NOATAK RIVER MOOSE RADIO TELEMETRY PROJECT

PROGRESS REPORT

Reporting Period:

April-December 1992

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March 9, 1993

Mr. Al Lovaas
National Park Service
Alaska Regional Office
2525 Gambell St. Rm 107
Anchorage, AK 99503

Dear Al,

Enclosed is the first progress report for the Noatak River moose radio telemetry project. We deployed the collars in April 1992 and I arbitrarily chose December 31 as the end of the reporting period. In the future, the reporting period will be by calendar year. I will send copies of this report to the Noatak IRA Council, and the Kotzebue Sound Fish & Game Advisory Committee.

The collared moose have provided important information at what could be a critical juncture in time. As you will note in the report, 29% of the collared individuals died during the first 9 months of the study (excluding known or possible capture mortalities). Twenty two percent died of natural causes, and 7-10% were killed by hunters. The extent of mortality is disturbing. The collars will allow us to assess whether this high mortality rate continues, and will provide us with hard information to base management decisions. Of course, the collars are also providing us with movement and distribution information to delineate a census area for the middle Noatak River drainage.

This project is the first significant step managers have taken toward improving the quality of moose survey data in the NANA Region. I appreciate your support for this project, and your long-standing support of other projects in this region that our agencies have cooperatively undertaken. I am excited about working on this project with Brad Shults during the next two years, and am grateful for Layne Adams' willingness to entertain my queries about moose and other species. Please don't hesitate to call me if you have any questions.

ncerely,

m Dau

: John Coady
Brad Shults

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INTRODUCTION

In April, 1992, the Alaska Department of Fish & Game (ADF&G) and the National Park Service (NPS) began a cooperative radio telemetry investigation of moose (*Alces alces gigas*) in the middle Noatak River drainage. The objectives of this study are to:

1. gather information on movements and distribution of moose to delineate a census area; and
2. evaluate sources and rates of moose mortality.

The purpose of this report is to summarize the background, methods, and preliminary results of this project.

BACKGROUND

Long-term local residents indicate that the most recent colonization of northwest Alaska by moose occurred during the late 1940's and early 1950's. From that time until the mid- to late 1980's moose populations generally increased throughout this region. Since 1990, it appears that a widespread decline of moose has begun in at least portions of the Seward Peninsula and Kotzebue Basin.

The earliest record of an aerial moose survey conducted in Game Management Unit (GMU) 23 occurred in 1959; however, moose surveys were not conducted regularly until the 1970's. From 1973 to the present, moose surveys have been conducted throughout portions of GMU 23 almost annually. In fact, during most years both spring and fall surveys have been conducted. Unfortunately, from 1973 to 1985, survey techniques and count areas were not standardized. As in other portions of Alaska during this management era, the parameters "moose per hour" and "percentage calves" were the foundation of survey data. In GMU 23, specific search areas and survey conditions were not recorded, and maps accompanying surveys were not filed. As a result, it is impossible to evaluate temporal or spatial changes in moose abundance from this data. Early moose survey data provides little more than limited information on the sex and age composition of moose populations in portions of GMU 23.

By the late 1970's, wildlife biologists throughout Alaska realized that moose survey techniques needed improvement. As a result, a technique was developed during the early 1980's to quantitatively estimate moose population size and composition (Gasaway et al. 1986). In 1985, three attempts were made to use and evaluate the Gasaway moose census technique in GMU 23; these were: 1) a 2115 mi^2 portion of the middle Noatak River drainage (March 15-19); 2) the Selawik National Wildlife Refuge (4360 mi^2, October 25-November 1); and 3) a 1602 mi^2 portion of the Squirrel River drainage (November 18-24).

The Selawik Refuge and Squirrel River census attempts failed, and the validity of the middle Noatak River estimate was compromised by technical difficulties. Factors that contributed to the failure of these attempts were too large a

census area; incomplete stratification; poor classification of sample units (SU) that were stratified; failure to estimate sightability of moose; inclement weather; and failure to standardize search effort among SU's.

In 1986, following the three Gasaway census attempts, area biologists began developing a trend count system for monitoring moose populations throughout GMU 23. Biologists recognized that trend count data was inferior to census data; however, trend counts were more feasible than censuses given the constraints of personnel, aircraft, and weather, and would theoretically illustrate changes in moose populations over time even if they did not provide cardinal estimates of abundance. In addition, moose populations appeared to be generally healthy and increasing thus minimizing the need for rigorous and expensive census data. Spring trend count areas were established in the lower Kobuk and lower Noatak River drainages during 1986. Fall trend count areas were established in the middle Noatak (1986), Tagagawik (1986), upper Nimiuktuk (1987), middle Wulik (1987), Buckland/Bear Crk (1989), and Inmachuk (1989) drainages.

Initially, trend count data appeared sufficient for monitoring moose populations in GMU 23. However, after 5-6 years of conducting the counts under a range of survey conditions, it became evident that snow depth greatly affected the number of moose and, to some degree, the sex and age composition of moose that were observed. Although moose trend counts were more repeatable than the earliest moose surveys that had been conducted in the Unit, they still failed to provide meaningful estimates of abundance. In addition, the trend count approach is not an estimation technique; therefore, it does not provide estimates of quality (i.e., accuracy and precision) of the surveys.

As the limitations of trend count data became evident, northwest Alaska experienced several consecutive severe winters beginning in 1988-89. At least 2 of these severe winters were followed by prolongued, extensive flooding of moose calving areas during the subsequent spring. The winter of 1990-91 was particularly harsh on ungulates and large numbers of moose in GMU 23 died directly or indirectly from starvation. At this time, brown bear and wolf populations were high and losses of moose to predation were exacerbated by the almost total absence of caribou wintering in GMU 23. In addition, interest in hunting moose by nonlocal recreational hunters continued to increase. Within a period of only 2-4 years, managers suddenly needed more accurate moose survey information than trend counts could provide.

