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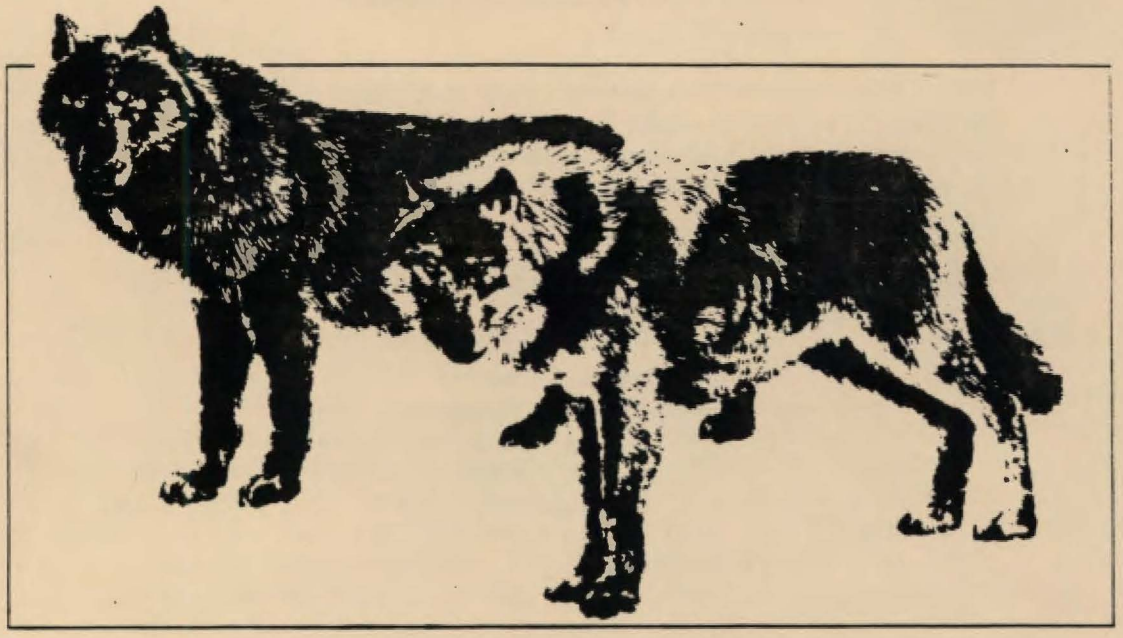
Research Progress Report

TESTING SOCIALLY ACCEPTABLE METHODS OF MANAGING PREDATORS: REDUCING WOLF PREDATION ON MOOSE THROUGH INCREASED CARIBOU ABUNDANCE



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Project W-23-3
Study 1.41
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PROGRESS REPORT (RESEARCH)

State: Alaska

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Period Covered: 1 July 1989-30 June 1990

SUMMARY

The objectives of this study are to determine if increased numbers of alternate prey (i.e., caribou [Rangifer tarandus]) will reduce wolf (Canis lupus) predation on moose (Alces alces) during the winter and thereby facilitate an increase in the moose population (i.e., above the low-density equilibria). Long-term comparisons of the amounts of radiocesium (Cs-137) in the muscle tissues of wolves, caribou, and moose will provide an estimate of the number of caribou consumed by wolves during winters having high and low caribou densities. The consumption of moose by wolves will be determined by the difference between their estimated consumption values in the literature and the number of caribou consumed by wolves; i.e., Cs-137 values.

Radiocesium amounts were estimated in 179 muscle samples during 1989-90 (n = 89 wolves, 87 caribou, 3 moose). The explosion of the nuclear reactor at Chernobyl, U.S.S.R., during 1986 contributed approximately 17% of the Cs-137 found in caribou in our study areas. The environmental half-life of Cs-137 is approximately 5.4 years. The estimated environmental half-life of Cs-137 and the percentage of Cs-137 contributed by the Chernobyl explosion will be used to standardize muscle Cs-137 values when estimating consumption of moose and caribou by wolves. Although a preliminary Lotus 1-2-3 spreadsheet model was developed to estimate daily caribou and moose consumption by wolves, it has not be completed.

