An Eye In The Sky

High-tech satellite telemetry improves reindeer management on Alaska's vast rangelands.

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Reindeer are an important livestock species in the circumpolar north. Currently there are approximately three to four million reindeer distributed across Russia, Scandinavia, Greenland, Iceland, Canada, and Alaska, with five hundred thousand animals slaughtered annually, producing over 20,000 metric tons of meat (Turi, 1998).

In Alaska, the majority of commercially produced reindeer occurs on the Seward Peninsula and Bering Sea Islands. Currently on the Seward Peninsula (the largest contiguous grazing area in the state), 14 herds graze on 16,200,000 acres of available rangeland with individual range permit areas averaging 1,012,500 acres (Workman et al. 1991). These permitted grazing ranges are remote, bisected by large rivers and mountain ranges with few or no roads.

Herders employ an extensive management scheme where reindeer are allowed to range freely. Most herders utilize boat, ATV, or foot travel to monitor and move their herds. This type of management is characterized by sporadic herder contact that often results in the herd being unsupervised for extended periods when overland travel is difficult, or during mechanical breakdown of all-terrain vehicles. Herders will often lose track of their animals and must extensively search for them when traveling conditions improve. Many animals, especially those co-mingling and migrating with the Western Arctic Caribou Herd (WACH), may leave permitted grazing areas and are permanently lost to the herder. Unsupervised grazing reindeer may not optimize use of range resources or may overgraze the range. For these reasons it is critical for reindeer herders to adopt new technology allowing year round monitoring of animal locations and evaluation of annual grazing patterns.

During the past 25 years, Natural Resources Conservation Service and University of Alaska Reindeer Research Program have assisted Northwest and Western Alaska reindeer herders with range management and animal husbandry technology. Range assistance has centered on traditional inventories, ecological site mapping, similarity (condition), trend, and utilization assessments. Annually, Bureau of Land Management (BLM) resource specialists coordinate with NRCS to conduct range assessments with reindeer herders during the summer. These inventories have provided the baseline information for range conservation planning and management.

Alaska's Rangeland

Native plant communities are comprised of different types of tundra that support sedges, grasses, forbs, lichens, and mosses. Many of the upland and mountainous areas support low growing alpine tundra shrubs with grasses, sedges, and lichens. Classification of Seward Peninsula vegetation has resulted in 39 ecological sites. Ecological sites described and mapped (Swanson et al. 1985), vary from White Spruce and Paper Birch Uplands confined to the southeastern portion of the Seward Peninsula, to widespread Tussock Tundra found throughout the Seward Peninsula lowlands.

Ecological site interpretations have been made for the major species of wildlife, forest products, recreation and hydrologic values, and seasonal reindeer grazing.

Reindeer winter range typically has a higher proportion of drier upland and alpine sites, and is characterized by lichens, sedge tussocks, dwarf ericaceous and rosaceous shrubs, low willow, birch and alder shrubs, herbaceous perennials, plus small amounts of grasses and mosses.

Summer range is generally in the moister lowlands, often in coastal areas. It is characterized by large expanses of sedge tussocks, mosses, rhizomatous sedges, dwarf ericaceous shrubs, medium to tall willow, birch

and alder shrubs, plus small amounts of lichen, grasses, and herbaceous perennials.

Sustained use of these ranges depends upon management of the winter range, which in most cases limits reindeer populations. Range assessments or ecological site mapping have been completed for most ranges throughout all Alaska reindeer ranges. The most widely used specifications for grazing management are the NRCS Prescribed Grazing Standards and Specifications.

Overall, most ranges are near pristine and support luxuriant stands of vascular plants and lichens. Reindeer populations during the past 30 years have been significantly below carrying capacity. In combination with under stocking and reindeer management, many of the overgrazed ranges of the early 1900's have recovered to near native historic climax plant communities. A typical intensively managed grazing plan employs winter management units that are grazed one winter then rested for five to seven winters. Use of forage in an intensively grazed winter management unit prescribes a grazing intensity (including significant disturbance) of <45% of live lichen biomass.

The Reindeer Industry

The primary focus of the reindeer industry is to provide a local meat supply and participate in wet-velvet antler foreign marketing. Herds are gathered once or twice a year when antlers are cut, fawns are tagged, vaccinations are given, and selected bulls are castrated. Animals are slaughtered and processed for local markets. Teller Fish and Meats, located 45 miles north of Nome in Teller, Alaska, is the one processing facility available on the Seward Peninsula.

Any given grazing permit area has many landowners including Native allotment holders, State of Alaska, Bureau of Land Management, National Park Service, US Fish and Wildlife Service, and Village and Regional Corporation lands. All land resource planning and management is coordinated with appropriate landowners.

Reindeer industry problems are centered on extreme weather conditions, absence of road systems, limited ground access during the summer, and distance the herder must travel from base of operation to herd. Limited meat processing facilities and high end marketing infrastructure limit economic viability. On the mainland, predators and caribou/reindeer interaction continue to significantly affect total reindeer industry viability.

