FEDERAL AID
FINAL RESEARCH REPORT

ALASKA DEPARTMENT OF FISH AND GAME
DIVISION OF WILDLIFE CONSERVATION
PO Box 25526
Juneau, AK 99802-5526

PROJECT TITLE: Factors limiting moose at low density in Unit 19D East; and response of moose to wolf control

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COOPERATORS: Eric Post, Pennsylvania State University

FEDERAL AID GRANT PROGRAM: Wildlife Restoration

GRANT AND SEGMENT NR: W-27-5, W-33-1, W-33-2, W-33-3

PROJECT NR: 1.58

WORK LOCATION: The eastern portion of Unit 19D, the Kuskokwim River drainage upstream of the Selatna River.

STATE: Alaska

PERIOD: 1 July 2004–30 June 2005

I. PROBLEM OR NEED THAT PROMPTED THIS RESEARCH

Demand for both subsistence and sport harvest of moose is high in the upper Kuskokwim region of Interior Alaska (Unit 19D East). However, in recent years the moose population has been unable to meet the subsistence needs of local Unit 19D hunters (Boudreau 2000a). In response, the commissioner of the Alaska Department of Fish and Game (ADF&G) appointed a team of Alaskans from diverse interest groups to recommend a management program that would increase moose harvest in Unit 19D East. By February 2001 the team recommended eliminating predation by wolves and reducing predation by black bears in a relatively small area along the Kuskokwim River in the vicinity of Takotna, McGrath, and Nikolai. The team also recommended a short-term moratorium on the hunting of moose and recommended research studies to gain additional information on moose, predators, and habitat in Unit 19D East.

Prior to the initiation of research in spring 2001, little quantitative information was available regarding moose population dynamics in Unit 19D East. Therefore, in order to obtain information necessary to make proper management decisions and to monitor the effectiveness of the resulting actions on the moose population, ADF&G initiated this Federal Aid in Wildlife Restoration project in March 2001.

II. REVIEW OF PRIOR RESEARCH AND STUDIES IN PROGRESS ON THE PROBLEM OR NEED

From an historical perspective, moose are a relatively recent addition to the fauna of western Interior Alaska. Oral histories record their arrival shortly after 1900 (Huntington and Reardon 1993; Whitman 1998). Moose apparently pioneered the McGrath area on the Kuskokwim River by about 1910–1915, with these few individuals seen as an important food source for local inhabitants (Sinka Gregory, personal communication with Jack Whitman). Since that time, moose are believed to have fluctuated similar to other populations across Interior Alaska, and moose numbers probably peaked throughout Interior Alaska, including Unit 19D, during the late 1960s (Shepherd 1975). An Interior-wide decline in moose followed, particularly during the severe winter of 1971–1972 (Shepherd 1975; Gasaway et al. 1983). Subsequently, moose populations in Unit 19 recovered (Shepherd 1975), and moose populations in most of Unit 19 were at moderate densities again by the mid 1980s (Pegau 1985). However, Pegau (1985) believed that moose numbers continued to be low in Unit 19D East, and he believed that moose were unable to sustain the combined mortality from hunting and predation. The relatively low moose population in Unit 19D East apparently declined further during a period of generally severe winters and increased wolf numbers, in the early 1990s (Whitman 1994; Whitman 1998; Boudreau 2000*a*; Boudreau 2000*b*).

III. APPROACHES USED AND FINDINGS RELATED TO THE OBJECTIVES AND TO PROBLEM OR NEED

OBJECTIVE 1A: Estimate moose numbers and population composition in Unit 19D East.

In October 2001 we conducted aerial surveys within the entire eastern portion of Unit 19D and within the Experimental Micro Management Area (EMMA), a smaller area nested within 19DE. No moose surveys were conducted in the study area during 2002 due to inadequate snow conditions. During November 2003 we conducted aerial surveys in the eastern portion of Unit 19D and the EMMA. Weather conditions during the 2003 survey were relatively poor, resulting in lower sampling intensity and lower precision of the population estimate. During November of 2004 we again conducted aerial surveys in the eastern portion of Unit 19D and in the EMMA.

