FEDERAL AID
RESEARCH FINAL PERFORMANCE REPORT

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

PROJECT TITLE: Population dynamics of moose in Alaska: effects of nutrition, predation, and harvest

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FEDERAL AID GRANT PROGRAM: Wildlife Restoration

GRANT AND SEGMENT NR: Initiated under W-27-5, completed under W-33-4

PROJECT NUMBER: 1.57

WORK LOCATION: Game Management Unit 20A

STATE: Alaska

PERIOD: 1 July 2000–30 June 2006

I. PROBLEM OR NEED THAT PROMPTED THIS RESEARCH

The GMU 20A moose population began a strong increase to high densities simultaneous to the Alaska Department of Fish and Game's (ADF&G) wolf control activities during 1976–1982 and has maintained a high density in the presence of 3 major predator species. However, most moose populations in Alaska are maintained at a low-density dynamic equilibrium largely by the combined predation of grizzly bears (*Ursus arctos*), black bears (*Ursus americanus*), and wolves (*Canis lupus*). Maintaining moose in Unit 20A above this common low-density dynamic equilibrium would be a significant wildlife management achievement.

To maintain moose at elevated densities, we need to know when and why population fluctuations are occurring. This knowledge will allow us to propose and evaluate management options for maintaining moose above predation-limited, low levels. This study focused on the effects of nutrition and predation on moose at a high density in Unit 20A.

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

Several prior moose studies in penned and wild populations provided data indicating that low twinning rates, delayed reproduction, and low short-yearling weights indicated poor nutritional status. More recent studies of browse removal rates indicated that browse removal rates were highest where twinning rates were low, reproduction was delayed, and short-yearling weights were low. Ongoing studies are collecting data to assess moose nutritional status near Lake Clark, Galena, Togiak, Unit 13, Unit 16, Unit 18, Unit 19, and on the Seward and Alaska Peninsulas.

Liberal antlerless harvests were recommended to halt growth of the moose population only in Unit 20A. In 2 adjacent study areas, moderate nutritional status was observed and conservative antlerless harvests were recommended to slow or prevent additional growth of the moose population. In other study areas in Interior Alaska, nutritional status ranked high or populations were not increasing, so antlerless harvests were deemed inappropriate.

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

OBJECTIVE 1: Review literature on moose biology, indices of nutritional status, ungulate population models, predator–prey relationships, and harvest data.

We continue to review available scientific literature using Internet searches.

OBJECTIVE 2: Estimate and evaluate the usefulness of several reproductive and condition indices for moose in Unit 20A and investigate the influence of weather on these parameters.

The indices that are contrasted among study areas include first age of reproduction, pregnancy rates, first age of twinning, twinning rates by age and population, proportion of calves in the immediate postcalving population, short-yearling weights, and proportions of browse removed over winter.

We concluded that density-dependent nutritional limitation is apparent today in Unit 20A and an expected result of maintaining moose at high density. We documented a maximum 10% decline in the expected proportion of calves in the immediate postcalving population. Although the population was increasing during this study, predation by wolves and bears limited moose population growth more than reduced productivity.

We observed low parturition rates for cows 4 years and older in 2001 (63% of 68 cows ≥4 years old gave birth). Cows had high parturition rates in 2002 (87.5% of 80 cows ≥4 years old gave birth). We believe the elevated productivity stressed the cows because in 2003 we observed the identical low parturition rate of 2001 (63% of 93 cows ≥4 years old gave birth). To test this hypothesis we predicted a high rate in 2004, a reduced rate in 2005, and a high rate in 2006, assuming no additional adverse summer weather. As predicted, we observed a high pregnancy rate in 2004 (89%), a low value in 2005 (66%), and a high value for 2006 (81%). Since 1996 we have observed a parturition rate of only 69% (n = 975) and a twinning rate of only 8% (n = 675) for radiocollared moose ≥3 years old. Strong age-specific indicators of nutritional stress also exist, including: 1) no 24-month-old moose (n = 38) were pregnant, 2) only 32% of 36-month-old moose gave birth, and 3) no marked moose less than 60 months old produced viable twins. We documented a minimum 20% decline in production with a 3.2-fold increase in density since 1978, but the increased moose population allows greater sustainable yields than would have been possible at the lower density.

