Alaska Department of Fish and Game
Division of Wildlife Conservation
2007

Age-specific natural mortality rates of male vs. female moose

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Research Annual Performance Report
1-July 2006-30 June 2007
Federal Aid in Wildlife Restoration
W-33-5
Project 1.65

This is a progress report on continuing research. Information may be refined at a later date

If using information from this report, please credit the author and the Alaska Department of Fish and Game. The reference may include the following: Boertje et al. 2007. Age-specific natural mortality rates of male vs. female. 1 July 2006 – 30 June 2007. Alaska Department of Fish and Game. Federal aid in wildlife restoration research annual performance report, grant W-33-5, project 1.65. Juneau, Alaska.

ALASKA DEPARTMENT OF FISH AND GAME
DIVISION OF WILDLIFE CONSERVATION
PO Box 115526
Juneau, AK 99811-5526

FEDERAL AID
ANNUAL RESEARCH PERFORMANCE REPORT

PROJECT TITLE: Age-specific natural mortality rates of male vs. female moose

PRINCIPAL INVESTIGATORS: Rodney D. Boertje; Donald D. Young, C. Tom Seaton, and Kalin A. Kellie

COOPERATORS: Layne G Adams (USGS); Brad Griffith and Michele M. Szepanski (University of Alaska Fairbanks)

FEDERAL AID GRANT PROGRAM: Wildlife Restoration

GRANT AND SEGMENT NR.: W-33-5

PROJECT NR.: 1.65

WORK LOCATION: Game Management Unit 20A

STATE: Alaska

PERIOD:1 July 2006 – 30 June 2007

I. PROGRESS ON PROJECT OBJECTIVES SINCE PROJECT INCEPTION

This was the first year of the study.

II. SUMMARY OF WORK COMPLETED ON JOBS IDENTIFIED IN ANNUAL PLAN THIS PERIOD

JOB/ACTIVITY 1: Review literature 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 and multi-predator systems; and (6) population and harvest data on moose, caribou, sheep, wolves, and bears in Unit 20A.

I routinely reviewed new abstracts using a weekly Thomson Internet bibliographic service (ISI Discovery Agent). Desired references were retrieved through ARLIS or the UAF library. I estimate that 20 person-days were spent on this job during this reporting period.

JOB/ACTIVITY 2: Estimate causes and age-specific rates of mortality among radiocollared male and female moose in Unit 20A.

We captured or recaptured 138 moose during this reporting period; 1 death occurred immediately after capture but the animal was extremely emaciated. To assess causes and rates of mortality of moose within the study area, all radiocollared moose (approximately 150 to 190 moose each month) were radiotracked at least monthly in winter and bi-monthly in summer with fixed-wing aircraft. In addition, we deployed a helicopter to recover collars and investigate causes of death. All data were entered into age-specific and sex-specific Kaplan-Meier Excel spreadsheets, as in previous years. Male and female moose aged 2 through 6 years of age continued to have minimal annual mortality rates (≤3%). Calves had the highest mortality rates followed by yearlings. Adequate sample sizes ($n > 25$) now exist through the 12-year-old cohort for females and into the 4-year-old cohort for males. The oldest radiocollared female was 17 years old and the oldest male was 8 years old. Based on a precalving population of about 12,500 moose, grizzly bears and black bears each kill about 800 moose annually in Unit 20A, similar to the number killed by hunters in recent years. In contrast, wolves kill about 1800 moose. Disease, malnutrition, and accidents account for about 500 deaths.

JOB/ACTIVITY 3A: Determine birth and twinning rates of known-age moose, particularly those older than 9 years old to complete data through the age of 14.

Blood samples indicated a pregnancy rate of 76% from 22 recaptured adult females that were mostly 5 years of age in March 2007. Aerial observations of 81 adult cows ≥5 years of age in May 2007 indicated a parturition rate of 72%. Twinning rate was 3% ($n = 60$) during late May transect surveys of all females (no telemetry), and 7% based on observations (48-hour intervals from mid May through mid June) of 58 parturient radioed females ≥5 years of age. Moose 4-, 5-, and ≥14-years-of-age had production rates of about 75 calves/100 females, slightly lower than moose aged 6 through 13 years of age. Sample sizes remain low (≤25) for moose 12 and 13 years old. These data continue to indicate that moose are nutritionally stressed relative to all other wild, non-insular moose populations in North America, but less stressed than the island moose populations on Newfoundland and several penned moose populations.

JOB/ACTIVITY 3B: Weigh male short-yearlings to determine if male weights are significantly different than previously-collected female weights.

We weighed 24 male short-yearlings that averaged 175 kg in early March 2007. This was the second highest average weight since weighing began in 1997, indicating a relatively easy winter. During this 11-year study, 106 males averaged 164 kg and 224 females averaged 165 kg.

JOB/ACTIVITY 4: Review literature, write annual reports, write final report, and publish results in peer-reviewed journals.

No activity during this period.

III. ADDITIONAL FEDERAL AID-FUNDED WORK NOT DESCRIBED ABOVE THAT WAS ACCOMPLISHED ON THIS PROJECT DURING THIS SEGMENT PERIOD

We developed a sightability correction factor for use in our Unit 20A population estimates based on whether radiocollared moose present in survey units were observed during early winter surveys.

IV. PUBLICATIONS

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. 2007. Ranking Alaska moose nutrition: Signals to begin liberal antlerless harvests. Journal of Wildlife Management 71:1494–1506.

V. RECOMMENDATIONS FOR THIS PROJECT

As recommended in 2003, we changed the emphasis from females to males when collaring short yearlings. This allowed us to investigate age-specific natural mortality rates of males, as we continue to investigate these rates for older females. No data exists on natural mortality rates of male moose older than calves, and area biologists have frequently requested this information to see if predation on 2- through 6-year-old males is very low, as documented for females in our previous work.