Key Words: Alaska, caribou, food consumption, moose, predation, predator-prey relationships, radiocesium, wolf.

CONTENTS

BACKGROUND

Predation profoundly influences moose (Alces alces) densities, and it can strongly reduce the harvest by hunters. Predation by wolves (Canis lupus), black bears (Ursus americanus), and grizzly bears (Ursus arctos) appears to be the primary factor limiting moose at densities well below K carrying capacity (KCC), where moose are primary prey and predators and moose are lightly exploited (McCullough 1979:85, Van Ballenberghe 1987, Gasaway et al. 1990); e.g., Quebec, Ontario, Yukon Territory, and Alaska (Bergerud et al. 1983; Messier and Crete 1985; Crete 1987, 1989; Van Ballenberghe 1987; Bergerud and Snider 1988; Larsen et al. 1989; Gasaway et al. 1990). The common conceptual model for the regulation of moose populations in these lightly exploited multipredator systems is a single, low-density equilibrium (LDE), where moose densities fluctuate in a range well below KCC (Messier and Crete 1985; Crete 1987, 1989; Van Ballenberghe 1987; Bergerud and Snider 1988). In contrast, high-density moose populations (i.e., near KCC) in Alaska appear to be products of predator management (Gasaway et al. 1990). Approximate sustainable harvest yields from populations at a LDE are low ($\leq$18 moose/1,000 km^2), compared with those (20-140 moose/1,000 km^2) from populations at elevated densities in Alaska and the Yukon Territory (Gasaway et al. 1990).

A controversy among wildlife conservationists has resulted from the intense use of lethal methods of controlling predators to elevate moose densities and harvests above levels common to populations at a LDE. On one side of the controversy are advocates for managing predation in some areas to increase prey densities and harvests; on the other side are advocates for maintaining more natural, lightly exploited and protected systems at a LDE. Many people in the latter group do not approve of killing wolves and bears as part of a wildlife management program designed to increase prey species above natural densities (Ballard and Larsen 1987). Concerns about lethal predator reduction programs goes beyond ethical questions about killing and treatment of animals to include concerns for the long-term welfare of wolf and bear populations. Humans have markedly reduced or extirpated populations of wolves and bears over large

portions of their native range in North America. For example, wolves once occurred throughout the contiguous United States, and now Minnesota has their only remaining secure population. Numbering less than 1,000, grizzly bears exist in a few small portions of the 48 contiguous United States (Peek et al. 1987). They once ranged over most of the area west of the Mississippi River.

Reducing the divisiveness of predator management is essential if conservationists are to unite in addressing the most serious threat to moose-wolf-bear systems in Alaska--loss of wilderness. To reduce the divisiveness, Gasaway et al. (1990) suggested management approaches that accommodate some major values and desires of conservationists having divergent objectives. One of those suggestions was the development of more socially acceptable alternatives to intense, lethal, government-sponsored predator reduction programs. These methods would be used where society sanctions management for elevated densities and harvests of prey species. Increasing alternate prey is an alternative that is the focus of this study.

Previous observations offer some support for the idea that large increases in alternate prey may decrease consumption of moose by wolves. For example, in southcentral Alaska, W. Ballard (ADF&G files) found that the percentage of caribou (Rangifer tarandus) in the diets of wolves increased as the Nelchina Caribou Herd grew and consumption of caribou increased seasonally as caribou migrated through the wolf study area (Ballard et al. 1982:66). Additionally, cesium analyses of wolf muscle samples from several herds also indicated that wolves in areas with high caribou densities consume more caribou than they do in areas having low caribou densities (Holleman and Stephenson 1981; R. Boertje, J. Davis, W. Gasaway, ADF&G files). Increased caribou consumption, however, does not always indicate a decrease in the consumption of other prey, including moose. Prey consumption rates (kg/day/wolf) can increase with prey availability when prey densities are low to moderate (Messier and Crete 1985). Therefore, as caribou availability and consumption increase, estimates of total consumption per wolf are necessary for estimating changes in moose consumption by wolves.