In 1990, ADF&G, NPS, Bureau of Land Management (BLM), and U.S. Fish & Wildlife Service (USF&WS) biologists began discussing ways to improve moose survey data. As a result, this study (Appendix A) and a cooperative ADF&G-BLM Gasaway moose census in the Squirrel River drainage were initiated. In addition, the USF&WS has proposed a radio telemetry project for the Tagagawik River area, and is considering a cooperative census of this area with ADF&G and BLM for 1994.

The Squirrel River census covered 1441 mi^2 and was conducted November 4-14, 1992. The 90% confidence interval was $\pm$23% of the estimate. As in the 1985 Gasaway census attempts, inclement weather affected the precision of this estimate. Nevertheless, this census provided the first meaningful estimate of moose abundance in Unit 23 and showed that with adequate personnel and aircraft it is possible to census moose in Northwest Alaska during fall.

STUDY AREA

The 3400 mi^2 (8806 km^2) study area is located in GMU 23 south of the crest of the DeLong Mountains between the Kelly and Nimiuktuk River drainages to 5-10 miles south of the Noatak River (Figure 1). Most of the study area is within the Noatak National Preserve. Other land owners include the State of Alaska, NANA Regional Corporation, and private citizens (Native allotments).

The physiography, climate and vegetation of this area have been previously described (Young 1981, Hulten 1968). In addition to moose, Dall sheep (*Ovis dalli*), caribou (*Rangifer tarandus*), brown bear (*Ursus arctos*), and wolves (*Canis lupus*) occur throughout the study area.

METHODS

We captured 84 moose (25 females and 59 males) between April 2 and 9, 1992 using standard helicopter darting techniques. All moose were immobilized with 4.3 mg carfentanil and 170 mg xylazine hydrochloride administered in a 3 ml dart (Palmer Chemical Equipment Inc., Douglasville, GA). Naloxone (400 mg) or naltrexone (600 mg) was injected intra-muscularly to reverse the effects of the carfentanil on 77 and 7 moose, respectively.

Total length, hind foot length, heart girth, and diameter of antler pedicles on bulls was recorded. A subjective body condition class was assigned to each moose (Table 1), and a fecal sample was taken. Approximately 60 ml of blood was collected from 57 moose. Packed cell volume and hemoglobin values were

determined, and serum was collected and frozen to evaluate incidence of disease. Each moose was subjectively aged based on wear of its incisors; the incisors of some moose were photographed for future reference.

All cows and 26 large bulls were radio collared with VHF transmitters equipped with a 5-hr mortality mode (Telonics, Inc., Mesa, AZ). All bulls were tagged with black ear tags (Temple Tag, Temple, TX). Twenty-three moose were radio collared in the Kelly River drainage, 16 in the Kugururok River drainage, 9 in the Nimiuktuk River, and 3 between the Kugururok and Nimiuktuk Rivers. Of the bulls ear tagged but not collared, 8 were tagged in the Kelly River drainage, 12 in the Kugururok, 11 in the Nimiuktuk, and 1 tagging location was not recorded.

Radio collared moose were relocated during June, July, August, September, October, and December via fixed-wing aircraft. Location, habitat type, snow depth, presence or absence of calves (cows), estimated antler width (bulls), group size, and group sex/age composition were recorded.

A poster requesting hunters to return ear tags and radio collars to ADF&G was developed and distributed to local airline terminals, transporters, and stores (Fig. 2). Hunters who returned ear tags and radio collars provided kill site and antler width, and received a $25.00 recovery fee.

RESULTS

Capture: Seven of the 84 immobilized moose required additional carfentanil: one moose required additional drug when the internal charge in the dart failed; injections of 1.1 and 2.1 mg of carfentanil were given by hand syringe in two cases where immobilization was incomplete; and 4 out of 7 moose in which the first dart bounced out required a second dart. No cases of narcotic recycling were observed during limited monitoring of collared moose immediately following capture. One large bull died within 24 hrs of capture from hemorrhage associated with the dart wound. This collar was retrieved and redeployed the following day.

There was no significant difference in body size measurements between bulls and cows (Table 2). Most moose were categorized in body condition class 5. The average estimated age of bulls was 4.7 years (n=39, SD=2.4), and for cows was 6.7 years (n=25, SD=2.9). Blood serum will be analyzed for incidence of disease at a later date.

Movements. We obtained 201 locations for the 50 radio collared moose (Table 3). Nine bulls and 5 cows were located at least once in drainages other than those they were captured in. The longest straight-line distance traveled was 84 mi (135 km) by bull 9254. This bull was captured in the middle Nimiuktuk River drainage. On June 5, he was located in the Kugururok drainage, and on July 15 he was 6-7 mi (8 km) east of Noatak Village where he remained through December 15. One bull captured on the Kugururok River spent the summer north of the DeLong Mountains but returned to the Kugururok River during rut. In December 1992, 20 radio collared moose were located in the Kelly River

drainage, 7 in the Kugururok River Drainage, and 7 in the Nimiuktuk River Drainage.

Mortality: The proximity of the capture location and mortality site suggest that 2 bulls and 3 cows (10%) of the initial 50 radio collared moose (excluding the known darting mortality) may have died of capture-related causes. If anything, this overestimates capture mortality. Mortality of the remaining 45 moose were: 9 (20%) known or probable predator kills (3 bulls, 6 cows); 1 (2%) probable rutting mortality (bull); and 3 (7%) hunting mortality (3 bulls). The cause of death was considered natural if hunting and capture-related mortality could be eliminated. Natural mortality accounted for 22% of the total mortality. The total mortality was 29%.

Based on the capture loss of radio collared moose (10%), we assume there was a minimum of 30 ear tagged bulls at the beginning of the hunting season. Three (10%) ear tagged bulls were reported harvested by hunters. Combining ear tagged and radio collared bulls (n=53), 6 (11%) were taken by hunters.