We used the large numbers of radioed moose in our study area to test the sightability of moose during 3 recent population estimates (early winter 2004–2006). This work should be funded in the future and expanded under a separate work plan. We recommended this in past years and expect a project to be funded beginning FY08 under the direction of Kalin Kellie.

VI. APPENDIX

Final submission of a paper for the July 2007 issue of the *Journal of Wildlife Management* occurred during this reporting period. The abstract follows:

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, LAYNE G. ADAMS, AND ANDREW R. ADERMAN

ABSTRACT: We focused on describing low nutritional status in an increasing moose (Alces alces gigas) population with reduced predation in Game Management Unit (GMU) 20A near Fairbanks, Alaska (USA). A skeptical public disallowed liberal antlerless harvests of this moose population until we provided convincing data on low nutritional status. We ranked nutritional status in 15 Alaska moose populations (in boreal forests and coastal tundra) based on multi-year twinning rates. Data on age-of-first-reproduction and parturition rates provided a ranking consistent with twinning rates in the 6 areas where comparative data were available. Also, short-yearling mass provided a ranking consistent with twinning rates in 5 of the 6 areas where data were available. Data from 5 areas implied an inverse relationship between twinning rate and browse removal rate. Only in GMU 20A did nutritional indices reach low levels where justification for halting population growth was apparent, which supports prior findings that nutrition is a minor factor limiting most Alaska moose populations compared to predation. With predator reductions, the GMU 20A moose population increased from 1976 until liberal antlerless harvests in 2004. During 1997 to 2005, GMU 20A moose exhibited the lowest nutritional status reported to date for wild, noninsular, North American populations, including 1) delayed reproduction until moose reached 36 months of age and the lowest parturition rate among 36-month-old moose (29%, n = 147); 2) the lowest average multi-year twinning rates from late-May aerial surveys ($\bar{x}$ = 7%, SE = 0.9%, n = 9 yr, range = 3%–10%) and delayed twinning until moose reached 60 months of age; 3) the lowest average mass of female short-yearlings in Alaska ($\bar{x}$ = 155 ± 1.6 [SE] kg in the Tanana Flats subpopulation, up to 58 kg below average masses found elsewhere); and 4) high removal (42%) of current annual browse biomass compared to 9% to 26% elsewhere in boreal forests. When average multi-year twinning rates in GMU 20A (sampled during 1960 to 2005) declined to <10% in the mid- to late 1990s, we began encouraging liberal antlerless harvests, but only conservative annual harvests of 61 to 76 antlerless moose were achieved during 1996 to 2001. Using data in the context of our broader ranking system, we convinced skeptical citizen advisory committees to allow liberal antlerless harvests of 600 to 690 moose in 2004 and 2005 with the objective of halting population growth of the 16,000 to 17,000 moose; total harvests were 7% to 8% of total pre-hunt numbers. The resulting liberal antlerless harvests served to protect the moose population's health and habitat and to fulfill a mandate for elevated yield. Liberal antlerless harvests appear justified to halt population growth when multi-year twinning rates average ≤10% and at least one of the following signals substantiate low nutritional status: <50% of 36-month-old moose are parturient, average multi-year short-yearling mass is <175 kg, or >35% of annual browse biomass is removed by moose.

Journal of Wildlife Management 71:1494–1506, 2007

We were invited to present an oral presentation at the annual national meeting of *The Wildlife Society* in Anchorage in September 2006. The following abstract encompasses the basis of the presentation.

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 99701-1599

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 offer 2 current challenges: (1) garnering support for rejuvenating habitat, and (2) gathering support for and administering substantial harvests of moose cows and calves.

We also submitted the following abstract to *Alces* in May 2007.

RECOVERY OF LOW BULL:COW RATIOS OF MOOSE IN INTERIOR ALASKA

DONALD D. YOUNG JR. AND RODNEY D. BOERTJE

ABSTRACT: During 1996–1999, high harvest rates (28–30%) of bull moose (*Alces alces*) in Game Management Unit 20A (17,000 km^2) resulted in posthunt bull:cow ratios declining below the management objective of 30:100 to 24:100. During 2000 and 2001 we shortened the hunting season from 25 to 20 days to reduce the harvest of bull moose to sustainable levels, but harvest rates of bulls remained high (22–26%) and ratios remained unacceptably low (22–26 bulls:100 cows). Unitwide antler restrictions (bulls with spike-fork antlers or antlers ≥50 inches wide or with ≥3 brow tines) were implemented in 2002 to further restrict the harvest of bull moose to recover bull:cow ratios and improve age structure of bulls. Results were that mean bull harvest declined 37% (669 in 2000 and 2001 to 423 in 2002 and 2003), mean harvest rates of bulls declined from 24% to 12% of the prehunt bull population, mean number of hunters declined 24% (1,568 to 1,187) and mean hunter success rates declined from 34% to 29%. Bull:cow ratios steadily increased after antler restrictions were imposed from 26:100 in 2001 to 38:100 in 2005. Other factors that likely contributed to the rapid recovery of bull:cow ratios included annual population growth of 5–6% and liberal antlerless harvest (3–4% of the prehunt moose population annually) in 2004 and 2005. Antler restrictions allowed bull seasons to be lengthened from 20 to 25 days beginning in 2004, which provided additional hunting opportunity. A limited number of drawing permits for any bull were also offered in 2006 and 2007 to increase harvest in this intensive management area where there was clear evidence of density-dependent nutritional limitation.

ALCES VOL. 00: 00–00(0000)

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