OBJECTIVE 1B: Determine primary causes of mortality among moose calves.

From May 2001–2005 we annually captured and radiocollared 52–81 newborn moose calves in Unit 19D East; most were captured within or near the EMMA. During the 2001–2005 period, 12 moose calves were either abandoned or trampled by their dam shortly after capture; those mortalities were censored from calculations of natural mortality. Each year we monitored calves through their first year of life and investigated causes of mortality. Annual survival rates among monitored calves ranged from 26–52% among the 2001–2004 cohorts. Causes of mortality were categorized as predation by black and grizzly bears, predation by wolves, drowning and other nonpredation mortality.

OBJECTIVE 1C: Determine nutritional condition, seasonal movements, and mortality rates of yearling and adult moose.

In March and April 2001–2005 we captured 40 adult and 75 yearling moose within the study area. We fitted radiocollars to most of these moose and obtained a blood sample, a tooth (adults only), morphometric measurements, ultrasound measurements of rump fat (adults only in 2001 and 2002), and weight (yearlings only). Collared individuals were monitored to determine reproductive indices, movements, and mortality rates. There were 4 potential capture-related mortalities, 1 short yearling each in 2001, 2002, and 2005, and 1 adult in 2001. Survival of collared yearlings (excluding legal hunter take) from May 2001 to May 2005 ranged from 74–94%. Survival of collared adult females ranged from 86–100%. Wolf predation was the greatest component of both yearling and adult mortality during each year of this study.

OBJECTIVE 1D: Determine twinning rates and age at first reproduction of moose in Unit 19D East.

During May and June 2001–2005 we monitored both collared and noncollared adult female moose from fixed-wing aircraft to determine twinning and parturition rates. Twinning rates ranged from 24 to 59% among radiocollared and 36–50% among noncollared females. Parturition rates for all adult females ranged from 73 to 92% during the 5-year period. Parturition rates for 3-year-old females ranged from 56 to 100% during 2003–2005. Through this reporting period, we detected only one parturient radiocollared 2-year-old moose, which occurred in spring 2005.

OBJECTIVE 1E: Obtain data snow depth and density within the EMMA.

Annually we obtained records from the National Oceanic and Atmospheric Administration on snow depth and temperature at the McGrath airport.

OBJECTIVE 2: Characterize winter moose browse in Unit 19D East.

Browse surveys were conducted in March 2003 via helicopter and snowmobile throughout the EMMA. A total of 39 locations and 234 plants were sampled within the area. Browse biomass removal in the EMMA was 12% in randomly selected sites and 24% in known high-use wintering areas. These rates of removal are similar to values observed in other areas of moderate moose density. Birch, poplar, and willow species were all present in the survey area, although willow species tend to be the most preferred winter browse species in the EMMA, similar to most areas in Interior Alaska.

OBJECTIVE 3A: Estimate wolf numbers in Unit 19D East and identify wolf packs that hunt moose within the EMMA.

In a February 2001 survey, 103 wolves were estimated to be present in the Unit 19D East Moose Survey Area, and 19 wolves were taken from the area prior to the survey. Results of this survey indicate that 33 wolves in 5 “core packs” were largely resident within the EMMA. No other wolf surveys were conducted in Unit 19D East until March 2005, at which time we estimated a minimum of 53 to 65 wolves within Unit 19D East (not all of 19D East was surveyed), 9 of which were residing within the “EMMA wolf control zone”.

OBJECTIVE 3B: Determine reproductive rates and condition of wolves in Unit 19D and compare rates with other wolf populations in Alaska.

We purchased hunter- and trapper-killed wolf carcasses for necropsy between July 2001 and October 2004. Data collected from carcasses and reproductive tracts indicate wolves from Unit 19D have normal parameters of condition.

OBJECTIVE 4: Document the distribution of black bear and grizzly bear numbers within and adjacent to the EMMA and characterize bear predation on moose calves.

In a collaborative project with Pennsylvania State University, we captured 21 black bears during May and June 2002 within the study area (1 died from capture-related injuries). Preliminary analysis of data obtained by monitoring these bears indicates that most black bears use riparian areas within the central portion of the study area in spring and summer and then move to higher elevations in fall.