Although the industry contributes to the social and cultural values of Western and Northwestern Alaska, the total statewide value of reindeer and reindeer products for year 2000 was $335,000; down from $540,000 in 1999 (Benz, 2001). This economic loss is primarily a re-

Tracking Reindeer By Satellite

In 1999, NRCS, University of Alaska Reindeer Research Program and Alaska reindeer herders initiated a reindeer satellite-tracking program. Environmental Quality Incentives Program educational grants for 2000 and 2001 funded the satellite telemetry program. Seventeen collars with Telonics model ST18 Platform Terminal Transmitters (PTT or satellite transmitter) and Very High Frequency MK8 beacon (VHF) transmitters, and 2 VHF scanning units were purchased. VHF transmitters are used to facilitate PTT recovery. One VHF unit was placed at Tanadgusix Corporation Headquarters at St. Paul, Alaska and the other at Reindeer Herders Association, Nome, Alaska.

Figure a ***Collar with ST18 PTT and VHF in sealed canister. Note VHF antenna (non-insulated cable) and PTT antenna (insulated short black object between canister and end of collar). (Source: Telonics)***

PTT and VHF Duty Cycles and other Details

The first 5 collars with PTT and VHF transmitters were purchased in FY 2000 (Figure 2).

In FY 2000, 5 PTT's were purchased. Duty cycle was programmed for 4 hours on, and 20 hours off with an expected battery life of 1.3 years (C cells). The VHF MK8 beacon was programmed with a duty cycle of 24 hours per day with an expected battery life of 10 years and powered by D cell batteries (Table 1).

The combined PTT/VHF and collar cost was approximately $1800 and the annual expense for NOAA satellite time and Argos data services combined were about $1500 per collar.

Table 1. PTT and VHF Duty Cycles with associated batteries and expected battery life.

Duty Cycle for: (year)	Number Installed	Duty cycle Hours on	Duty cycle Hours off	PTT Battery	Battery Life (years)
2000 PTT (ST18)	5	4	20	C	1.3
2000 VHF MK8	5	24	0	D	10.0
2001 Ptt (ST18)	12	8	112	D	5.4
2001 VHF MK 8	12	10	14	C	6.9

sult of reindeer losses to the WACH on the Seward Peninsula.

In summer herders are faced with high insect populations, rivers and bogs, bears, rain and fog, and sometimes very high temperatures. In winter, factors include extreme snow conditions, whiteouts, minimal daylight conditions, high wind chill factors, and dangerously low temperatures. Reindeer herders struggle with storms, thin ice, overflow, and protecting their herds from wolves, bears, and ravens. Under the best of conditions, reindeer herding and grazing management is difficult; yet sound management is paramount to the sustained and productive use of these ranges.

On the Seward Peninsula, by far the most dominant concern is the effect of the Western Artic Caribou Herd (WACH). The WACH started increasing in 1976, expanding from 75,000 to about 430,000 by 1999 (Dau, 2001). Since the mid 1980's, caribou have encroached farther west into reindeer ranges each year. Many Seward Peninsula reindeer have moved off their original home ranges, following the caribou. Not only are the reindeer affected, the range is impacted as well.

The increasing use of the Seward Peninsula by caribou adds an impact factor to winter range that is cumulative over time. Vegetation transects established by BLM in the Buckland River Valley and northern Nulato Hills in 1981 when the WACH population was 140,000, and sampled again in 1995 when herd size increased to 450,000 (Dau, 2001) showed a 14% decline in lichen cover (Cole et al., in press).

EQIP Helps Fund New Program

In the 1990's, natural resource information such as ecological sites, soils, hydrology, subsistence use, grazing permit area, seasonal reindeer management units, fire history, grazing history, range trend, utilization, game management units, wildlife information, and land ownership were incorporated into a geographical information system (GIS) database. In an effort to accelerate reindeer grazing management, reindeer tracking using satellite telemetry was introduced in 1999.

The USDA Environmental Quality Incentives Program (EQIP) was used to initiate a functional telemetry program. The Environmental Quality Incentives Program provides funding to agricultural producers for cost sharing and educational programs to facilitate application of

In FY 2001, 12 Telonics ST18 PTT and VHF transmitters on collars were acquired. For these collars, PTT duty cycle was programmed 8 hours on, 112 hours off and VHF duty cycle was changed from continuous to 10 hours on and 14 hours off. The PTT antenna length was reduced from 2 inches to 1.5 inches and the collar length was reduced from 22-28 inches to 18-28 inches. Batteries and duty cycles were adjusted to optimize battery life to reduce recapture expenses. The new PTT battery configuration resulted in an expected battery life of 5.4 years and 6.96 years for the PTT and VHF transmitters respectively (Table 1). More specific details on the ST18 can be acquired at www.telonics.com.