Studies in the southern range of moose also support the concept that increased alternate prey reduces predation on moose (Crete 1987, Bergerud and Snider 1988). Wolves prefer deer (Odocoileus virginianus) and elk (Cervus elaphus) over moose (Carbyn 1983, Wilton 1987), and in deer- and/or elk-moose-wolf-bear systems, moose became more abundant than in areas having a scarcity of alternate prey. For example, moose are more abundant in northeastern Minnesota ($\geq$800 moose/1,000 km^2 in 30% of 15,000 km^2 of moose range; Mech 1977; Mech and Karns 1977; P. Karns, pers. commun.), Algonquin Provincial Park, Ontario (400-700 moose/1,000 km^2 and increasing, Wilton 1987), and Riding Mountain National Park, Manitoba (800 moose/1,000 km^2, Carbyn 1983) than

in Quebec (400 moose/1,000 km^2, Messier and Crete 1985), where alternate prey is scarce.

Our approach for assessing whether increasing caribou abundance will markedly reduce wolf predation on moose relies on measurements of radiocesium (Cs-137) in muscle tissue to determine wolf food habits (Holleman and Stephenson 1981). Nuclear tests introduced Cs-137 into the atmosphere during the 1950's and 1960's. Lichens eaten by caribou and, consequently, caribou muscle tissue have high concentrations of Cs-137; whereas foods eaten by moose and muscle tissue of moose have very little Cs-137. Wolves have concentrations of Cs-137 that are proportional to their consumption rate of caribou (kg/day/wolf, Holleman and Stephenson 1981). Consumption of moose by wolves is estimated by the differences between estimated total consumption from values in the literature and estimated caribou consumption from Cs-137. We will estimate Cs-137 concentrations in muscle samples from wolves, moose, and caribou in portions of the Fortymile, Delta, Nelchina, and Western Arctic Caribou Herd ranges and compare these data with previous Cs-137 data from the respective areas, but at different caribou densities. Using historical and current population estimates of moose, wolves, and caribou in the study herd ranges, we will attempt to roughly estimate the changes in predation rates on moose and caribou populations as caribou numbers increase.

STUDY OBJECTIVES

To estimate winter wolf consumption rates of moose and caribou as caribou abundance increases in the Delta, Nelchina, Fortymile, and Western Arctic Caribou Herd study areas from 1975 to 1992.

To develop a general computer model for the above study areas that predicts increased or decreased predation on moose and caribou when large changes in caribou, moose, and/or wolf populations occur.

To assess whether increasing or the maintaining of moderate-to-big caribou populations will reduce the need for intense lethal predator reductions to increase moose abundance.

STUDY AREA

The study areas include the ranges of the Delta and Nelchina Caribou Herds and the southeast portions of the Fortymile and Western Arctic Caribou Herds.

METHODS

Muscle samples from wolves, caribou, and moose were purchased from hunters and trappers during the winter of 1989-90. We

solicited trappers and hunters by letter, phone, and in person to obtain muscle samples. Staff stationed in Tok, Glennallen, Palmer, Delta, Anchorage, Galena, and Fairbanks participated in specimen collections. We paid the following amounts for muscle samples: $15 for a wolf hind leg or a 1-kg meat sample from moose or caribou and $30 for a wolf carcass from Subunit 20A.

We estimated Cs-137 concentration in muscle samples following methods of Holleman and Stephenson (1981). Approximately 1 kg of fat-free, fresh muscle tissue was double-wrapped in plastic bags and frozen; Cs-137 assays of the samples were made at the Institute of Arctic Biology, Fairbanks, by D. Holleman.