DISCUSSION

As in most other radio telemetry studies of moose, individuals have exhibited a variety of movement patterns ranging from sedentary to wide ranging. Two to 3 more years of relocation information should allow identification of seasonal ranges of this moose population if there is sufficient variability in snow conditions. There appears to be substantial exchange of moose between the Kelly and Kugururok River drainages. Only 1 moose (a bull) collared in the

Nimiuktuk River drainage moved west of the Kaluktavik River. Bulls have tended to move farther than cows, although exceptions to this have occurred for each sex. At this point, there is insufficient data to warrant detailed anaylses of movements. Movements will be examined more thoroughly in future progress reports.

The loss of almost one third of the collared moose in the first 9 months of this project is disturbing. This underscores the need for additional information on moose mortality, and necessitates deploying a higher number of radio collars during April 1993 than was originally intended (Appendix A). If high levels of natural mortality continue, complementary studies, e.g. quantitative estimates of wolf abundance or evaluation of critical moose winter habitat, should be considered.

Mortality information from this study, trend count data, opportunistic observations by management personnel, and public reports strongly suggest that some moose populations in northwest Alaska may be rapidly transitioning from a 40-50-year period of growth to a phase of decline. This argues persuasively for censusing the middle Noatak moose population during fall 1993 as originally proposed (Appendix A). A benchmark quantifying moose density and sex/age composition would minimize the uncertainty of interpreting varied sources of nonrigorous information. Because the bull:cow ratio has been a management concern in this portion of GMU 23 since 1989, a fall census would provide both abundance and composition information needed by managers.

The need for quantitative moose census data in GMU 23 goes beyond verifying whether moose are currently declining in the middle Noatak River drainage.

Throughout Alaska, management biologists have largely forsaken trend counts in favor of censuses as the basic survey and inventory technique for monitoring moose populations. The approach that appears to be evolving for management purposes incorporates components of trend count and census techniques.

This "new" approach begins with a full scale Gasaway census of approximately 2000 mi^2 to establish baseline population information for an area. At 2-4-year intervals thereafter, a subsample of the original area is censused using either the basic or some streamlined version of the Gasaway technique. The size of the subsample census area depends upon typical movements of moose in the study area as well as financial, personnel, weather, and aircraft constraints; 800-1200 mi^2 is generally accepted as the minimum size of the subsample census area. Thus, this approach generates information on moose populations on a regular basis just as trend counts did. However, this approach is superior to classic trend counts in that: the estimates of moose density and population composition are standardized through statistical sampling techniques so are objective and repeatable; censuses provide estimates of accuracy and precision; and censuses cover areas large enough to avoid the effects of snow-induced movements of moose.

A census area covering approximately 1700 mi^2 of moose habitat in the middle Noatak River drainage has been tentatively delineated. This area includes all drainages flowing south into the Noatak River from Kiyak Creek to the Kugururok River, to approximately 5-10 miles south of the Noatak River. This boundary may be modified as additional movement data is collected. The possibility of basing this census out of the Red Dog Mine is currently being explored.

The middle Noatak census area would be 1 of 3 or possibly 4 1500-1800 mi^2 census areas located throughout Unit 23. Other census areas would be located in the Kobuk and Tagagawik River drainages, and possible on the northern Seward Peninsula. Therefore, the middle Noatak River census area would theoretically be censused every 3-4 years. Realistically, due to weather constraints, one census will probably be accomplished every 4-5 years. This should illustrate differences in moose abundance and population composition through space and time.

RECOMMENDATIONS

1. Radio collar 20-25 moose in the Kelly and Kugururok River drainages during April 1993. This would re-establish a minimum sample size for evaluating moose mortality during 1993 and place most of the collars in the western portion of the study area where movement information is needed to refine the census area boundary. Eight new collars and 3 collars retrieved from dead moose are available at the Kotzebue ADF&G office. Twelve new brown bear collars are available at the Kotzebue NPS office; these collars will be modified to accomodate moose. Additional collars will be retrieved from mortality sites during March and redeployed if possible. Estimated total cost for the collaring operation is $17-22,000. This will be shared approximately equally between ADF&G and NPS.

2. Retrieve radio collars from mortality sites during late spring and early fall 1993 and refurbish those that cannot be reused. Deploy these collars

during April 1994 to maintain an adequate sample size of collared moose to evaluate mortality.

3. Conduct a Gasaway census of the middle Noatak River drainage between Kiyak Creek and Kugururok River drainages during late October or November 1993. Explore the possibility of basing this census out of Red Dog.

4. Relocate collared moose a minimum of 5 times annually. This would reduce the probability of collared moose emigrating out of the study area undetected and provide better information regarding temporal patterns of moose mortality. Relocation flights would be most useful during: August (pre-hunting); October (post-hunting); December (early winter); March-April (late winter); and June (calving).

LITERATURE CITED

Hulten, E. 1968. Flora of Alaska and neighboring territories. Standford University Press, Standford, California. 584pp.

Young, S.B. editor. 1981. The environment of the Noatak Basin, Alaska. Center for Northern Studies, Wolcott, Vermont. 584pp.

Table 1. Criteria used to assign a body condition value for moose captured in the Middle Noatak Moose Telemetry Project, April 1992.

Condition Class	Description
10	A prime, fat animal with thick, firm rump fat by sight. Well fleshed over back and loin. Shoulders round and full.
9	A choice, fat moose with evidence of rump fat by feel. Fleshed over back and loin. Shoulders round and full.
8	A good, fat moose with slight evidence of rump fat by feel. Bony structures of back and loin not prominent. Shoulders well fleshed.
7	An average moose with no evidence of rump fat, but well fleshed. Bony structures of back and loin evident by feel. Shoulders with some angularity.
6	A moderately fleshed moose beginning to demonstrate one of the following conditions: (A) definition of neck from shoulders; (B) upper foreleg (humerus and musculature) distinct from chest; or (C) rib cage prominent.
5	A condition in which two of the characteristics listed in Class 6 are evident.
4	A condition in which all three of the characteristics listed in Class 6 are evident.
3	A condition in which the hide fits loosely about neck and shoulders. Head is carried at a lower profile. Walking and running postures appear normal.
2	Signs of malnutrition are obvious. The outline of the scapula is evident. Head and neck are low and extended. The moose walks normally but trots and paces with difficulty, and cannot canter.
1	A point of no return. A generalized appearance of weakness. The moose walks with difficulty and can no longer trot.
0	Dead.

