technician, U.S. Forest Service, Pacific Southwest Forest and Range Experiment Station, Fresno, CA. Intermittent June 1985 to October 1987
Seasonal Biologist, Kings River Conservation District, Fresno, CA.
September 1986 to March 1987
Assistant Scientist, Moss Landing Marine Laboratories, Moss Landing CA.
February to March 1986
Student Intern, California Department of Parks and Recreation, Millerton Lake, Friant, CA.
Winters 1984 to 1986

PROFESSIONAL EXPERIENCE:

Collected data on distribution and population size and trend for various species of birds and marine mammals. Conducted studies on various aspects of natural history of eiders, seabirds, shorebirds, and bowhead and beluga whales and other wildlife species. Participated in studies of the levels of environmental contaminants in various wildlife species.

TEACHING EXPERIENCE:

Affiliate Faculty, Arctic Sivunmun Iligsavik College, Barrow, AK, 1992 to Present.
Graduate Teaching Assistant, University of Alaska Fairbanks, Fairbanks, AK, 1988 and 1989.
Invited Speaker, Alaska Science Consortium Institute for Instructional Assistants, Barrow, AK, June 1994.

PROFESSIONAL MEMBERSHIPS:

Member of 10 professional/honor organizations

PUBLICATIONS:

Twenty-two peer-reviewed articles on eiders, bowhead and beluga whales, and various other bird and marine mammals species (and an additional 13 breeding bird censuses published).

KENNETH R. WHITTEN
RESEARCH COORDINATOR
DIVISION OF WILDLIFE CONSERVATION
ALASKA DEPT. OF FISH AND GAME
1300 COLLEGE ROAD
FAIRBANKS, AK 99701

EDUCATION:

AB in Biosciences Stanford University 1970
MS in Biology University of Alaska Fairbanks 1975
Thesis: Population dynamics and habitat relationships of Dall sheep (*Ovis dalli dalli*) in Mt. McKinley National Park, Alaska.

WORK EXPERIENCE:

May-September 1975:
U.S. Fish and Wildlife Service, Aleutian Islands National Wildlife Refuge
October 1975 to present:
Alaska Dept. of Fish and Game (North Slope caribou research, sheep research)

SCOTT L. WILBOR
ALASKA NATURAL HERITAGE PROGRAM, UAA
707 A ST.
ANCHORAGE, AK 99501

CAREER SUMMARY:

Twelve years experience as a research biologist working for private, county, state, federal, and non-profit natural resource management, science, and land conservation organizations. Expertise in conservation science, ecological research, and pollutant effects.

EDUCATION:

Colorado State University, Fort Collins, Colorado BACHELOR OF SCIENCE, WILDLIFE BIOLOGY	9/81 to 12/85 Degree: 12/85
University of Alaska Fairbanks, Fairbanks, Alaska MASTER OF SCIENCE, WILDLIFE BIOLOGY	1/91 to 12/96 Degree: 12/96

PROFESSIONAL EXPERIENCE:

ALASKA NATURAL HERITAGE PROGRAM, University of Alaska Anchorage Anchorage, Alaska RESEARCH ASSOCIATE	12/96 to present
ALASKA DEPARTMENT OF FISH AND GAME, Division of Wildlife Conservation Fairbanks, Alaska GRADUATE INTERN	5/95 to 9/95
THE NATURE CONSERVANCY, New Mexico Field Office Santa Fe, New Mexico STEWARDSHIP ECOLOGIST	9/95 to 10/95
PRINCE WILLIAM SOUND SCIENCE CENTER Cordova, Alaska PROJECT BIOLOGIST	4/95 to 8/95
COPPER RIVER DELTA INSTITUTE, U.S. FOREST SERVICE Cordova, Alaska BIOLOGICAL TECHNICIAN	4/94 to 6/94
DENALI NATIONAL PARK AND PRESERVE, U.S. NATIONAL PARK SERVICE Denali Park, Alaska WILDLIFE BIOLOGIST	5/90 to 9/93
ALASKA BIOLOGICAL RESEARCH, INC. Fairbanks, Alaska BIOLOGICAL TECHNICIAN	4/89 to 3/90

JACK F. WINTERS
ALASKA DEPARTMENT OF FISH AND GAME
1300 COLLEGE ROAD
FAIRBANKS, AK 99701

EDUCATION:

B.S., Biological Sciences, University of Alaska, Fairbanks, 1975
M.S., Biology, University of Alaska, Fairbanks, 1980

APPLICABLE WORK EXPERIENCE:

Operating Engineer, May-August 1974-1976
Dozer/scraper operation - Dalton Highway/TAPS construction

Biologist, Renewable Resources Consulting Services, 1981-1982
Atigun River Valley Dall sheep/Nelchina caribou studies

Habitat Biologist, Alaska Department of Fish and Game, Fairbanks, 1983-1986
Placer Mining Permitting, Alaska Habitat Management Guides Impacts Working Group - Wildlife

Fishery Technician, Alaska Department of Fish and Game, Fairbanks, 1986-1987
Stocked lakes program

Habitat Biologist, Alaska Department of Fish and Game, Fairbanks, 1987-1997
North Slope Gravel Pit Studies; NPR-A annotated bibliographies - fish, muskoxen, caribou; Exxon Valdez oil spill response; TAPS Atigun pipeline reroute construction monitoring; Atigun River fish investigations; review of industry oil spill contingency plans; oil and hazardous spill response; review of state and federal oil and gas lease sales; North Slope reserve pit closeout; Jarvis Creek, Usibelli, Deadfall Syncline coal mine review; Illinois Creek heap leach gold mine permitting.