OBJECTIVE 5: Write annual progress reports and a final report, and publish results in peer-reviewed journals.

Federal Aid research performance reports covering 1 July 2001–30 June 2004 have been written and submitted to Federal Aid for this project, and they have been posted to the ADF&G Web site. Preliminary results "Causes and timing of moose calf mortality on the Kuskokwim River, Alaska" were presented at the Fifth International Moose Symposia, in Hafjell, Norway, in August 2002. Preliminary results "McGrath moose: a research and management update" were presented at the University of Alaska Fairbanks in April 2003, and "Preliminary results of removing bears to increase moose calf survival on the Kuskokwim River, Alaska" was presented at the Northwest Chapter of the Wildlife Society meeting in Girdwood, Alaska, in May 2004.

IV. MANAGEMENT IMPLICATIONS

Aerial surveys within the EMMA portion of our study area indicate moose are at moderate densities for Interior Alaska, approximately 1 moose/mi^2. Additional information collected on physical and reproductive condition of individual animals indicates EMMA moose are in relatively good physical and reproductive condition. Most indices of condition fall between those observed in high density and those observed in low density populations. Data collected on moose browse within the EMMA suggests the same regarding browse usage. This information suggests that the EMMA moose population is capable of withstanding some population growth without moose showing signs from severe nutritional limitation.

Mortality studies of adult, yearling, and calf moose within and near the EMMA indicated mortality of adult and yearling moose is relatively low. However, mortality rates of moose calves were relatively high, with predation by bears and wolves being significant factors during 2001 and 2002. Following an ADF&G management project that involved removing 134 bears from the EMMA study area, over-summer survival of moose calves increased, primarily as the result of decreased bear predation. This increased over-summer survival of moose calves translated into increased survival to 1 year of age for the 2003 and 2004 cohort of calves; however, the 2004 cohort experienced the high overwinter mortality, likely as a result of one of the deepest snow winters in the McGrath area in recent years. Thus, survival to 1 year of age for the 2004 cohort was only slightly higher than in years prior to bear removal. The extreme deep snow

winter of 2004–05 had no detectable effect on survival of collared adult or yearling moose in the EMMA.

V. SUMMARY OF WORK COMPLETED ON JOBS IDENTIFIED IN ANNUAL PLAN FOR LAST SEGMENT PERIOD ONLY

JOB 1A. Surveys of moose in study area.

During November 2004 we conducted aerial moose surveys within both the EMMA and the remainder of Unit 19DE. We estimated 634 moose in the 528 mi^2 EMMA and 2190 moose in the remainder of Unit 19D East (4676 mi^2). We used 5 fixed-wing aircraft to complete the surveys and provided fuel, lodging, and food for pilots and observers.

JOB 1B. Calf mortality study.

In May 2005 we captured and radiocollared 50 newborn moose calves in the EMMA. Eight additional calves died following capture as a result of abandonment or injury inflicted by their dams following and capture. These individuals were not used in calculations of natural mortality; however, it is possible that some of those deaths were not capture-related, even though it is necessary to classify them as possible capture mortalities. Calf survival through 11 August 2005 was 56% (28 of 50 lived). We attributed 12 deaths (55%) to black bears, 3 deaths (14%) to grizzly bears, 2 deaths (9%) to wolves, and 5 deaths (23%) to nonpredation causes. During this reporting period we purchased 50 moose calf collars and paid for helicopter time (R-44) to conduct captures and onsite mortality investigations. We also provided fuel, food, and lodging for pilots and biologists participating in the study.

JOB 1C. Radiocollaring and tracking moose.

Through this reporting period, monthly locations of study animals indicated that moose within the EMMA are relatively nonmigratory. We radiocollared 9 of 15 short-yearling moose captured in March 2005. One of these short-yearlings died shortly after captured and was considered a capture mortality. Survival of yearlings was 94% from May 2004 to May 2005. Survival of collared adult moose from May 2004 to May 2005 was 100%. Using helicopters and airplanes, we landed and investigated causes of mortality. Monitoring movements and mortality of yearling and adult moose required expenditures for aircraft fuel, aircraft charters, and food and lodging for pilots and biologists.