Table 2. Summary of physical characteristics of moose captured in the Noatak River drainage, Alaska, April 1992.

	Total Length (cm)	Heart Girth (cm)	Foot Length (cm)	Body Condition	Age (yrs)	Hb (%)[a]	PCV[b]
All Moose (n=64)							
Mean	297	104	75	5	5.5	13	40
SD[c]	22	35	22	1	2.8	5	15
Variance	505	1200	503	1	7.9	25	230
Cows (n= 25)							
Mean	296	99	74	5	6.7	13	40
SD[c]	10	44	22	1	2.9	5	16
Variance	99	1914	501	2	8.4	28	256
Bulls (n = 39)							
Mean	297	108	76	5	4.7	13	40
SD[c]	28	26	22	0	2.4	5	14
Variance	765	696	503	0	6.1	23	213

[a] Percent hemoglobin

[b] Packed cell volume

[c] Standard deviation

Table 3. Relocation data from radio collared moose in the Noatak River moose radio telemetry project.

Moose ID	April 92	June 92	July 92	Aug 92	Sept 92	Oct 92	Dec 92
9201	Noat/Kug R.	Noat/Kug R.	Evaing. Cr.	Sivu/Noat		L. Kelly	
Bull	captured	active	active	active		active	
149.180			35" antlers	54" antlers		63" antlers	
9202	U. Kugururok	Utukok R.	not located	Driftwood Cr.		Copter Pk.	King Mt.
Bull	captured	active	missing	active		active	mortality
149.210				46" antlers		48" antlers	
9203	U. Kugururok	Trail Cr.	not located	Imikneyak Cr.			
Bull	captured	active	missing	active			
149.670				48" antlers			
9204	L. Kugururok	Noat/Kug R.	L. Kugururok	L. Kugururok	L. Wrench		
Bull	captured	active	active	active	mortality		
148.820			40" antlers	58" antlers	63" antlers		
9205	L. Kugururok	L. Kugururok	Evaing. Cr.	Evaing. Cr.		Pung. Cr.	Sivu./Noat R.
Cow	captured	active	active	active		active	active
148.100							
9206	U. Kugururok	U. Kugururok	Mid Kug.	U. Kugururok		Copter Pk.	Kingaviksak
Cow	captured	active	active	active		active	mortality
149.580		2 calves	1 calf				
9207	Noat/Kelly R.	Noat/Kelly R.	Sivukat Mt/Noat R.	Kelly/Noat R.		L. Kelly	Avon/Kelly R.
Bull	captured	active	active	active		active	active
148.870			24" antlers	42" antlers		46" antlers	
9208	U. Kugururok	Trail Cr.	Uvgoon Cr.	Uvgoon Cr.	Uvgoon/Eli Base		
Bull	captured	active	active	active	mortality		
149.030			30" antlers	53" antlers	52" antlers		

Table 3 (cont.).

Moose ID	April 92	June 92	July 92	Aug 92	Sept 92	Oct 92	Dec 92
9209	L. Kelly	No Name Cr.	No Name Cr.	Kiyak Cr.		Kikmiksot	Kiyak Cr./Noat R.
Bull	captured	active	active	active		active	active
148.060				54" antlers		53" antlers	
9210	U. Kelly	Kelly R.	Evaing. Cr.	Sivukat Mt.		L. Wrench	Middle Kelly R.
Cow	captured	active	active	active		active	active
148.400							
9212	U. Kelly	U. Kelly	Kelly R./No Name Cr.	Kelly R./No Name Cr.		U. Kelly	U. Kelly
Cow	captured	active	active	active		active	active
149.080							
9213	Wrench Cr.	Wrench Cr.					
Cow	captured	mortality					
149.240							
9214	L. Wrench	Lower Kelly	Not located	Not located		Wulik R.	Deadlock Mt.
Cow	captured	active	missing	missing		active	active
148.260						1 calf	
9214				Not located			
Cow							
148.420				missing			
9215	L. Wrench	Kug/Noat R.	L. Kelly	Sivukat Mt./Noat R.		L. Kelly	L. Kelly
Bull	captured	active	active	active		active	active
149.680							
9216	L. Wrench	L. Kelly	L. Kelly R. West				
Bull	captured	active	mortality				
149.190							

Table 3 (cont.).

Moose ID	April 92	June 92	July 92	Aug 92	Sept 92	Oct 92	Dec 92
9217	L. Wrench	L. Kelly					
Cow	captured	mortality					
148.940							
9218	L. Kelly	Noat/Kelly R.	Sivukat Mt./Noat R.	Sivukat Mt.		L. Kelly	L. Wrench
Cow	captured	active	active	active		active	active
149.170							
9219	Imikneyak Cr	Kalaktavik	Sivukat Mt./Noat R.	Kelly/Noat R.		Kelly/Noat R.	L. Kelly
Bull	captured	active	active	active		active	mortality
149.070							
9220	Imikneyak Cr.						
Bull	mortality						
148.130							
9221	Tumit Cr.	Tumit Cr.	Tumit Cr.				
Cow	captured	active	mortality				
149.200		1 calf					
9226	Nimiuktuk R.	U. Nimiuktuk	L. Nimiuktuk	L. Nimiuktuk		U. Nimiuktuk	U. Nimiuktuk
Cow	captured	active	active	active		active	active
148.140							
9231	Nimiuktuk R.	U. Nimiuktuk	Anisak	Seagull Cr.		U. Nimiuktuk	U. Nimiuktuk
Bull	captured	active	active	active		active	active
149.160							
9232	Nimiuktuk R.	Makpik Cr.	Makpik Cr.	Makpik Cr.		U. Nimiuktuk	L. Nimiuktuk
Cow	captured	active	active	active		active	active
149.100		1 calf	1 calf	1 calf		1 calf	

Table 3 (cont.).

