FEDERAL AID FINAL RESEARCH PERFORMANCE REPORT

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

PROJECT TITLE: Analysis and summary of data from the Fortymile caribou range

PRINCIPAL INVESTIGATOR: Scott M. Brainerd

COOPERATORS: Rodney D. Boertje (retired 2012, Alaska Department of Fish and Game). Jim Herriges (Bureau of Land Management), John Burch (U.S. National Park Service), Layne Adams (U.S. Geological Survey)

FEDERAL AID GRANT PROGRAM: Wildlife Restoration

GRANT AND SEGMENT NO.: AKW-20

PROJECT NO.: 3.50

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STATE: Alaska

PERIOD: 1 July 2008–30 June 2017

I. PROBLEM OR NEED THAT PROMPTED THIS RESEARCH

In the early 1990's, there was an absence of collaborative management plans for the international Fortymile herd. Also, Fortymile caribou (*Rangifer tarandus*) numbers were stalled at low numbers (ca. 22,000 caribou, 1990–1995) relative to much higher numbers in the 1960s (ca. 50,000). Given relatively low numbers, movements were restricted. Also, 3 agencies were independently overseeing harvests from the herd. Thus, stakeholders were critical of management.

This criticism led to a unique and diverse cooperative management planning effort with international, inter-agency, and public involvement (Boertje and Gardner 1996, 2000*a*, *b*; Gronquist et al. 2005). The resulting management plan directed that research continue on the Fortymile caribou herd beyond the 5-year study plan that was due to terminate in 1997 (Boertje and Gardner 1996, 1998). Research during 1992–2008 was focused on monitoring herd numbers, nutritional indices, reproduction, mortality, causes of mortality, and movements. One specific objective was to evaluate the potential effects of a restricted, nonlethal wolf (*Canis lupus*) control program using data collected prior to wolf control (May 1994– April 1998) and during the period of reduced wolf numbers (May 1998–May 2004).

Research was conducted as planned during 1992–2008, yet the principal investigator did not publish results after 1997 in a timely manner because of simultaneous commitments to federal aid projects on moose, which had similar obligations for peer-reviewed

publications (Boertje et al. 2007, 2009, 2010). Thus, this writing project (3.50) was funded during 2008–2017 to allow the principal investigator to compile, analyze, summarize, and publish summary data pertinent to 3 prior 5-year projects on Fortymile caribou and wolves, as well as data through 2014. The 3 prior 5-year projects were as follows: 1) Project 3.38, Factors Limiting the Fortymile Caribou Herd, 1992–1997 (Boertje and Gardner 1998); 2) Project 3.43, Reducing Mortality of the Fortymile Caribou Herd, 1997–2003 (Boertje and Gardner 2003); and 3) Project 3.48, Monitoring Fortymile Ungulates and Wolves Following Wolf Sterilization and Translocation, 2003–2008 (Boertje et al. 2008).

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

Prior to the initiation of this writing project (3.50) in 2008, research published in peer-reviewed journals by the principal investigator on the 3 former 5-year projects was limited to:

Boertje, R. D., and C. L. Gardner. 2000. The Fortymile caribou herd: novel proposed management and relevant biology, 1992–1997. Rangifer, Special Issue 12:17–37.

This publication covered topics of interest immediately prior to the nonlethal wolf control project. The data analysis needed to evaluate the effectiveness of the nonlethal wolf control program remained incomplete until 2016, when we completed a peer-reviewed research article for this project 3.50 (Boertje et al. 2017). However, 3 authors, in advocating for nonlethal wolf control and cooperative management planning, prematurely assumed that our nonlethal program contributed to the coincidental recovery of the Fortymile herd (Hayes et al. 2003, Gronquist et al. 2005, Farnell 2009, Hayes 2010). These authors did not consult with the principal investigator on the effectiveness or ineffectiveness of nonlethal wolf control.

Other prior research on the Fortymile herd was published in a case history of the Fortymile herd, 1920–1990 (Valkenburg et al. 1994). Summaries of the Fortymile data were also published in reference to other herds to better understand the variability in herd ecology in Alaska and the development of monitoring techniques and management theory (Davis and Valkenburg 1991, Valkenburg 1998, Valkenburg et al. 1985, 1996, 2016; Valkenburg and Davis 1986, 1989).