Satellite Orbital Track and Altitude

The National Oceanic and Atmospheric Administration (NOAA) TIROS-N satellite, (called the protoflight), launched by NASA in October 1978, was the first satellite to carry the Argos instrument. Since then, the Argos instrument has flown on-board all the NOAA TIROS series polar orbiting environmental satellites (POES), (Figure b.) Currently, NOAA-15 and NOAA-16 are the primary satellites used for this program.

Figure b. *NASA Titan II rocket with NOAA-K satellite on board launched May 1998 from Vandenberg Airforce Base, California. (Source: Service Argos, Inc.)*

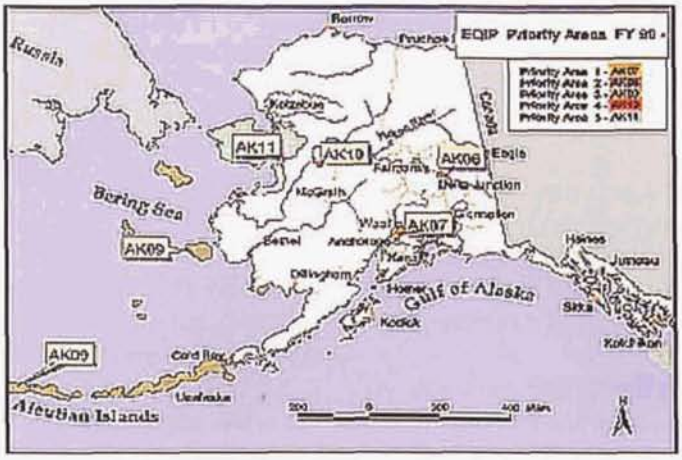

Figure 1. *Seward Peninsula EQIP Priority Area AK11 and Bering Sea and Aleutian Island EQIP Priority Area AK09. (Source: USDA, NRCS)*

new technologies. University of Alaska Reindeer Research Program provided both funding and on the ground support including capturing reindeer and retrieving non-operational satellite transmitters. Supplemental funding from the Grazing Lands Conservation Initiative and assistance from Alaska Department of Fish and Game has also been utilized.

The reindeer-tracking program potentially encompasses approximately 22 million acres throughout the Seward Peninsula EQIP Priority Area AK11, and Bering Sea and Aleutian Island EQIP Priority Area AK09 (Figure 1). Traditional reindeer operations cover large expanses of land. The area is mostly roadless. Access is primarily limited to boat, snow machine, helicopter, or

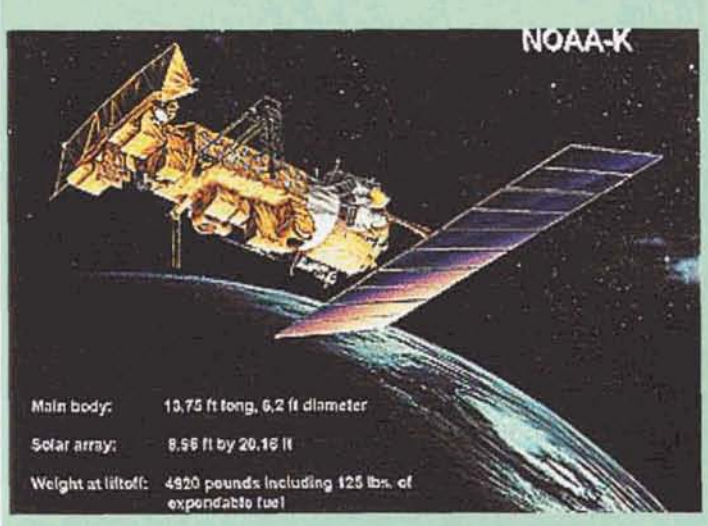

Figure c. *NOAA-K satellite in orbit. (Source: Service Argos, Inc.)*

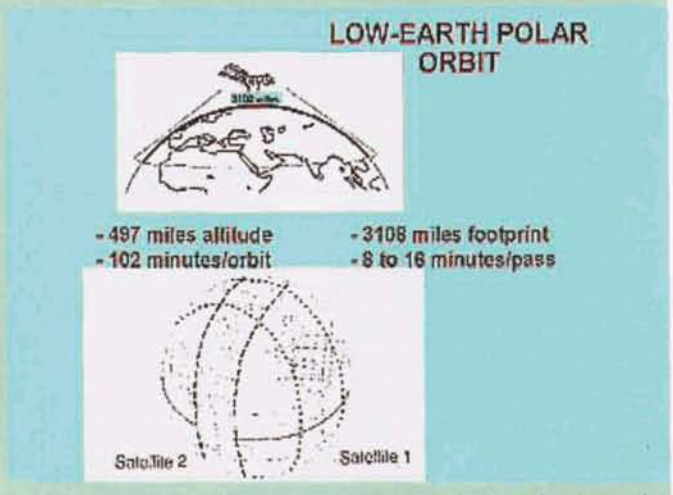

Figure d. *Low earth-Polar orbit and footprint of NOAA-K and other satellites used for the program. (Source: Service Argos, Inc.) . Low earth-polar orbits are at an altitude 497 miles above earth. These satellites complete their orbit every 102 minutes and acquire data for 8 to 16 minutes in the footprint area for every pass. Note the different paths and footprints of satellites 1 and 2 as they orbit the poles.*

small fixed wing aircraft. Mountain ridges, rivers, lava beds, and the Bering and Chukchi Seas are natural grazing management barriers; there are no fences.