Concentrations of Cs-137 in samples will be standardized for a specific recent date using estimates of the environmental half-life of Cs-137 (Holleman and Stephenson 1981) plus the amount of Cs-137 deposited by the explosion of the nuclear reactor at Chernobyl, U.S.S.R., on 26 April 1986. The environmental half-life of Cs-137 is the number of years it takes to decrease by 50%. We estimated the environmental half-life of Cs-137 using caribou muscle samples collected in the Nelchina herd during the period 1969 through 1972 (Holleman and Stephenson 1981) and 1989-90. We regressed the natural log of Cs-137 concentration in caribou muscle on the date of death. The half-life was calculated by dividing the slope of that regression line into the natural log of 2. We calculated the percentage Cs-137 from Chernobyl by estimating the ratio of Cs-134:Cs-137 in the caribou samples. The Cs-134 present in samples was produced entirely by Chernobyl. Cs-137 concentrations in muscle samples collected before the explosion will be increased by the percentage of Cs-137 contributed by the explosion.

A preliminary Lotus 1-2-3 spreadsheet model was developed to estimate caribou consumption by each wolf and the "average" for wolves in each study area. Methods and assumptions for calculating caribou consumption/day by wolves follow those of Holleman and Stephenson (1981) and Gasaway et al. (1990). The difference between estimated caribou consumption and total consumption is assumed to be composed mainly of moose, because they are the only alternate ungulate prey. Wolf muscle samples from areas with only moose provide estimates of background Cs-137 levels in wolves. These background levels are subtracted from caribou Cs-137 levels before estimating wolf consumption rates.

RESULTS AND DISCUSSION

Work during this first reporting period focused on collecting muscle samples from caribou, wolves, and moose in the study areas and estimating Cs-137 concentrations. We estimated Cs-137 concentrations in muscle samples from 89 wolves, 87 caribou, and 3 moose.

The explosion of the nuclear reactor at Chernobyl contributed a mean of 17.4% (SD = 5.8, n = 43) of the Cs-137 present in the study areas and Denali National Park (Table 1). The percentage of Cs-137 in the environment contributed by Chernobyl differed significantly only between samples from the Western Arctic Caribou Herd range and the Delta Caribou Herd range ($P < 0.05$, one-way ANOVA and Tukey's multirange test; Table 1). The Cs-137 concentration in muscle samples collected during winters before the Chernobyl explosion will be increased by the percentages from Table 1. Making these adjustments allows comparisons of data collected before and after the Chernobyl explosion.

Environmental half-life for Cs-137 in the range of the Nelchina Caribou Herd was estimated at 5.4 years. This compares with 8.2 years estimated by Holleman and Stephenson (1981) using lichens, the only other estimate of Cs-137 half-life in our study areas. The environmental half-life is used to standardize the concentration of Cs-137 in wolves to a date when caribou samples are also available. This standardization is needed because few Cs-137 samples were collected from caribou prior to 1989.

A preliminary model to estimate caribou and moose consumption by wolves was developed using historic (i.e., 1976 to April 1989) Cs-137 data from wolves and caribou in the Delta Caribou Herd range. Because the model and data base were incomplete, no consumption estimates have been reported. The model will be refined next year, and the preliminary findings will be reported.

RECOMMENDATIONS

Additional caribou samples from the Delta Caribou Herd should be collected during the winter of 1990-91. Food consumption estimates for wolves based on Cs-137 should be evaluated for accuracy and precision. If accuracy and precision are adequate to provide useful ecological and management insights, the collection and analysis of data should be continued. If accuracy and precision are inadequate, a final report should be written and the project terminated.

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Table 1. The percentage Cs-137 in caribou muscle that was contributed by fallout from the explosion of the nuclear reactor at Chernobyl, U.S.S.R., on 26 April 1986.

Parameter	Herds					
	Western Arctic	Fortymile	Denali	Nelchina	Delta	Combined
Mean	14	16	16	20	22	17
n	10	9	9	6	9	43
SD	6	5	7	2	7	6
SE	2.0	1.5	2.3	0.7	2.2	0.9
Range	20	14	20	5	22	30

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