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Investigation of Regulating and Limiting Factors in the Delta Caribou Herd

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Research Final Performance Report
1 July 1996–30 June 2002
Federal Aid in Wildlife Restoration
W-24-5 and W-27-1 to 5
Project 3.42

FEDERAL AID
FINAL RESEARCH REPORT

ALASKA DEPARTMENT OF FISH AND GAME
DIVISION OF WILDLIFE CONSERVATION
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PROJECT TITLE: Investigation of regulating and limiting factors in the Delta Caribou Herd

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I PROBLEM OR NEED THAT PROMPTED THIS RESEARCH

There is a great demand for caribou hunting in the relatively accessible areas of Interior Alaska, but managers are unsure how to maximize long-term sustainable harvest from caribou herds. This doubt exists because natural regulation of caribou numbers is not well understood. Although progress has been made in recent years in understanding the mechanisms involved in caribou declines, the role of density-dependent nutrition, summer versus winter nutrition, and interactions with weather and predation are not clear. Natural systems are complex, and different factors may limit caribou population growth at low and high density. Managers need guidelines on approximate herd densities at which maximum harvests can be achieved.

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

A continuing long-term population dynamics study of the Delta caribou herd (*Rangifer tarandus*) herd (DCH) began in 1979. Results of the first 17 years of research were presented in 8 progress reports, 3 final reports, each covering 5 years, (Davis and Valkenburg 1985; Davis et al. 1991; Valkenburg 1997), and numerous scientific papers (c.f. Boertje et al. 1996; Valkenburg et al. 1996). Predator–prey relationships and harvest of moose (*Alces alces*), caribou, sheep (*Ovis dalli*), grizzly bears (*Ursus arctos*), and wolves

(*Canis lupus*) within the range of the DCH were reviewed by Gasaway et al. (1983) and Boertje et al. (1996).

Since 1979 the DCH has gone through 5 growth phases. Herd size rapidly grew after wolf control from 1979–1982 (r = 0.18), with high recruitment and low mortality from hunting and natural causes. The herd then grew slowly (r = 0.05) from 1982–1985, with moderate to high recruitment, low to moderate natural mortality, and high hunting mortality. The herd also grew slowly (r = 0.07) from 1986–1988, with moderate recruitment, moderate to high natural mortality, and low hunting mortality. Then the herd rapidly declined (r = -0.20) from 1989–1993, with low recruitment, high natural mortality, and low hunting mortality. The fifth phase from 1994 to 2000 has been one of relative stability or slow decline with low recruitment, moderate adult mortality, and insignificant hunting mortality.

In June 1993 the Alaska Board of Game approved a 3-year ground-based wolf predation control program for a portion of Unit 20A. One of the objectives of the program, which began in October 1993, was "to reverse the decline of the DCH and increase the midsummer population to 6000–8000 caribou, with a sustainable annual harvest of 300–500 caribou." To better evaluate the effectiveness of intensive management (i.e., control of wolf numbers) of the DCH, we extended the project with state funds to include 3 annual calf mortality studies from 1995 to 1997.

Population decline in the DCH was reversed in 1994, coincident with the wolf control program, and the herd increased somewhat to over 4000. However, after wolf control ended in December 1995, the herd once again began slowly declining. Since 1997 work in the DCH has been concentrated on monitoring body condition to determine if lowered population size will eventually result in improved condition and long-term weight gain, and also to determine if the population objective (6000–8000) is realistic.

Since the mid-1990s, with the cooperation of other agencies, the study of limiting and regulating factors in caribou has been extended to other herds where pressing research and management questions have resulted in greater availability of funding, and the study has become statewide in scope. This new approach was possible because of the active interest taken by cooperating area biologists and cooperating federal agencies in establishing a coordinated caribou research and management program. Besides the DCH, the Nelchina, Northern Alaska Peninsula, Southern Alaska Peninsula, Mulchatna, Kenai Mountains, Killey River, White Mountains, Ray Mountains, and Nushagak herds have yielded valuable information in the study of limiting and regulating factors and determination of optimum herd sizes. In 1999 Bruce Dale filled a new caribou research biologist position in the Palmer office. Future reports containing more detailed data on the Nelchina Herd will be forthcoming under his separate research project. For simplicity, and to make it easier for readers to access information on Alaskan caribou research, we have compiled and reported on much of the information that was collected with funding other than that for Federal Aid (Pittman–Robertson) projects. These other funds have included state funds and funds from cooperating federal agencies (Bureau of Land Management, US Fish and Wildlife Service, and National Park Service). For a complete review of caribou research done in Alaska in the late 1990s and early 2000s, readers should also refer to the biennial survey-inventory