Special Objectives

Short term satellite telemetry program objectives are to: 1) monitor wolf/reindeer interaction; 2) monitor caribou and reindeer interaction; 3) evaluate preferred reindeer winter grazing areas; 4) increase reindeer herder awareness of telemetry technology; and 5) improve utilization check efficiency.

Long term objectives are more in the experimental realm: 6) making use of reindeer tracking information by integrating satellite tracking with GIS to develop predictive reindeer grazing systems and 7) gaining better control of reindeer by increased herder and reindeer interaction. The long term objectives will not be discussed further, as sufficient information has not been acquired.

What Was Learned

Seventeen satellite transmitter collars were utilized to track movements of the reindeer. Satellite telemetry data from three collared reindeer (Reindeer 89, Reindeer 90 and Reindeer 91) from the Noyakuk herd were used to monitor reindeer behavior and travel patterns. Also, reindeer herder and hunter observations were compared to the telemetry data. It is recognized that this information deals with macro scale information; statistics are not addressed. Following is a brief discussion of the short term objectives and how satellite telemetry data were used to more fully understand reindeer relationships and interactions.

Wolf/Reindeer Interaction

During winter, the most detrimental predator interacting with reindeer are wolves. Without telemetry, conventional herd checking procedures (leaving the community via snow machine, then searching for and finding the herd) are logistically difficult and sometimes relatively inefficient. Because reindeer may travel so far from the last known location after being checked, they are difficult to locate and herders frequently arrive too late to prevent reindeer losses.

To enhance detection of wolf and other predator interaction, almost any telemetry monitoring duty cycle (2–5 days) can improve herder success in preventing reindeer losses plus help to refine herd grazing management. Although we were not able to use real time monitoring because of the time lapse in our duty cycles, reindeer herd travel is as follows:

Argos Data Receiving and Data Preparation

The Gilmore Creek receiving station site, near Fairbanks, Alaska (Figure e) is an important part of the system. The eighty five-foot diameter parabolic antenna is pivotal to real time and other data acquisition throughout Alaska.

Location data are received each day from Argos at Largo, Maryland, via e-mail at 3:00 p.m. Alaska Standard Time in DS format. Illustrated below in bold is the data format. Following the format is a brief definition of the data (in Italics).

02044 *program number*; **17589,** *transmitter ID*; **2,** *number of lines of results in satellite pass;* **1,** *number of sensors;* **J,** *name of satellite*; **3,** *location class*; **2001-01-31,** *date*; **18:56:42,** *time*; **65.203,** *latitude in decimal degrees;* **197.210,** *longitude in decimal degrees*; **0.000,** *transmitter altitude in kilometers*; **401649033,** *transmitted frequency*

Figure e. Gilmore Creek receiving station site, near Fairbanks, Alaska. (Source: NOAA)

Figure 2. *Path of Noyakuk reindeer herd moving from the north (black star) south to Kuzitrin River within 2-day period after wolf pack arrived in area. (Source: UAF Reindeer Research Program)*

When evaluating reindeer locations from March 2000, we noticed an abrupt change in the average reindeer daily travel pattern. Figure 2 shows satellite telemetry reindeer locations in the vicinity of the black star. Continual monitoring of the herd revealed a dramatic change in average travel from 1 to 2 miles/day to 10 miles/day. The herd moved abruptly from suitable winter range, 20 miles down to the Kuzitrin River. This herd activity caused us to look at what had happened more closely, and it was discovered that activity was attributed to a wolf pack in pursuit. Reindeer herders and hunters substantiated this event.