We found no significant differences in newborn singleton or twin birth weights with regard to location or capture year in GMU 20A. As expected, newborn weights on the Tanana Flats are relatively low compared with those from the Yukon Flats, where moose density is 85% lower and the observed twinning rate (63%) indicates a high nutritional status during ovulation.

Mean maximum depth of rump fat was significantly greater among pregnant versus nonpregnant adult cow moose. Mean maximum depth of rump fat was also significantly greater for moose observed parturient versus those never observed with a calf and for dams giving birth to twins versus those with singletons. We also found that the fattest dams produced the heaviest calves and calved earlier than dams with low rump fat.

Weighing short yearling moose appears to be a particularly useful and relatively inexpensive tool for evaluating moose population condition. We noted substantial differences between weights in the adjacent Denali and Unit 20A populations. We concluded that adult rump fat depths are less sensitive indices of nutrient regime compared to short yearling weights and twinning rates.

OBJECTIVE 3: <u>Estimate causes and respective rates of mortality among radiocollared moose of various age classes in Unit 20A</u>.

Annual calf survival was 53% from May 1996 to May 2006 (n= 79 newborn calves and 292 short-yearlings). Predation was the major proximate cause of death. Wolves killed more calves than either bear species, but combined predation by both bear species exceeded calf predation by wolves. In addition to mortality detected using radiocollared calves, mortality prior to birth or neonatal mortality during the first 24 hours after birth apparently occurred in 7 (17%) of 42 pregnancies in 1996 and 3 (13%) of 23 pregnancies in 1997.

The annual composite yearling survival rate for females from mid May 1997 through early May 2006 was 83%.The 2-year-old through 5-year-old annual composite rates ranged from 97% to 100%. These rates averaged 92% for ages 6 through 10 years, and 80% for ages 11 to 16. No moose were known to live to 18 years. Female moose appear to be most vigorous and capable of avoiding predation from 2 through 5 years of age.

Wolf predation was the major cause of death among adult and yearling moose. In 47 cases where we were able to investigate natural causes of death among radiocollared moose older than 24 months, wolves killed 25 (53%), grizzly bears killed 8 (17%), and 14 (30%) died from factors other than predation or harvest. Of 47 yearlings (12 to 24 months old) that died, wolves killed 33 (70%), bears killed 9 (19%), and 5 (11%) died from factors other than predation or harvest.

Objective 4: <u>Write progress reports and publish a final report. Also, incorporate results into appropriate Alaska wildlife planning, discussions, and management activities</u>.

We wrote progress reports each year and reference several papers and a presentation in the appendix that resulted from this work. We have incorporated these data into discussions with area biologists, the Board of Game, local students, and wildlife professionals. Nine different area biologists contributed data on moose productivity to help rank nutritional status in 15 different moose populations in Alaska (see appendix). Management activities related to achieving nutrition-based population objectives have increased because of this work.

IV. MANAGEMENT IMPLICATIONS

We recommend several indices to evaluate relative moose nutritional status. We also recommend that certain signals to low nutritional status be used by managers to help decide when to implement antlerless moose harvests. Those recommendations were the subject of a manuscript submitted for publication (see appendix).

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

JOB 1: Continue literature review on (1) moose biology and ecology at high densities; (2) indices to nutritional status of ungulates; (3) models of ungulate population dynamics; (4) predator–prey ratios in relation to population dynamics of moose, caribou, sheep, wolves, and grizzly bears; (5) predator–prey relationships in multi-prey, multi-predator systems; and (6) population and harvest data on moose, caribou, sheep, wolves, and bears in Unit 20A.

We routinely reviewed old and new literature as necessary to remain current on relevant aspects of moose biology; approximately 10 person-days were spent on this job during this reporting period.

JOB 2: Estimate and evaluate the usefulness of several reproductive and condition indices for moose in Unit 20A and investigate the influence of weather on these parameters.

We radiocollared and weighed 23 male short-yearlings, 2 male yearlings, and 19 adult females during this reporting period; there was 1 capture-related mortality. We replaced radio collars and collected blood samples to obtain a pregnancy-specific-protein-B analysis. The pregnancy rate was 84%; we did not measure rump fat depths.