ATTACHMENT B

FINAL AGENDA

NPR-A SYMPOSIUM

SCIENCE, TRADITIONAL KNOWLEDGE, AND THE RESOURCES OF THE NORTHEAST PLANNING AREA OF THE NATIONAL PETROLEUM RESERVE-ALASKA

SPONSORED BY
THE UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT &
MINERALS MANAGEMENT SERVICE

FINAL AGENDA
April 16
Sheraton Anchorage Hotel

1:00 pm Introduction and Meeting Objectives
Tom Allen, State Director, Bureau of Land Management (BLM);
Rance Wall, Acting Regional Director, Minerals Management Service (MMS);
Deborah Williams, Special Assistant to the Secretary for Alaska

TYPICAL NORTH SLOPE OIL AND GAS OPERATIONS *(Session Co-chairs: Rance Wall, Acting Regional Director, MMS; and Greg Swank, Acting State Pipeline Coordinator, Joint Pipeline Office)*

1:30 pm On-shore Geophysical (Seismic) Exploration
Shawn Rice, Western Geophysical Company, Denver

1:50 pm Discussion period (Note: the last 10 minutes during all of the following presentations will be reserved for similar discussion periods.)

2:00 pm Typical Development Scenario and Production Operations
Mike Joyce, ARCO Alaska, Inc., Anchorage

2:30 pm Typical Exploratory Drilling Operations with Ice Pads
Beez Hazen, Northern Engineering and Scientific, Anchorage

3:00 pm Open Discussion, led by Session Co-chairs

3:10 pm Break

HISTORIC AND PREHISTORIC CULTURAL RESOURCES IN NPR-A (*Session Co-chairs: Mike Kunz, BLM, Fairbanks; and Mike Burwell, MMS, Anchorage)*

3:30 pm Regional Cultural History and Prehistoric Sites (10,000 B.C. to 1,500 A.D.)
Dr. Richard Reanier, Reanier and Associates, Seattle

4:00 pm The Most Successful Hunters: Northern Economy A.D. 400 to Present
Dr. Glenn Sheehan, Senior Scientist, Ukpeagvik Iñupiat Corporation (UIC), Barrow

4:30 pm Paleontological Resources of the NPR-A Planning Area: an Overview
Dr. Roland Gangloff, University of Alaska Museum, Fairbanks

5:00 pm Open Discussion, led by the Session Co-chairs

5:15 pm End of Day One

Thursday - April 17

NORTH SLOPE VILLAGE SUBSISTENCE AND SOCIO-ECONOMICS (*Session Chair: Craig George, Department of Wildlife Management (DWM), North Slope Borough, Barrow*)

8:00 am North Slope Subsistence Harvests and Mapping: Barrow and Wainwright
Stephen Braund, Stephen R. Braund and Associates, Anchorage

8:30 am Panel on Land Use and Subsistence Resources (Terrestrial Mammals, Birds, Fish and Plants)
Harry Brower Jr., DWM, North Slope Borough;
Sverre Pedersen, Subsistence Div., AK Dept. of Fish & Game (ADF&G), Fairbanks;
Thomas Napageak, Alaska Eskimo Whaling Commission, Commissioner of Nuiqsut

9:15 am Open Discussion, led by the Session Chair

9:30 am Break

WETLANDS AND THEIR SIGNIFICANCE IN NPR-A (*Session Co-chairs: John Payne, BLM, Anchorage, and Tim Jennings, U.S. Army Corps of Engineers (COE), Anchorage*)

10:00 am Distribution of High-value Wetland Habitats on a Regional Scale
Dr. Fredric (Fritz) Reid and Richard Kempka, BLM/Ducks Unlimited, Inc., Sacramento, CA

10:30 am Corps of Engineers Jurisdiction and Wetlands
Terry Carpenter, COE, Anchorage

11:00 am Effects of Petroleum Spills on Tundra Ecosystems
Torre Jorgenson, Alaska Biological Research, Inc. (ABR), Fairbanks

11:30 am Recovery and Rehabilitation of Disturbed Wetland Sites
Dr. Jay McKendrick, University of Alaska Fairbanks

12:15 pm Open Discussion, led by the Session Co-chairs

12:30 pm Lunch

FISH, AND RARE AND SENSITIVE SPECIES (*Session Chair: Dennis Tol, BLM, Anchorage*)