management reports written by ADF&G area biologists, research progress reports (Boertje and Gardner 1999, 2000, 2001), special reports (e.g., Sellers et al. 1998a,b, 2000), reports from the Biological Resources Division of the US Geological Survey, and papers published in *Rangifer* from the North American caribou workshops and arctic ungulate conferences.

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

OBJECTIVE 1: Evaluate the influence of weather, density, food limitation, hunting, and predation on the population dynamics of the DCH.

Density-dependent feedback mechanisms may influence the upper bounds of caribou herd sizes in many cases, but in the absence of hunting, the sizes of Interior Alaskan caribou herds can be expected to fluctuate with unpredictable amplitudes and periods or remain relative stable. Few, if any, of the proposed theoretical models of population growth and regulation have been supported by empirical data from the Interior caribou herds, and these theoretical models appear to have little relevance in caribou management. We suggest that if the term "carrying capacity" is used in relation to caribou, it should be defined as discussed by Leopold (1948). That is, the maximum number of animals that can be indefinitely maintained in a given area (i.e., herd) in a reasonably healthy condition. We suggest that this approach will be the most useful concept for management and will approximate an optimum population size that will provide the greatest harvest over long periods of time. With historical data on population size and annually or periodically collected data on population parameters and body condition, managers will be able to make reasonable estimates of "carrying capacity" in the few caribou herds where we have the ability to control the upper limits of herd size through harvest.

In the caribou herds of Interior Alaska, predation and weather are the primary factors that influence population size and the numbers of caribou that can be harvested. In many herds, in the absence of heavy hunting of females, the size of a particular herd at a given time is likely to be a function of the number of caribou remaining in the herd at the end of the previous decline and the number of favorable years of weather in the interim. However, in many herds, predation is such an overwhelming influence that herd growth rarely occurs, and in some herds, the population may remain on the verge of extinction for years.

OTHER FINDINGS AND CONCLUSIONS FROM THE STUDY

1 Natality in caribou herds is variable and is determined by caribou density on summer range, and weather.

2 Caribou herds can be considered populations or metapopulations, and dispersal had no significant influence on caribou herd sizes in Interior Alaska during 1970–2002. In addition, there appears to be no credible evidence that the interchange of groups of caribou between herds has ever occurred in Alaska. However, in two cases, one involving the Delta and Yanert herds in the late 1980s, and another involving the Mulchatna and Kilbuck herds more recently, a large caribou herd has overwhelmed and assimilated a small herd by repeated mixing on all seasonal ranges.

3 Nutrition can explain the entire range of body size of caribou in Interior Alaska. However, caribou in Southwest Alaska appear to be inherently smaller than Interior

caribou, and for unknown reasons, caribou from the Western Arctic Herd are much smaller than any of the other caribou in Alaska.

4 Live body weight of female calves is likely to be the most useful index to condition in Alaskan caribou. Other potentially useful indices are difficult to employ because of logistical and/or sampling problems.

5 Diversionary feeding of wolves near caribou calving areas could be a successful method of reducing predation in some circumstances, but it has significant limitations, primarily because wolves will continue to hunt even when they are not hungry.

6 The wolf control program during 1993–1994 contributed to reversing the decline of the DCH, but it did not result in a dramatic increase in recruitment of caribou calves or a dramatic population increase. The program was of limited success because it was terminated prematurely, and it was not conducted on the main caribou calving area.