JOB 1D. Calving/twinning surveys in study area.

During May and June 2005 we conducted approximately 30 flights to determine parturition and twinning rates among both radiocollared and non-radiocollared cows. Eleven of 11 radiocollared 3-year-old moose were observed with calves, giving an observed parturition rate of 100% for that age class during spring 2005. Overall parturition rate for 2005 was 92% and twinning rate was 44. Also in June 2005, for the first time during this study we observed one 2-year-old moose with a singleton calf, although that birth was not used in our overall calculations of partition or twinning rate. Parturition and twinning surveys required expenditures for aircraft fuel, aircraft charters, and food and lodging for pilots and biologists.

JOB 1E. Snow data collection.

We obtained data on snow depth from the National Weather Service for this reporting period and have summarized that data. No federal aid funds were used for this job, beyond salary funding during time spent collecting and summarizing data.

JOB 2. Browse surveys and habitat mapping.

This job was not accomplished during the reporting period. No federal aid funds were used for browse surveys. Funds that were allocated for this job were used to help pay for the 2005 calf capture and monitoring project.

JOB 3A. Wolf population estimation.

During March 2005 we conducted a wolf survey within 19D East. We estimated a minimum of 53–65 wolves within the portion of Unit 19D East surveyed (not all of 19D East was surveyed), 9 of which were residing within the "EMMA wolf control zone." This wolf survey required Federal Aid funds to pay for expenditures for aircraft fuel, aircraft charters, and food and lodging for pilots and biologists.

JOB 3B. Wolf carcass collection and necropsy.

During winter 2004–2005, we purchased carcasses of wolves killed by hunters and trappers and conducted postmortem examinations to determine wolf body condition, age and reproductive performance. Results of those postmortem examinations have not been compiled.

JOB 4. DNA analysis of hair samples.

During summer 2004 and spring 2005 we collected hair samples of bears found at calf mortality sites. We did not have hair samples analyzed during this reporting period; thus, no federal aid funds were used for this job.

JOB 5. Literature review, data analysis, report writing.

The principal investigator reviewed additional literature on moose calf mortality, DNA analysis, and methods to evaluate browsing intensities by moose. The annual progress report for the period 2003–2004 was completed in August 2004.

VI. ADDITIONAL FEDERAL AID-FUNDED WORK NOT DESCRIBED ABOVE THAT WAS ACCOMPLISHED ON THIS PROJECT DURING THE LAST SEGMENT PERIOD, IF NOT REPORTED PREVIOUSLY

None.

VII. PUBLICATIONS

An ADF&G research final report is near completion. The summary of that report is in the appendix. The following publications were produced during the course of this project; however, none were produced during the last segment period.

Publications and Presentations:

KEECH M. A., T. A. BOUDREAU, AND P. VALKENBURG. 2002 (posted to the ADF&G website). Factors limiting moose at low density in Unit 19D East, and response of moose to wolf control and increased bear harvest. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration Research Performance Report. Grant W-27-5. Project 1.58. Juneau, Alaska.

KEECH M. A., AND T. A. BOUDREAU. 2003 (posted to the ADF&G website). Factors limiting moose at low density in Unit 19D East, and response of moose to wolf control and increased bear harvest. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration Research Performance Report. Grant W-27-5. Project 1.58. Juneau, Alaska.

KEECH M. A., AND T. A. BOUDREAU. 2004 (posted to the ADF&G website). Factors limiting moose at low density in Unit 19D East, and response of moose to wolf control and increased bear harvest. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration Research Performance Report. Grant W-33-2. Project 1.58. Juneau, Alaska.

KEECH M. A., T. A. BOUDREAU, AND P. VALKENBURG**.** 2002. Causes and timing of moose calf mortality on the Kuskokwim River, Alaska. Fifth international moose symposia, oral presentation, August 2002. Hafjell, Norway.

KEECH M. A. 2003. McGrath moose: a research and management update. University of Alaska Fairbanks, oral presentation, April 2003. Fairbanks, Alaska.