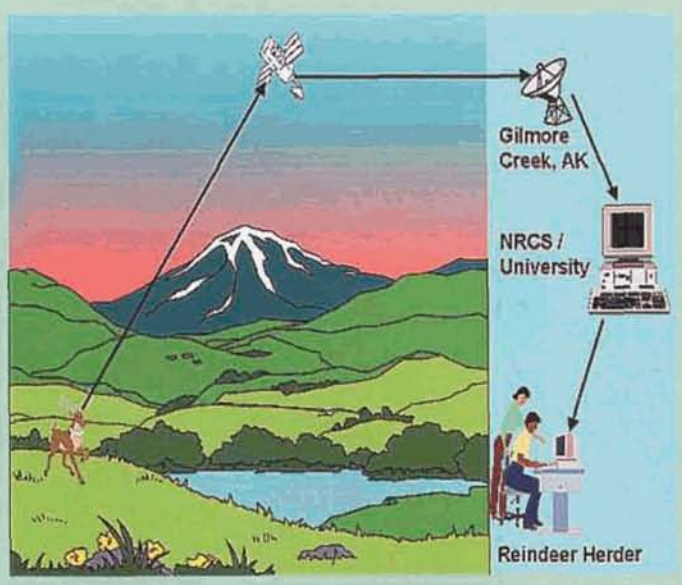

Figure f. *How the telemetry system works.*

Illustrated in Figure f is a generalized diagram of how the system functions. A signal is sent from the PTT on the collar where the signal is received by the orbiting satellite. Data is downlinked to a receiving station, and then relayed to the processing station at Service Argos, Inc., Largo, Maryland. Data is then sent via e-mail to Reindeer Research Program and NRCS offices. Coordinate data are superimposed over a USGS digital raster graphic (DRG) base map for the herder's grazing permit area. The herder goes to the University's web page, or location information on the DRG is faxed to the herder.

ADS telemetry data (type PRV/DS) received by NRCS, is filtered and imported into a Microsoft Access97 database (ReindeerLocations.mdb). All non-pertinent data is stripped off; the x-y coordinates are converted to a latitude and longitudinal coordinate, and appropriate field names and data types are created. Data is imported from a text file, processed, and exported to .dbf files automatically for creating point files in Arc View 3.2 (Martin, 2000).

Field Testing PTT's

PTT's were field tested in Anchorage and at Fairbanks prior to installing collars on reindeer. By removing both the VHF and PTT magnets the PTT's were activated. PTT data frequency, constancy, and duty cycle were then evaluated. PTT accuracy was determined by comparing transmitted coordinates to known coordinates on a 1:63,360 USGS quad. Scanner signal reception and frequency were tested. After this 2-month testing period, PTT's were shipped to the field and arrangements made for installation on reindeer.

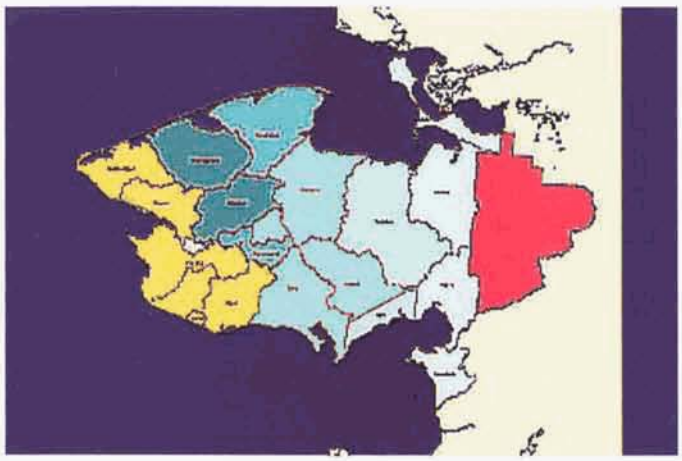

Figure 3. *Yellow area on the western Seward Peninsula tip indicating reindeer grazing areas where remaining, relatively undisturbed reindeer herds still exist. Most reindeer east of the yellow area have been assimilated into the WACH. (Source: NRCS)*

Palmer Sagoonick (personal communication) noted that reindeer would travel over 25 miles in one 24-hour period to escape pursuing wolves. Wolf pack size and age are factors related to distance reindeer are pursued. A larger pack of 12–15 wolves or several packs in the area can cause reindeer to move both day and night. If a bitch is training yearling pups to hunt, wolf harassment can be severe and reindeer can be widely scattered.

Caribou/Reindeer Interaction

The incursion of the WACH into Seward Peninsula reindeer ranges has reduced viable reindeer operations. Caribou-free reindeer range has been reduced by 70 percent since 1976. Starting on the East Side of the Seward Peninsula (Figure 3), the pink area (starting East of longitude 160 degrees) was withdrawn from reindeer graz-

Reindeer Capture for Collar Installation

Three different strategies were used to capture reindeer on the Seward Peninsula, St. Lawrence Island, and at St. Paul Island. At annual handlings, Seward Peninsula and St. Lawrence Island female reindeer with a good return history were selected whenever possible. Seward Peninsula reindeer were also captured from free roaming herds on open range using snow machine and net gun (Figure g).

On St. Paul Island, herders on foot attempted to herd reindeer past a concealed shooter but they were not able to bring reindeer into the shooters range. Reindeer were eventually driven to the west end of the Island around a lava flow boulder field and herders facilitated the shooter by forming a U around the herd. The shooter was able to stalk to within 20 yards of the animals. The shooter darted two reindeer in the rump using a brown color-coded charge propelling a dart from a standard Cap-Chur dart gun. One adult female and one yearling male reindeer, both in excellent condition, were darted (Figure h). Three mg of Carsentanil and 100 mg of xylazine were used to tranquilize each reindeer. Three hundred mg of Nalprexone and 500 mg of Tolazoline reversal drugs were used as reversal drugs.