IV MANAGEMENT IMPLICATIONS

The main thrust of this research project was to determine which factors are most important in driving caribou population fluctuations, particularly in the small to moderately sized herds that occur in Alaska's Interior. Our working hypothesis during the latter part of the study was that population fluctuations are primarily caused by the interaction of population density (i.e., intraspecific competition for food), weather, and predation. Data collected over the last 20 years are consistent with this hypothesis and indicate that both winter and summer food shortages influence caribou nutrition, body condition, and population dynamics. Winter food limitation appears to be most limiting in the Delta Herd, but summer nutrition appears to be most limiting in the Nelchina Herd. Variation in summer nutrition due to weather also seems to occur regardless of population size and density. When poor summer weather occurs where herds are also experiencing suboptimal nutrition due to high population size, natality can be significantly reduced (e.g., Delta Herd in 1993 and Nelchina Herd in 1999 and 2000). In most of the Interior herds, however, natality seldom influences population growth. In the smaller Interior herds (i.e., those less than about 20,000), the primary factors that influence caribou dynamics are predation and weather.

During the course of this study, it has not been difficult to document the occurrence of density-dependent effects on body size and natality, but documenting population regulation is another matter. However, it is reasonable to believe that the effects of high population density would eventually contribute in some way to cause a population to decline. Thus, is appears that the amplitude and period of population fluctuations in Interior caribou herds, although constrained within certain upper limits by habitat, are likely to be rather unpredictable, and herd trajectories would be unlikely to follow any of the proposed theoretical models of population regulation.

As a practical matter, for managers of the DCH whose goal it is to regulate population size to provide for optimum and somewhat predictable harvests, it is probably more useful to estimate the optimum population size for management rather than trying to estimate "carrying capacity" in any theoretical sense. If the term "carrying capacity" is used in

relation to Interior caribou, we recommend a return to the original definition discussed by Leopold (1948). That is, the maximum number of animals that can be indefinitely maintained in a given area (i.e., herd) in a reasonably healthy condition. We suggest that this approach will be the most useful concept for management and will approximate an optimum population size that will provide the greatest harvest over long periods of time. With historical data on population size and annually or periodically collected data on population parameters and body condition, managers will be able to make reasonable estimates of "carrying capacity" in the few important caribou herds where we have the ability to control the upper limits of herd size through harvest.

Even though it is currently difficult for wildlife biologists in ADF&G or the Alaska Board of Game to manage predation, the DCH may eventually increase to the point where harvest could be used to limit population growth. It would therefore be useful to have a target population in mind. At the present time and population size, besides predation, the DCH appears more strongly influenced by a shortage of high quality winter range than by summer range. Based on the past history of population fluctuations, and the tendency of the herd to explore for new seasonal ranges at population sizes above 4000, we recommend maintaining the herd at about 3500. With good recruitment and survival, even a herd of this relatively small size could provide an annual sustainable harvest of about 300–400 caribou.

V SUMMARY OF WORK COMPLETED ON JOBS IDENTIFIED IN ANNUAL PLAN FOR LAST SEGMENT PERIOD ONLY (if not reported in previous performance report)

JOB 1: Preparing final report and publications

We completed the final report and worked on 3 publications.

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

SELLERS RA, P VALKENBURG, R SQUIBB, BW DALE, AND R ZARNKE. 2002. Natality and early calf mortality in the Northern Alaska Peninsula and Southern Alaska Peninsula caribou herds. *Rangifer* Special Issue (in press).

VALKENBURG P. 2002. Stumbling towards enlightenment: understanding caribou dynamics. *Alces* 37(2):457–474.

———, RW TOBEY, BW DALE, BD SCOTTON, AND JM VER HOEF. 2002a. Body weight of female calves and natality rate of adults as indicators of summer and winter limitation in two Alaskan caribou herds. *Rangifer* (in press).

———, RA SELLERS, RC SQUIBB, JD WOOLINGTON, AR ADERMAN, AND BW DALE. 2002b. Population dynamics of caribou herds in southwestern Alaska. *Rangifer* (in press).

VIII RESEARCH EVALUATION AND RECOMMENDATIONS

The approach to this study was successful. We designed and implemented a coordinated statewide program for evaluating condition in caribou by sampling female calves annually or periodically. The research program initiated by Bruce Dale and Bill Collins (Studies 3.44 and 3.47) have built on our approach and expanded work on foraging ecology on the Nelchina Caribou Herd. This work includes monitoring and measuring individual caribou at 4-, 10-, and 16-months of age to determine if the patterns we found in 4- and 10-month-old calves persist.

IX PROJECT COSTS FROM LAST SEGMENT PERIOD ONLY

FEDERAL AID SHARE = $11.3 + STATE SHARE $3.8 = TOTAL $15.0

X APPENDIX

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