Moose ID	April 92	June 92	July 92	Aug 92	Sept 92	Oct 92	Dec 92
9241	Nimiuktuk R.	U. Nimiuktuk	not located	Picnic Cr./Anisak R.		U. Nimiuktuk	U. Cottonwood C
Bull	captured	active	missing	active		active	active
148.750				52" antlers		56" antlers	
9242	Nimiuktuk R.	U. Nimmiuktuk	U. Nimiuktuk	U. Nimiuktuk		U. Nimiuktuk	U. Nimiuktuk
Cow	captured	active	active	active		active	active
149.730		2 calves					
9243	U. Kelly	Kelly R.	Kikmiksot	Amphitheater Mt.			
Bull	captured	active	active	active			
149.470			30" antlers				
9244	U. Kugururok	Kugururok R.				L. Wrench	Kelly R.
Cow	captured	mortality				active	active
149.130						46" antlers	
9246	U. Kugururok	U. Kugururok	U. Kugururok	U. Kugururok		Copter Pk.	Kingaviksak Mt
Bull	captured	active	active	active		active	active
149.290			30" antlers	48" antlers		48" antlers	
9247	U. Kugururok	Trail Cr.	Sivukat Mt.	Deadlock Mt.		Avon/Kugururok R.	Mouth Kagvik C
Bull	captured	active	active	active		active	active
148.170				64" antlers		63" antlers	
9248	U. Kugururok	Mid Kugururok					
Cow	captured	mortality					
149.050							
9249	U. Kugururok	Kugururok R.	Avan R./Kagvik Cr.	Kagvik Cr.		Kagvik Cr.	Kagvik Cr.
Cow	captured	active	active	active		active	mortality
149.480							

Table 3 (cont.).

Moose ID	April 92	June 92	July 92	Aug 92	Sept 92	Oct 92	Dec 92
9249							Mid Kagvik C
Cow							mortality
149.480							
9250	No Name Cr.	Kelly R.	No Name Cr./Kelly R.	Kelly R./No Name Cr.		U. Kelly	Mouth Kagvik
Cow	captured	active	active	active		active	active
149.430			1 calf			1 calf	
9251	L. Wrench	Avan R.	Deadlock Mt./Wrench Cr.	Deadlock Mt.			L. Wrench
Cow	captured	active	active	active			active
149.700							
9251						L. Wrench	
Bull						active	
149.700							
9253	Tumit Cr.	Tumit Cr.	Tumit Cr.	Tumit Cr.		Tumit/Seagull	Nimiuktuk/Se
Cow	captured	active	active	active		active	active
148.610		1 calf					
9254	Tumit Cr.	U. Kugururok	L. Eli	Noatak/Eli		Eli/Noatak	Uvgoon Cr.
Bull	captured	active	active	active		active	active
149.630			40" antlers	52" antlers		55" antlers	
9255	Imikneya Cr.	L. Nimmiuktuk	L. Nimmiuktuk	Kingasivik/Imikneyak	3 Mi up Seagull Cr.		
Bull	captured	active	active	active	mortality		
148.510			35" antlers	64" antlers	63" antlers		
9256	L. Kelly	Kelly /Avan R.					
Cow	captured	mortality					
149.610							

Table 3 (cont.).

Moose ID	April 92	June 92	July 92	Aug 92	Sept 92	Oct 92	Dec 92
9257	L. Wrench	Noatak/Avan R.	Sivukat Mt/Noat	Sivukat Mt./Noatak R.		Noatak R.	L. Kelly
Cow	captured	active	active	active		active	active
149.560							
9258	L. Wrench	Wrench Cr.	L. Wrench	L. Wrench		L. Wrench	L. Kelly
Cow	captured	active	active	active		active	active
149.650			1 calf			1 calf	
9261	U. Kelly	Kelly R.	not located	U. Kelly			
Bull	captured	active	missing	active			
148.420							
9262	U. Kelly	Anteerich					
Bull	captured	mortality					
149.140							
9263	U. Kugururok	Trail Cr.	Trail Cr.	Kagvik/Kugururok		Mt. Bastille	Kingaviksak Mt
Bull	captured	active	active	active		active	active
149.090							
9264	U. Kugurutok	L. Kelly	Avan R.	Kelly /Noatak R.		Kelly	Kelly R./Avon R
Cow	captured	active	active	active		active	active
148.590							
9265	U. Kugururok	L. Kugururok	L. Kugururok/Avan R.	Kelly /Avan R.		L. Kelly	Avon R.
cow	captured	active	active	active		active	active
149.110							
9266	L. Kelly	L. Noatak	Kiyak Cr.	Kiyak Cr.		L. Wrench/Deadlock	L. Kelly
Bull	captured	active	active	active		active	active
149.060			24" antlers	46" antlers			

Table 3 (cont.).

Moose ID	April 92	June 92	July 92	Aug 92	Sept 92	Oct 92	Dec 92
9267	L. Kelly	L. Noatak	Kiyak Cr.	Kikmiksot/Noatak		Noatak/Deadlock	L. Kelly River
Bull	captured	active	active	active		active	active
149.640			35" antlers	55" antlers		48" antlers	
9268	Noatak/Kelly R	Noatak/Kelly R	L. Noat/Kikmiksot	Kiyak Cr.		Kiyak/Noatak	Noatak village
Cow	captured	active	active	active		active	active
148.270			1 calf	1 calf		1 calf	1 calf
9269	L. Kugururok	Kalaktavik	Kalaktavik/Analak	Kaluktavik/Poktoviks		Poktoviks	Noatak/Kaluktav
Bull	captured	active	active	active		active	active
148.360			20" antlers	42" antlers		45" antlers	
9270	Noatak/Kelly R.	Noatak/Kelly R.	Deadlock Mt.	Sikukat		L. Kelly	L. Kelly
Cow	captured	active	active	active		active	active
148.770		1 calf					
9272	Avan R.	Kivivik	Kukururok/Avan	L. Kugururok		Avan R.	L. Kugururok
Bull	captured	active	active	active		active	active
148.130			35" antlers	54" antlers		58" antlers	
9290	Unknown	U. Nimmiuktuk	Mid Nimiuktuk	Mid Nimiuktuk		Mid Seagull	Nimiuktuk/Seagu
Cow	captured	active	active	active		active	active
149.340							