Approximately 30 fixed-wing radiotracking flights were flown between mid May and mid June 2006 to observe parturition and twinning rates of 91 radiocollared moose. Of the 91 cows ≥4 years old, 74 (81%) were observed with newborn calves during alternate-day flights. We observed a twinning rate of 9% among the 67 radiocollared cows ≥5 years old that gave birth. Twinning rates from an aerial transect survey totaled 11% (n = 55 cows with calves) on 23 May. The median calving date was 24 May, similar to previous years. Newborn calves were observed from 12 May to 1 June, although flights continued until 18 June.

JOB 3: Assess causes and rate of mortality among radiocollared moose of various age classes in Unit 20A.

To assess causes and rates of mortality of moose within the study area, all radiocollared moose (approximately 140 to 160 moose) were tracked at least monthly with fixed-wing aircraft during this reporting period. Flights were most frequent in the summer. In addition, a helicopter (R-22) was deployed to recover collars and investigate causes of death of 17 collared moose.

JOB 4: Write progress reports and publish a final report. Also, incorporate results into appropriate Alaska wildlife planning, discussions, and management activities.

Data collected from this project are being used in Unit 20A moose management reports, advisory committee meetings, Board of Game meetings, discussions with the public regarding harvest opportunities, and discussions with the Alaska Department of Natural Resources regarding the need to improve habitat in Unit 20A using burns. Papers and presentations completed during this reporting period are documented in the appendix.

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

No additional work was accomplished.

VII. PUBLICATIONS

We submitted papers to the *Journal of Wildlife Management*, to the journal *Alces*, and to the journal *Wildlife Biology in Practice*. The citations are listed below:

Boertje, R. D., K. A. Kellie, C. T. Seaton, M. A. Keech, D. D. Young, B. W. Dale, L. G. Adams, and A. R. Aderman. In review. Ranking Alaska moose nutrition: signals to begin liberal antlerless harvests. *Journal of Wildlife Management*: in review.

Regelin, W. L., P. Valkenburg, and R. D. Boertje. 2005. Management of large predators in Alaska. *Wildlife Biology in Practice* 1:77–85.

Young, D. D., R. D. Boertje, C. T. Seaton, and K. A. Kellie. 2006. Intensive management of moose at high density: impediments, achievements, and recommendations. *Alces* 42: in press.

We also submitted an abstract for the following invited oral presentation at The Wildlife Society meeting in Anchorage scheduled for September 2006.

Boertje, R. D., D. D. Young, C. T. Seaton, and C. L. Gardner. Twenty-plus years of population and habitat studies that support predator control to increase moose harvest in rural interior Alaska.

VIII. RESEARCH EVALUATION AND RECOMMENDATIONS

IX. PROJECT COSTS FROM LAST SEGMENT PERIOD ONLY

Total Costs

FEDERAL AID SHARE $106.7 STATE SHARE $35.6 = TOTAL $142.3

X. APPENDIX. The following was submitted to the *Journal of Wildlife Management.*

RANKING ALASKA MOOSE NUTRITION: SIGNALS TO BEGIN LIBERAL ANTLERLESS HARVESTS

Rodney D. Boertje, Kalin A. Kellie, C. Tom Seaton, Mark A. Keech, Donald D. Young, Bruce W. Dale[1]. Alaska Department of Fish and Game, 1300 College Road, Fairbanks, AK 99701-1599, USA

Layne G. Adams. U.S. Geological Survey – Alaska Science Center, 1011 E. Tudor Road, Anchorage, AK 99503, USA

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The following has been accepted by *Alces* for publication in 2006.

INTENSIVE MANAGEMENT OF MOOSE AT HIGH DENSITY: IMPEDIMENTS, ACHIEVEMENTS, AND RECOMMENDATIONS

Donald D. Young Jr., Rodney D. Boertje, C. Tom Seaton, and Kalin A. Kellie
Alaska Department of Fish and Game, 1300 College Road, Fairbanks, AK 99701-1599, USA