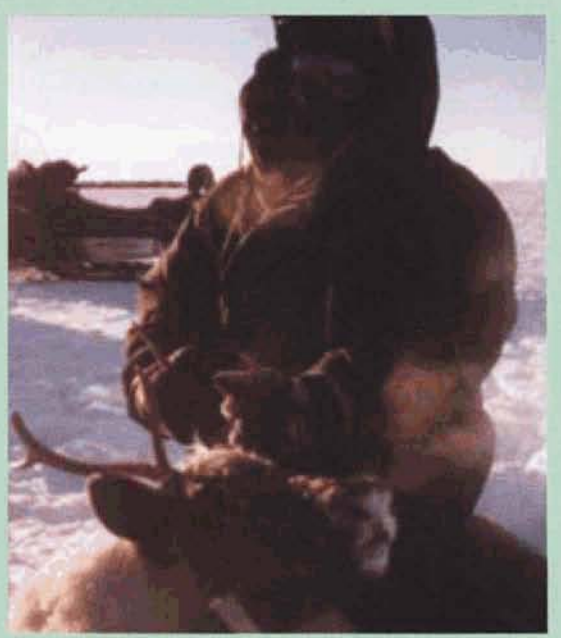

Figure g. *University of Alaska Researcher capturing reindeer for collaring in winter. (Source: UAF Reindeer Research Program)*

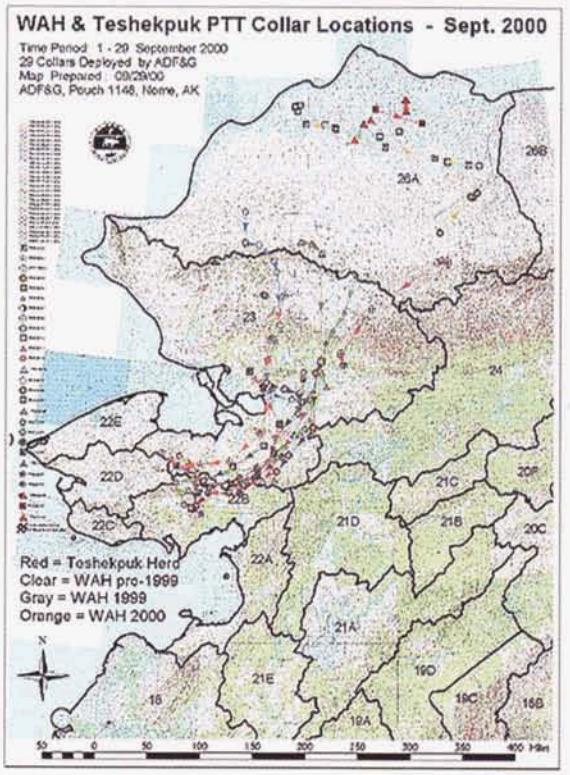

Figure 4. ***Western Arctic Caribou Herd PTT showing generalized migration pattern onto the Seward Peninsula, Septem-ber 2000. (Source: Alaska Department of Fish and Game)***

ing during the early 1980's as a result of initial reindeer and caribou interaction. Although the interaction was minimal at that time, a few caribou had started to move into and utilize the area.

Alaska Department of Fish and Game biologists monitoring WACH activity on the Seward Peninsula in October of 2000, particularly in the Pilgrim and Kuzitrin River drainage's reported: "Large numbers of caribou from the WACH began moving onto the Seward Peninsula in late September and the beginning of October. Based on aerial surveys and numbers of radio collared caribou, we estimated there were roughly 75,000 caribou on the Seward Peninsula by early November" (Gorn, Bente and Dau, 2002). Caribou monitoring and location information on the Seward Peninsula provided by Alaska Department of Fish and Game has evolved into a reasonably effective management tool for the herders to use. Information is also posted on a web site.

The number of platform terminal transmitters (PTT's), or satellite collars on caribou is very low; a maximum of 0.01 percent (Dau, pers. comm.). Despite these shortcomings, any caribou location data significantly enhances herders' ability for detecting caribou as they approach Seward Peninsula reindeer herds. Reindeer herders and affiliated groups receive WACH locations from ADF&G on a regular weekly basis from the fall through spring periods, (Figure 4).

Installation of Collars on Reindeer:

Reindeer collar tightness is a critical factor and effective installation is essential. The need for collar tightness varies seasonally between summer and winter, and between reindeer bulls and cows. Collar tightness was determined by slipping two or three fingers between the collar and side of neck. For those collars installed in the spring, tightness was determined by slipping three fingers between the neck and the collar. Winter installed collar tightness was determined by slipping two fingers between the neck and collar. Collars were connected with appropriate nuts and bolts. Reindeer returned to grazing on open range after collar installation. Magnets were removed and PTT's were turned to transmit on different dates. They were deployed as soon as possible.

WACH and Satellite Telemetry

During 1987 through 2001, Alaska Department of Fish and Game (ADF&G) installed 66 PTT's on selected caribou from the WACH. Telonics PTT's were deployed and data were collected using the Service Argos, Inc. and NOAA systems. During 2001, U.S. Fish and Wildlife Service bought and ADF&G deployed ten additional satellite collars (Dau, 2002). The maximum number of satellite collars on WACH animals during any single year was 35.