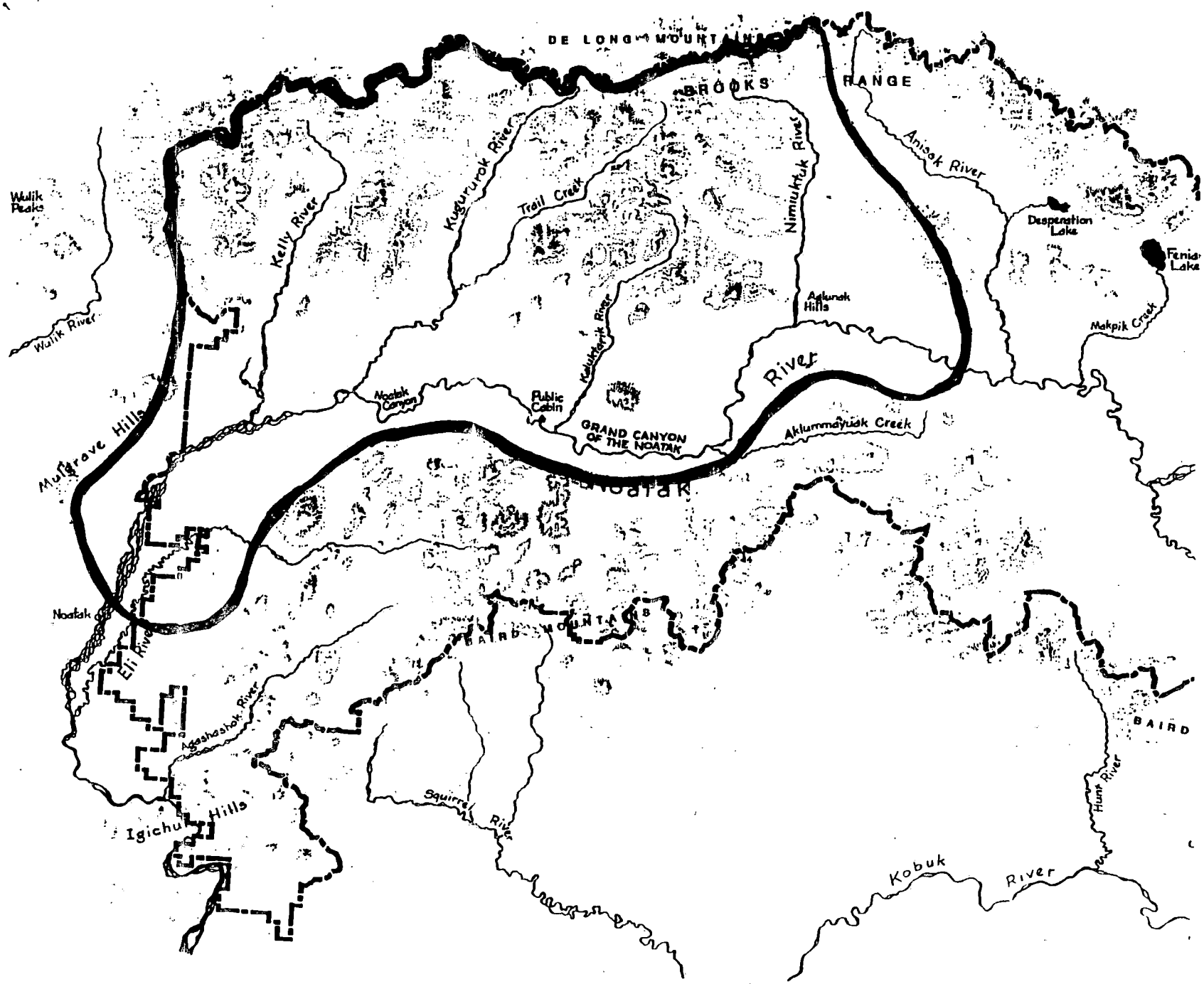

Figure 1. Noatak River moose radio telemetry project study area.

MOOSE HUNTERS!
Help ADF&G Help You!

The Alaska Department of Fish and Game and the National Park Service are conducting a research project on moose in the Noatak River drainage. As part of this study, 80 moose between the Kelly and Nimiuktuk Rivers have been radio collared and/or ear tagged. If you shoot a moose in the study area.

PLEASE CHECK FOR EAR TAGS.

If you kill a marked moose, please return the collar and/or ear tags to the Fish and Game office in Kotzebue. or mail them to:

Alaska Department of Fish and Game
Wildlife Conservation
Box 689
Kotzebue, Alaska 99752
(907) 442-3420

We are located on 5th Avenue, 1/2 mile north of the airport.

In addition to the collar and ear tags, the following information would be appreciated: **specific location of kill**
antler width
lower jaw with incisors intact

Marked animals are legal game. If you shoot a marked animal, Alaska Game Regulations require you to notify ADF&G, and return all identification equipment to the Department. (5AAC92.160).

Figure 2. Poster used to solicit hunter cooperation in returning radio collars and ear tags from Noatak River moose radio telemetry project study area.

Appendix A. Addendum to the master memorandum of understanding between the Alaska Department of Fish and Game and the U.S. National Park Service to conduct a research project on moose in the Noatak River drainage.