Abstract: In 1994 the Alaska Legislature passed legislation directing the Board of Game (Board) to identify big game prey populations where “intensive management” (IM) would be used to attain and sustain high levels of harvest. The IM law specifically provides for active management of predators and habitat, but fails to mention that antlerless hunts are key to achieving high levels of harvest. We discuss IM for moose in Game Management Unit (GMU) 20A through 2005, because GMU 20A has a unique history of predator management and currently supports the highest moose density for any equivalent-sized area in Alaska. Moose numbers in GMU 20A exceeded the IM population objectives beginning in 1999, but the IM harvest objectives were not met during 2002–2005. We identified the following impediments to achieving IM harvest objectives in GMU 20A: (1) negative public attitude toward antlerless moose hunts; (2) local citizen advisory committees have veto power over antlerless hunts; (3) bull:cow ratios are difficult to maintain when harvests are restricted largely to bulls; (4) access issues, including spatial and temporal distribution of the harvest; (5) social issues including local–nonlocal hunter conflicts, hunter–landowner conflicts, and illegal harvest; and (6) insufficient funding for research programs, management activities, and public education. Despite these impediments, liberal antlerless harvests were sufficient in 2004 and 2005 to halt moose population growth and attain high levels of harvest; annual harvests reached the highest levels recorded for GMU 20A. To facilitate the management of high-density moose for high levels of harvest, we recommend: (1) elimination of advisory committee veto power over antlerless hunts; (2) greater flexibility by the Alaska Department of Fish and Game (ADF&G) to implement and manage antlerless hunts; (3) close monitoring of hunting-related social issues; (4) ADF&G authorization to initiate prescribed burns; and (5) increased funding for management activities, research programs, and public education.

The following was accepted for oral presentation to The Wildlife Society in Anchorage in September 2006.

TWENTY-PLUS YEARS OF POPULATION AND HABITAT STUDIES THAT SUPPORT PREDATOR CONTROL TO INCREASE MOOSE HARVEST IN RURAL INTERIOR ALASKA

Boertje, Rodney D., Donald D. Young, C. Tom Seaton, and Craig L. Gardner.
Alaska Department of Fish and Game, 1300 College Road, Fairbanks, AK USA 99701

Abstract: Data show that moose in rural Interior Alaska live at relatively low densities because of high, largely additive predation from black and grizzly bears and wolves (and a lack of alternate large prey). Sustainable harvests of moose are limited to 4–15 moose/1000 km^2 despite habitat that is adequate to support higher moose densities (indicated by twinning rates, bodyweights, diet, and browse characteristics). In contrast, after wolves were strongly controlled (56–79% reduction, 1976–1982) in 13,044 km^2 near Fairbanks, moose: (1) increased 5-fold and continue to increase, (2) now live at >5-fold higher density and sustain >5-fold higher harvest density than respective rural Interior averages, (3) have supported >7% of the statewide reported moose harvest since 1995 in <1% of the state, and (4) support higher wolf densities than rural areas but with several times more moose per wolf. Habitat declined and is relatively poor in this 13,044 km^2 (lowest twinning rates, lowest bodyweights, highest browse removal rates and prevalence of brooming, and reduced diet quality), yet calf survival is the highest among 6 calf mortality studies in the Interior because predation is relatively low. In most rural systems, grizzly and/or black bears limited moose by killing large proportions of moose calves; calf survival increased significantly following translocation or diversionary feeding of bears. Wolves were significant secondary predators in most rural systems; case histories indicate that only prolonged wolf control elevated moose harvest. No data support the theory that, following significant predator control, sensitive nutritional feedback keeps moose density low. Rather, near Fairbanks, nutritional feedback began 10 years after the initiation of strong predator control (1976–1982), but has not yet halted population growth. Results of this wolf control program offer 2 current challenges: (1) garnering support for rejuvenating habitat, and (2) gathering support for and administering substantial harvests of moose cows and calves.

The following was published in *Wildlife Biology in Practice* in 2005.

MANAGEMENT OF LARGE PREDATORS IN ALASKA

W. L. Regelin, P. Valkenburg, and R. D. Boertje.
Alaska Department of Fish and Game, 1300 College Road, Fairbanks,Alaska.

Abstract: In contrast to most places in the world, Alaska continues to have an abundance of large predators. Populations of wolves (Canis lupus), brown bears (Ursus arctos), and black bears (Ursus americanus) are abundant, widely distributed, and highly productive. Their long-term future is secure due to an abundance of high quality, remote habitat and good wildlife management practices. Yet management of large predators, especially wolves, is highly controversial. Public attitudes toward wolf management are based on deeply held values, and conflicts between people with divergent values have fueled controversy for decades. Some people and organizations have no desire to understand and accept the values of others on this issue, which makes it difficult to establish lasting wildlife policies.

XI. PREPARED BY:

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