1:30 pm Fish Resources of Northeastern NPR-A
Terry Bendock, Soldotna, AK

2:00 pm Effects of Oil and Gas Exploration and Development Activities on Fish and Fish Habitat
Jack Winters, ADF&G, Fairbanks

2:30 pm Subsistence and Commercial Fisheries in the Planning Area
Craig George, DWM, North Slope Borough, Barrow

3:00 pm Open Discussion, led by Session Chair

3:15 pm Break

3:30 pm Effects of Winter Seismic Exploration on Tundra Vegetation and Soils
Janet Jorgensen and Philip Martin, Northern Ecological Services, FWS, Fairbanks
(Presented by Philip Martin).

3:45 pm Known Rare or Sensitive Plant Species within the Planning Area
Rob Lipkin, Alaska Natural Heritage Program (ANHP), University of Alaska Anchorage

4:15 pm Review of Rare and Sensitive Vertebrate Species in the NPR-A
Scott Wilbor, ANHP, University of Alaska Anchorage

4:45 pm Open Discussion, led by Session Chair

Friday - April 18

BIRDS ***(Session Co-chairs: Dr. Joel Hubbard, MMS, Anchorage; and Dr. Dirk Derksen, Alaska Science Center, Biological Resources Division (BRD), U.S. Geological Survey (USGS), Anchorage)***

8:00 am Overview: NPR-A Waterfowl in the Big Picture
Thomas Rothe, Waterfowl Coordinator, ADF&G, Anchorage

8:30 am Important Bird Habitats and Populations
Rod King, Migratory Bird Office, FWS, Fairbanks, (Teshekpuk Area Geese)
Robert Suydam, DWM, North Slope Borough, Barrow (Coastal Plain)
Ted Swem, FWS, Fairbanks (Colville River Riparian Zones; Raptors & Passerines)

9:30 am Break

10:00 am Threats to the Recovery of Rare, Threatened, and Endangered Birds
Greg Balogh, Ecological Services, FWS, Anchorage (Spectacled Eider)
Ted Swem, FWS, Fairbanks (Arctic Peregrine Falcon)
Robert Suydam, DWM, North Slope Borough, Barrow (Steller's Eider)

11:00 am Responses of Molting Pacific Black Brant to Experimental Aircraft Overflights & Habitat Selection by Molting Brant
Dr. K.C. Jensen, COE, Vicksburg, MS

11:30 am Lunch

12:30 pm Potential Effects of Ground-Related Oilfield Activities on Birds
Robert Ritchie, ABR, Fairbanks

1:00 pm Predators and Scavengers Attracted to Locales of Human Activity
Philip Martin, Northern Ecological Services, FWS, Fairbanks,

1:15 pm Open Discussion, led by the Session Co-chairs

1:30 pm Break

MAMMALS ***(Session Chair: Dr. David Yokel, BLM, Fairbanks)***

2:00 pm Mammals of the Northeastern NPR-A
Ken Whitten, ADF&G, Fairbanks

2:30 pm Caribou and Oil Development in Northern Alaska: Lessons from the Central Arctic Herd
Brian Lawhead, ABR, Fairbanks

3:00 pm Polar Bear Populations and Denning in the Beaufort Sea
Dr. Steve Amstrup, BRD, USGS, Anchorage

3:30 pm Open Discussion, led by the Session Chair

CLOSING SESSION ***(Session Chair: Bob Brock, Regional Supervisor, MMS)***

4:00 pm Closing Summary Statements by the Chairs for All of the Sessions

4:30 pm Recapitulation on Future Steps in the NPR-A Planning Process
Robert Brock, Regional Supervisor, MMS; and
Tom Allen, State Director, BLM

5:00 pm End of Symposium

ATTACHMENT C

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The Department of the Interior Mission

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 sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; 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 ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The Department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

The Minerals Management Service Mission

As a bureau of the Department of the Interior, the Minerals Management Service's (MMS) primary responsibilities are to manage the mineral resources located on the Nation's Outer Continental Shelf (OCS), collect revenue from the Federal OCS and onshore Federal and Indian lands, and distribute those revenues.

Moreover, in working to meet its responsibilities, the **Offshore Minerals Management Program** administers the OCS competitive leasing program and oversees the safe and environmentally sound exploration and production of our Nation's offshore natural gas, oil, and other mineral resources. The MMS **Royalty Management Program** meets its responsibilities by ensuring the efficient, timely, and accurate collection and disbursement of revenue from mineral leasing and production due to Indian tribes and allottees, States, and the U.S. Treasury.

The MMS strives to fulfill its responsibilities through the general guiding principles of: (1) being responsive to the public's concerns and interests by maintaining a dialogue with all potentially affected parties and (2) carrying out its programs with an emphasis on working to enhance the quality of life for all Americans by lending MMS assistance and expertise to economic development and environmental protection.