ADDENDUM TO THE
MASTER MEMORANDUM OF UNDERSTANDING
BETWEEN
THE ALASKA DEPARTMENT OF FISH AND GAME
AND
THE U.S. NATIONAL PARK SERVICE
TO
CONDUCT A RESEARCH PROJECT ON MOOSE IN THE NOATAK RIVER DRAINAGE

ARTICLE I. BACKGROUND AND OBJECTIVES

This addendum to the Master Memorandum of Understanding (MOU) dated October 14 1982 between the Alaska Department of Fish and Game hereinafter referred to as ADF&G, and the U.S. National Park Service, hereinafter referred to as NPS, is for the purpose of conducting a cooperative research project on the movements and population dynamics of moose in the Noatak River Drainage.

NPS and ADF&G share concerns and responsibilities for the conservation of moose in the Noatak National Preserve (NOAT). Under the Alaska National Interest Lands Conservation Act Section 812, NPS is directed to undertake research on fish and wildlife populations cooperatively with the State of Alaska on lands administered by the NPS. Both state and federal managers are currently faced with insufficient information on moose in GMU 23/NOAT to establish an effective management program.

ARTICLE II. STATEMENT OF WORK

NOW THEREFORE to satisfy mutual responsibilities and to derive mutual benefits ADF&G and NPS agree to cooperatively conduct a research project on the movement patterns of moose in the Noatak River Drainage as discussed in the attached proposal.

A. ADF&G agrees:

1. To assume primary responsibility for conduct of the study and to fulfill its obligations as outlined in the appended Study Proposal as submitted by ADF&G;

2. To assign Jim Dau, ADF&G biologist as Principal Investigator to the project; and

3. To coordinate any field operations in NOAT with the Superintendent and recognize the Superintendent's responsibility for all activities within the Preserve.

B. NPS agrees:

1. To actively participate and collaborate in the study by assigning NPS staff to assist the Principal Investigator in field aspects of the project.

C. ADF&G and NPS mutually agree:

1. The conduct of this agreement is dependent upon the availability of state and federal funds and administrative decisions on the use of available funds.

ARTICLE III. TERM OF AGREEMENT

This addendum to the MOU shall remain in effect from the date of last signature for a period of three (3) years unless terminated earlier according to ARTICLE VII of the Addendum. On an annual basis both agencies may reassess research needs, funding availability public benefits and may reaffirm, revise, or create amendments to this Addendum. Continuation of this work shall be subject to the availability of funds and administrative decisions in future fiscal years.

ARTICLE IV. KEY OFFICIALS

Key officials representing ADF&G will be the Director, Wildlife Conservation Division; the Regional Supervisor, Wildlife Conservation Division - Region 5; and the Principal Investigator for this study.

Key officials representing NPS will be the Regional Director; the Regional Chief Scientist; the Regional Wildlife Research Biologist; and the Superintendent NWAK

ARTICLE V. PRIOR APPROVAL

Any amendments extensions, changes or additions to this Addendum must be in writing and be approved and signed by the original signing authority.

ARTICLE VI. REPORTS

Technical reports shall take the form of progress reports a draft final report, and a final report. Progress reports shall be completed by March 1, 1993 and 1994. A draft final report for NPS and ADF&G review shall be completed by March 1, 1995

If State or Federal funds are not available to support this work in subsequent years, then a draft final report and a final report will be due on a date that is mutually agreeable to both agencies. The scope of the final report shall be limited to an analysis, interpretation, and discussion of research conducted during funded years of the study.

The final report shall contain:

1. A statement on the title page acknowledging the cooperation and financial assistance of NPS and ADF&G in conducting the study.

2. Documentation, analysis, interpretation, and discussion of the field studies, collections, estimates, and assessments conducted according to the Study Proposal. The report shall be sufficiently comprehensive and detailed to stand on its own as a definitive information source concerning the movements of moose in the Noatak River drainage.

3. A discussion of the management implications of the research conducted.

4. A discussion of future research and/or monitoring needs from the perspective of ADF&G and NPS concerning management of moose in NOAT/GMU 23.

Manuscripts for publication resulting from this study shall be reviewed by both ADF&G and NPS prior to submission for publication. Costs associated with publication will be shared by ADF&G and NPS. A minimum of ten (10) copies of publications from this study shall be provided to both ADF&G and NPS. Financial support and cooperation provided by ADF&G and NPS will be acknowledged in each publication.

ARTICLE VII. TERMINATION

This Addendum may be terminated by either party by providing notification in writing to the other party 60 days prior to the intended date of termination.

The undersigned agree to the provisions of this Addendum to the MOU:

FOR THE STATE OF ALASKA DEPARTMENT OF FISH AND GAME:

D. J. Kelleyhouse — 5/26/92

Director Wildlife Conservation Division — Date

FOR THE DEPARTMENT OF INTERIOR NATIONAL PARK SERVICE:

for — 6/3/92

Regional Director Alaska Region — Date

STUDY PROPOSAL

TITLE: ASSESS DISTRIBUTION PATTERNS OF MOOSE IN THE NOATAK RIVER DRAINAGE AND DEVELOP A POPULATION MONITORING PROGRAM

(NOATAK MOOSE STUDY)

PROBLEM STATEMENT: Moose management problems have developed in portions of GMU 23 including the Noatak National Preserve. Trend count data has indicated a steady decline in bull:cow ratios in the heavily harvested area of the Noatak River drainage beginning in 1987. In addition, moose populations unit wide (including Kobuk Valley) experienced high winter mortality during the winter of 1990-91. This was because deep snow and ice conditions made forage unavailable, and few caribou overwintered in Unit 23 thus increasing the loss of moose to predation and human harvest.

The current trend count areas are to small to accurately monitor moose abundance. It appears that snow-induced movements of moose affect the total counts in each trend count area more than changes in population size. Also, the current method does not provide estimates of precision or accuracy.

OBJECTIVES

1. Document the movements and seasonal distribution of moose in the middle Noatak drainage.

2. Establish a permanent count area (800-1000 mi2) which can be censused using a modified Gasaway technique to provide data on the abundance, recruitment, and sex/age composition of the middle Noatak moose population on a regular basis.