Figure h. ***Richard Zacharof, St. Paul Island Chief Reindeer Manager and Rick Sinnot, Alaska Department of Fish and Game, Regional Biologist, Anchorage, installing collar on reindeer steer on St. Paul Island. (Source: Tanadgusix Corporation)***

Figure 5. *Illustrates the dynamics and range of travel for Reindeer 89, 90 and 91 during fall to winter in year 2000.*

Reindeer and caribou interaction was evaluated on a daily basis from July—December 2000 and continued through 2001 using collared Reindeer 89, 90 and 91 from the Noyakuk herd. Unfortunately, Reindeer 90 stopped moving mid summer and was later found dead; she died from unknown causes.

From August–October, Reindeer 91 and 89 maintained a relatively small home range, traveling about 1-2 miles/day in the southern portion of the Noyakuk range (Fig. 5). All of this travel was within the traditional home range. On about October 10, presumably caribou started to encroach and began mixing with reindeer. On October 18—20, Reindeer 91 and 89 (and presumably a good part of the reindeer herd), started moving Northeast, 7.5 miles/day around their home range area. During October 20–25 Reindeer 91 and 89 traveled 4 to 6 miles/day (northwest pointing arrow) until reaching the northern point of their travels, turned southeast, travelling 74 miles in 6 days or 12.3 miles/day (Figure 5).

Their travels continued to Golovin and on to Fish River Flats. At the Flats, they separated. Reindeer 91 continued to travel east to Koyuk, arriving about one month later, travelling approximately 275 miles. During about a 2-year period, Reindeer 91 and 89 traveled 1,450 and 1,200 miles respectively. Reindeer, left to their own natural tendencies, will stay in their home range travelling 1 to 2 miles per day, remaining content and docile. When reindeer intermingle with caribou, they become unmanageable and impossible to herd or control.

Preferred Reindeer Winter Grazing Areas

As the need continues for developing more functional grazing plans, the dynamics of reindeer grazing becomes more important to understand. Predators, musk oxen, caribou, snow conditions, insects, climate, topography and seasonal forage interactions all become very important when making planning decisions.

In time, as information is further refined, all of these factors will be analyzed using GIS technology. Ecological site information is presently digitized and with sufficient time, reindeer presence on specific ecological sites state can be determined. Preliminary conclusions indicate that frequency and duration on the site is indicative of grazing intensity. By using GIS and superimposing location data over ecological sites, we determined where reindeer were spending their time during a mid winter period.

Figure 6 shows Reindeer 89 using Ecological Sites 41, 61, and 81. These are tundra, mountain and alpine tundra sites respectively, which support lichens with a good mix of vascular plants. Notice how Reindeer 89 avoided drainage sites 21 and 35. These drainages support stands of 6–8 foot high willows and no lichens. Although reindeer will browse willows in winter, in this environment, snow density is low; travel and access are problematic. Stream drainages usually trap 3–7 feet of snow and also provide hiding cover for predators. Although the best accuracy attainable with this present system is 164 yards or less, for most large-scale work, it seems sufficiently accurate.

Improved Grazing Management

Presently, reindeer location information has been made available through the University's web site, to reindeer herders with Internet access. For those that do not have access, information is provided by direct communication with the herder or by fax. This technology provides

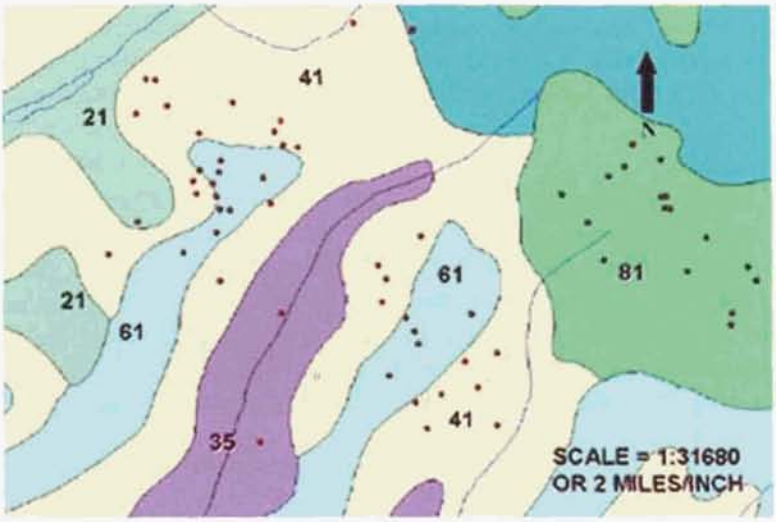

Figure 6. *Reindeer 89 location data in relationship to ecological sites 41, 61 and 81.*

herders sufficient information to follow a management plan as identified in Figure 7. Although PTT duty cycles for most Seward Peninsula reindeer transmit once every 4 days, information at that frequency is helpful and allows herders to locate and move animals to desired locations more efficiently.