KEECH M. A. 2004. Preliminary results of removing bears to increase moose calf survival on the Kuskokwim River, Alaska. Northwest Chapter meeting of the Wildlife Society, oral presentation, May 2004. Girdwood, Alaska.

VIII. RESEARCH EVALUATION AND RECOMMENDATIONS

This was an excellent study regarding moose population dynamics in the upper Kuskokwim drainage. It allowed us to monitor moose dynamics through several different management actions, including both agency bear removal and public wolf control. However, in retrospect not enough emphasis was put into the active monitoring of the bear and wolf populations in the area (and those, of course, were the populations that were directly influenced by actions). Instead, we relied on monitoring changes in those populations indirectly by intensively monitoring the moose

population responses. The approach did work; however, had we more directly studied bear and wolf populations, through activities such as more population surveys of those species, we would have more data and have to make fewer inferences from indirect information.

Because it often takes several years to see population level changes in moose, bears, and wolves, and that is the desire of on going management activities in this area, I recommend that we continue to conduct similar research in this area for at least 2 more years—or until we see stabilization in both populations and management actions.

IX. PROJECT COSTS FROM LAST SEGMENT PERIOD ONLY

Stewardship Investment items purchased: *list any equipment or other items purchased for which the cost of the individual item was $5,000 or more (include cost)*
None

FEDERAL AID SHARE $144,000 STATE SHARE $48,000 = TOTAL $192,000

X. APPENDIX .

Factors limiting moose at low density in Unit 19D East; and response of moose to wolf control

Mark Keech, Alaska Department of Fish and Game, 1300 College Road, Fairbanks, AK 99701

Summary:

We monitored moose (*Alces alces gigas*) mortality, reproduction, nutritional status, movements, and population size and composition, as well as moose habitat, winter weather conditions, and predators of moose, during this study. Our work was conducted in Unit 19D East, and was focused most closely within the 528 mi^2 central portion of the unit known as the EMMA (or Experimental Micro Management Area). Demand for human harvest of moose is high within this region and in recent years the moose population has been unable to meet the needs of hunters. Because little quantitative information was available regarding moose population dynamics in Unit 19D East prior to the initiation of this project, our goal was to obtain information necessary for managers to make proper management decisions and to monitor the effectiveness of the resulting actions on the moose population. A summary of our most significant observations are:

- The EMMA moose population is at a moderate density, approximately 1 moose/mi^2; this is near the upper limit of the LDDE as defined by Gasaway et al. (1992). The remainder of Unit 19D East that we surveyed has a much lower moose density, approximately 0.5 moose/mi^2.

- EMMA moose are in relatively good physical and reproductive condition. Most indices of condition fall between those observed in high density and those observed in low density populations.

- Browse within the EMMA appears adequate; use of available browse is between that seen in high density and that seen in low density populations.

- Monthly locations of study animals indicated that moose within and near the EMMA are relatively nonmigratory, and no discernable large-scale movement pattern was evident. However, some moose that reside in the Pitka Flats (east of the EMMA) during calving season are apparently migratory, spending spring and summer in the Pitka Flats and then moving to the Farewell Burn/Alaska Range foothills in fall and winter.

- Wolves are the primary predators of adult and yearling moose within or near the EMMA, although the number of study animals they killed was not excessively high. Black bears (*Ursus americanus*) and to a lesser extent grizzly bears (*Ursus arctos*) are a significant predator of moose calves during the summer within and near the EMMA, and wolves (*Canis lupus*) are an important predator of moose calves throughout their first year of life.

- Annual survival of adult moose within and near the EMMA from 2001 to 2005 varied from 86% to 100%.

- Annual survival of yearling moose within and near the EMMA from 2001 to 2005 varied from 74% to 94%.

- Annual survival of moose calves within and near the EMMA from 2001 to 2005 varied from 27% to 52%. Highest annual survival rates for moose calves were experienced during the 2 years coinciding with department removal of bears from the area. The highest over-summer survival of calves occurred during the second year of bear removal suggesting that removal of bears may have been additive.

- Severe winter weather during the winter of 2004–05 resulted in large numbers of calves dying from nonpredation causes; however, that weather event did not appear to influence adult and yearling moose survival.

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