2. Evaluate the mortality rate of large bull moose in the most heavily hunted portion of GMU 23.

STUDY DESIGN

YEAR ONE (6/91-6/92)

The objectives of the first year will be to collar and begin monitoring movements and harvest of moose. Fifty moose of both sexes (25 bulls and 25 cows) in representative age classes will be collared and their movements monitored year-round. Additional bulls will be ear tagged in drainages receiving high harvest, as time permits. In addition to increasing the sample size of bulls for estimating harvest rates, additional marks will be useful for assessing the harvest bias for radio collared bulls.

Monitoring Schedule:

Mid August (immediately before hunting season)
Early October (immediately after hunting season)
November (following rut)
March
May
Late June

BUDGET

	ADF&G	NPS
Capture Effort		
Radio collars		
(25 retrofit @ 285 ea, 25 new @ 400 ea)	17,125	
Drugs (Carfentenail 75 moose @ 125 ea)	9,375	
Capture equipment	650	
Helicopter		
7 days availability @ 850 a day		5,950
12 hours commute time @ 240 hr		2,880
30 hours for capture @ 240 hr		7,200
Aircraft Support		
ADF&G PA-18 17 hours at 80 hr	1,350	
Charter PA-18 30 hours at 155 hr		4,650
Fuel		
Jet B 750 gal @ 3.9/gal to Red Dog		2,925
Jet B Red Dog to Kelly		1,750
Av Gas 220 gal to Kelly		920
Monitoring		
ADF&G PA-18 30 hrs @ 80 hr	2,430	
Charter PA-18 27 hrs @ 155 hr		4,185
NPS PA-18 27 hrs @ 80 hr		2,160
AGENCY CONTRIBUTION	33,780	29,720

PROJECT TOTAL 63,500

SECOND YEAR (6/92 - 6/93)

In addition to routine monitoring of collared moose the major focus for the second year will be to delineate and census an 800-1000 sq. mi. trend count area. A Gasaway census of the entire middle Noatak area is recommended as a complement to the study and would be most appropriate during November 1992*. Retrieved collars will be redeployed using snow machines.

BUDGET

	ADF&G	NPS
Monitoring		
ADF&G PA-18 54 hrs @ 80 hr	4,320	
NPS PA-18 27 hrs @ 80 hr		2,160
Modified-Gasaway Census		
ADF&G C-185 16 hrs @ 115 hr	1,840	
ADF&G PA-18 35 hrs @ 80 hr	2,800	
NPS PA-18 35 hrs @ 80 hr		2,800
Charter PA-18 27 hrs @ 155 hr		4,185
Misc Equipment/Fuel	1,000	
AGENCY CONTRIBUTIONS	9,960	9,145

PROJECT TOTAL 19,105

* The additional cost of a Gasaway census for the middle and lower Noatak River drainage (approx. 2,000 sq. mi.) would be approximately $15,000.

THIRD YEAR (6/93-6/94)

Routine monitoring of collared moose will be continued. Collars that have been retrieved will be redeployed by snow machine capture. An annual fall census will be conducted in the 800-1,000 sq. mi. census area. The movements of radio collared animals will be used to define and evaluate census area boundaries.

BUDGET

	ADF&G	NPS
Monitoring		
ADF&G PA-18 54 hrs @ 80 hr	4,320	
NPS PA-18 27 hrs @ 80 hr		2,160
Modified-Gasaway Census		
ADF&G C-185 16 hrs @ 115 hr	1,840	
ADF&G PA-18 35 hrs @ 80 hr	2,800	
NPS PA-18 35 hrs @ 80 hr		2,800
Charter PA-18 27 hrs @ 155 hr		4,185
Misc Equipment/Fuel	1,000	
AGENCY CONTRIBUTIONS	9,960	9,145

PROJECT TOTAL 19,105

FOURTH YEAR (6/94-6/95)

Routine monitoring of the collars will be continued. No collars will be redeployed. Collared animals will be relocated to verify the count area boundaries and estimation technique used. The final project report will be prepared.

BUDGET

	ADF&G	NPS
Monitoring		
ADF&G PA-18 54 hrs @ 80 hr	4,320	
NPS PA-18 27 hrs @ 80 hr		2,160
Modified-Gasaway Census		
ADF&G C-185 16 hrs @ 115 hr	1,840	
ADF&G PA-18 35 hrs @ 80 hr	2,800	
NPS PA-18 35 hrs @ 80 hr		2,800
Charter PA-18 27 hrs @ 155 hr		4,185
Misc Equipment/Fuel	1,000	
AGENCY CONTRIBUTIONS	9,960	9,145

PROJECT TOTAL 19,105

* The collars are estimated to last at least four years. We would like to leave them on moose in order to verify our survey area boundaries; however, we also feel it to be important to remove these collars as they reach the end of field life. The cost and method for retrieving collars will be based on the number of moose that remain collared. Although money is not being programed at this time, it is understood that both NPS and ADF&G will share the cost of removing the collars.

The program costs for the second through the fourth year will be supported by reoccurring program funding identified by the agencies for wildlife monitoring.

NOATAK MOOSE STUDY SCHEDULE

YEAR ONE: 6/91 - 92

April: Collar Moose

April - June: Two radio-tracking rounds

YEAR TWO 6/92 - 6/93

June - Nov: Three radio tracking rounds

Nov: Modified Gasaway Census on proposed 800 -1000 sq mi area; or Gasaway Census of the entire Middle and Lower Noatak if NPS provides additional funding.

March: Radio tracking plus spring counts in old trend count areas(?). Redeploy radio collars.

May-June: Two radio tracking rounds

YEAR THREE

June-Nov: Three radio tracking rounds

Nov: Modified Gasawsy Census in new trend count area

March: Radio tracking and redeploy collars.

May-June: Two radio tracking rounds

YEAR FOUR

June- Nov: Three radio tracking rounds.

Nov-Feb: Prepare Final Report

March/April: Spring trend count

Continue monitoring for mortality and to verfify count boundaries.

YEAR FIVE:

March-April: Remove collars