Real time data will become increasingly more important as technology develops and grazing management efforts intensify.

Increased reindeer herder awareness of potential technology

Funded through USDA EQIP and the University's Reindeer Research Program, two workshops were held in Nome, Alaska to address satellite telemetry technology. Another workshop will be held in Anchorage in the fall of 2002 for the reindeer herders from islands in the Bering Sea region. Topics discussed range from becoming familiar with PTT and VHF transmitters, installation of collars on reindeer, how the system works, and man-

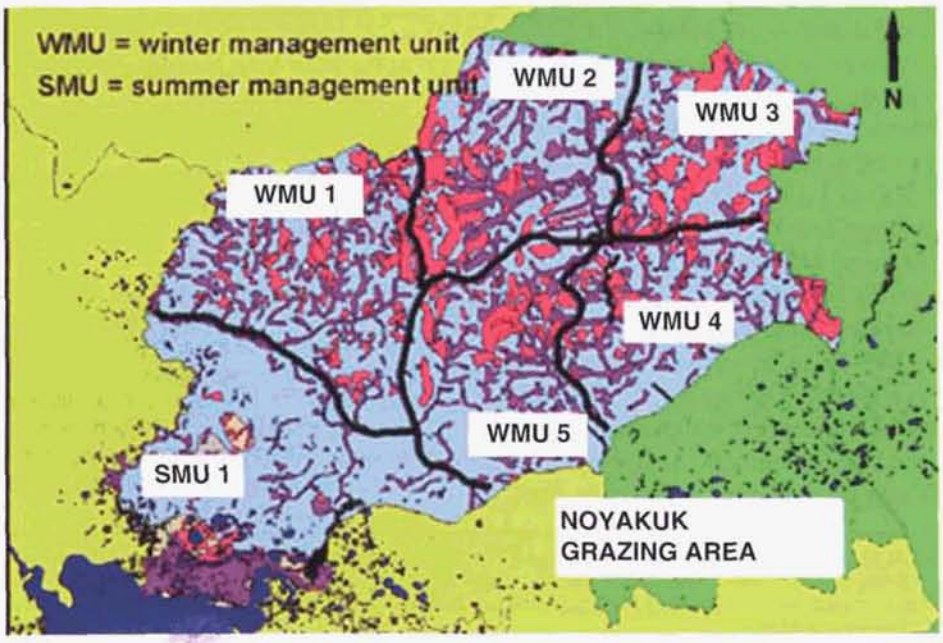

Figure 7. *Noyakuk rotational grazing management plan map indicating seasonal ranges. Blue areas support tussock tundra with low lichen production; purple areas are predominately shrubs, and red areas are high producing lichen tundra.*

agement implications and real life applications. The program was well received by herders and agencies alike. Reindeer telemetry program participation is limited only by the number of collars available and funding to keep them operational.

Improve Utilization Check Efficiency

Driving out to a unit to check utilization on a permit area is not an option in these vast roadless areas of Alaska. Here utilization checks are done via helicopter. Helicopter time is costly, so making the best use of time is critical. The checks have become more efficient and effective since implementing satellite telemetry. Survey crews can review the location data and quickly see where and when reindeer were present and how long they stayed. Using GPS and past reindeer location coordinates for navigation, crews fly directly to previously grazed locations, making more efficient use of field time.

Summary

There is no substitute for 24-hour reindeer herding; however, in this day and age, it is no longer feasible. Although cabins and trail systems are slowly being developed, telemetry systems can play an important immediate role for improving reindeer management. Satellite telemetry offers a variety of benefits to reindeer herders wanting to improve their herd grazing management, avoid caribou interaction, and save time and money when gathering the herd for handling.

Key to an effective satellite telemetry program is getting good herd representation with the minimum number of PTT's. Without good herd representation, use of reindeer location data is proportionally diminished for intensive management or tracking. Ratios of 1:100 (PTT's/reindeer respectively) have been discussed and presently thought to be optimal. At present, PTT ratios in test herds are 1:500 to 1:1000. Even at these large ratios, it is widely recognized by reindeer herders that a small amount of location information is invaluable and can provide tremendous benefits. To help reduce overall satellite telemetry expenses, individual VHF transmitters (without satellite PTT's) can be deployed and reindeer can be located by aerial survey using a VHF scanner.

We can locate and follow reindeer travel routes, monitoring distance and time spent traveling. Changes in reindeer movement patterns can be detected, which then alert the herder to possible encounters with wolves and caribou. We can also determine time utilizing ecological sites, and without any doubt reduce expenses for making utilization checks. Most importantly, we have a system in place that herders can use to acquire real time location data.

We have learned a lot about this system and some about reindeer grazing, but can herders utilize satellite telemetry in a cost-effective manner? The answer is, perhaps: if herders regain control of their ranges, if wet velvet antler prices improve, and if specialty meat markets continue to develop. One thing is certain. The technology will continue to develop and become less expensive in this era of technological revolution.

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