Continuing study of the Fortymile caribou herd includes Project 3.53; Nutritional Status, Range Use, and Demographics of the Fortymile and Central Arctic Caribou Herds. The duration of Project 3.53 is expected to be 1 July 2014–30 June 2019. Two annual progress reports are available on Project 3.53 to date (Bentsen 2015, 2016). Project 3.53 is evaluating, in part, the relative effectiveness of an increasingly intensive lethal wolf control project on Fortymile caribou survival.

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

Objective 1: Conduct literature review and review existing data on (1) caribou biology and ecology; (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 continued literature reviews as needed using web-based search engines through ARLIS. Also, Dr. Layne Adams provided literature to the principal investigator in a timely manner when requested.

Objective 2: Determine response among wolves and ungulates to experimental wolf sterilization and translocation.

Nonlethal wolf control efforts during 4 winters, 1997–1998 through 2000–2001, included sterilizing 2 dominant wolves in each of 15 packs and translocating 129 subordinate wolves from these 15 pack territories. In retrospect, nonlethal efforts were too localized to decrease total wolf numbers, e.g., adjacent untreated wolf packs reached maximum mean numbers. Subsequent lethal wolf control efforts (2005–2013) had only seasonal and localized effects on wolf numbers. During nonlethal and lethal control, we detected little or no decline in autumn wolf numbers over the Fortymile herd's annual ranges compared with precontrol autumn numbers. We concluded that too few wolves were affected by nonlethal and lethal control over the herd's summer and annual ranges to elicit a measurable response in Fortymile herd numbers (Boertje et al. 2017). Also, we detected no significant increases in numbers of moose (*Alces alces*) or Dall sheep (*Ovis dalli*) during nonlethal wolf control (Boertje et al. 2008).

Using radiocollared newborn and older caribou, we documented that wolves were the primary predator both before and during nonlethal wolf control (Boertje et al. 2017). We detected no convincing support for decreased wolf predation during nonlethal control. We also detected no support for increased caribou survival during nonlethal or lethal wolf control, but during lethal wolf control we only monitored herd trend and October calf:cow ratios.

We verified that nonlethal wolf control using fertility control and translocation can reduce local wolf numbers substantially, and that the effects of such a control program on individual packs can endure for ≥3 years following cessation of wolf sterilization and translocation (Boertje et al. 2017). We inferred that a nonlethal wolf control program restricted to affecting 15 wolf packs would be more suited to annual caribou ranges of ≤20,000 km^2, whereas the Fortymile caribou annual range encompassed about 50,000 km^2 (Boertje et al. 2012).

Objective 3: Evaluate the feasibility of determining trend of the Fortymile caribou herd using conventional indices.

Based on photocensus results, the herd's rate of increase was negligible during 1990–1995 (λ_r = 1.00), highest during the 3 years immediately before nonlethal wolf control (λ_r

= 1.11, 1995–1998), moderate during nonlethal wolf control (λ_r = 1.07, 1998–2003), and low during lethal wolf control (λ_r = 1.02, 2003–2010). In comparison, the female-only model indicated growth rates of 1.05 during the 3 years prior to wolf control (1995–1998) and 1.02 during nonlethal wolf control (1998–2003). Apparently, we underestimated reproductive and/or survival rates with the current modeling, so total count photocensuses remain the optimum method for evaluating herd trend (Boertje et al. 2017).

Objective 4: Evaluate managing for elevated yield of the Fortymile caribou herd and related herd demography.

Using a 5-year weighted mean of 3-year-old caribou parturition rates, we proposed a cautionary signal for managers to begin to stabilize a herd using elevated yield to prevent range depletion and eventual herd decline from density-related factors (Boertje et al. 2012, 2017).

Objective 5: Determine the seasonal ranges of the Fortymile caribou herd, 1992–2008.

We chose to depict seasonal herd range maps in the Alaska Department of Fish and Game Wildlife Technical Bulletin 14 (Boertje et al. 2012). We found no peer-reviewed journals that would print these series of maps, because the mapping was largely valued only by a local audience. As such, we published the maps in the Department's numbered series of technical papers after internal and external review. The Department's numbered series of technical bulletins constitutes publication of results, per the instructions for authors of peer-reviewed journals.

Objective 6: Publish papers on 2–5.

We completed 2 lengthy publications. First, we completed Wildlife Technical Bulletin 14 that included data on Fortymile caribou herd numbers, birth rates, calf weights, calf:cow ratios, movements, ranges, and densities (Boertje et al. 2012). This publication included data through 2012, as well as data from the 3 prior 5-year research projects on the Fortymile herd (1992–2008). We also summarized historical Fortymile caribou data and comparative data from other Alaska caribou herds. Our primary contribution was in providing a nutrition-related cautionary signal to inform managers as to when the increasing Fortymile herd should be stabilized through increased harvest. The rationale was to avoid an unsustainable high caribou density.

Second, we completed a research article with data through 2014 (Boertje et al. 2017). In this peer-reviewed publication, we more thoroughly discussed factors and considerations relevant to describing a sustainable herd size. We documented herd parturition rates (1990–2014), calf mortality (1994–2003), adult mortality (1991–2008), and herd size and composition (1990–2013). We also discussed the results from nonlethal and lethal wolf control programs (1998–2013). We studied herd demography most comprehensively during 9 years (1994–2003) to develop annual models investigating roles of parturition rates and various causes of mortality on herd numbers. Specific objectives related to wolf control included estimating changes in wolf numbers within treatment areas and on the respective annual caribou ranges, evaluating whether wolf control had detectable effects on caribou survival, recruitment, and numbers, and summarizing circumstantial support for and against the effect of wolf control on the caribou herd.

IV. MANAGEMENT IMPLICATIONS

As of this writing, wolf control has intensified on the Fortymile herd to increase herd numbers and sustainable yields. Yet the Fortymile herd is at a relatively high density for Interior Alaska. Where a high-density, increasing caribou herd is intensively managed via predator control for elevated sustained yield and is accessible to adequate numbers of hunters, stakeholders and policymakers need to be prepared to substantially increase harvest to curtail herd growth as the herd approaches K-carrying capacity. The importance of linking increasing herbivore numbers with declining herbivore nutritional status should not be underestimated. For this purpose, we recommend continued monitoring of trends in the reproductive rates of young female caribou, October calf weights, and birthweights (inversely related to mortality rates). These data will be essential if managers are to convince skeptical stakeholders and policymakers that increased harvest is timely and prudent. When ungulates overshoot K-carrying capacity, the effects of high density, adverse weather, and increased predation can have synergistic negative effects on prey numbers and long-lasting negative effects on sustainable yields, contrary to the intended purpose of wolf control programs. Maximum sustained yield (in absolute numbers of caribou harvested) may well be attained when caribou first exhibit a sustained period of nutritional limitation during favorable weather.

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

During the last reporting period, the principal investigator completed editorial tasks on Boertje et al. (2017), and wrote this final report. The principal investigator reviewed the most current pertinent literature and included citations and discussion as deemed appropriate.

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

None.

VII. PUBLICATIONS

Boertje, R. D., C. L. Gardner, K. A. Kellie, and B. D. Taras. 2012. Fortymile caribou herd: increasing numbers, declining nutrition, and expanding range. Alaska Department of Fish and Game, Wildlife Technical Bulletin 14, ADF&G/DWC/WTB-2012-14, Juneau, Alaska, USA.

Boertje, R. D., C. L. Gardner, M. M. Ellis, T. W. Bentzen, and J. A. Gross. 2017. Demography of an increasing caribou herd with restricted wolf control. Journal of Wildlife Management 81:429–448.

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Valkenburg, P., B. W. Dale, J. L. Davis, M. M. Ellis, R. D. Boertje, M. A. Keech, D. D. Young Jr., R. M. Eagan, R. W. Tobey, C. L. Gardner, R. A. Sellers, L. G. Butler, J. D. Woolington, B. D. Scotton, T. H. Spraker, M. E. McNay, A. R. Aderman, and M. J. Warren. 2016. Monitoring caribou herds in Alaska, 1970–2008, with focus on the Delta caribou herd, 1979–2007. Alaska Department of Fish and Game, Wildlife Technical Bulletin 16 ADF&G/DWC/WTB-2016-16, Juneau, Alaska.

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VIII. RESEARCH EVALUATION AND RECOMMENDATIONS

We deem objectives in the continuing research project 3.53 (Bentzen 2016) appropriate to evaluate trends in density-dependent indices. Trends in these indices need to be addressed as stakeholders and policymakers develop future plans for Fortymile herd size and harvest. We recommend researchers and managers focus on 1) evaluating sustainable herd size by continued studies of caribou nutritional status, e.g., monitoring trends in young female parturition rates and calf weights; and 2) preparing stakeholders and policymakers to consider increasing caribou harvest to ultimately maintain or improve caribou nutritional status and decrease the chance of population declines attributed at least partly to high density and range depletion.

PREPARED BY: Rodney D. Boertje (retired 2012) for Scott M. Brainerd

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