ALASKA DEPARTMENT OF FISH AND GAME
DIVISION OF WILDLIFE CONSERVATION
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Alaska Department of Fish and Game
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Project Title: Factors affecting moose forage quality and subsequent reproductive success

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PRINCIPAL INVESTIGATORS: William Collins, ADF&G

WORK LOCATION: Matanuska Research Farm, Togiak Valley, Colville River, Nelchina Basin, Game Management Unit 16

I. PROBLEM OR NEED THAT PROMPTED THIS RESEARCH

Moose reproductive success is closely tied to browse quality, particularly digestible protein, and this nutritional parameter is at least partially controlled by browse growing conditions, including length of growing season, and possibly temperature, moisture, and cloud cover. Low dietary nitrogen levels may explain the generally low productivity of moose in some ranges, including relatively low pregnancy rates, extremely low twinning rates, and high age of first reproduction. Although predation on calves clearly has a dramatic effect on the population dynamics of moose, nutritional deficiencies can potentially exacerbate such interactions. Clarification of the role of moose nutrition is fundamental to an informed and integrated approach to management of habitats, moose and their predators.

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

McArt et al. (2009) suggest that moose reproductive success is closely tied to browse quality, particularly digestible protein, and that this nutritional parameter is at least partially controlled by browse growing conditions, including length of growing season, and possibly temperature, moisture, and cloud cover.

In some cases, the causal link between climate and population limitation is clear and uncomplicated. For example, winter conditions can play a strong role in ungulate survivorship by determining their vulnerability to predation (Post and Stenseth 1998). In the absence of significant predation, however, winter severity can mediate animal body condition, theoretically influencing health or mortality of neonates born in the following spring and summer, or by directly influencing survival rates of sub-adult animals (Coulson et al. 2001, Grotan et al. 2008). Likewise, unseasonably cold, late winter or early spring conditions can significantly reduce neonatal survivorship in the following

summer (Forchhammer et al. 2001) and thus affect population growth rates (Hone et al. 2007).

A growing body of research indicates that the linkage between climate and ungulate productivity is often more complex than this. For example, in Soay sheep on the Scottish Isle of Hirta, neonatal survivorship is lower following a high North Atlantic Oscillation (NAO) winter (warmer, wetter, and windier), but those lambs that survive exhibit higher adult survivorship and higher fecundity(Forchhammer et al. 2001). Forchhammer et al. (2001) argue that higher fecundity is a result of higher forage quality and availability to lambs in the summer following high NAO winters. Likewise, growth rates of moose calves in summer in Norway have been attributed to various climate-related factors, including growing season length (positively correlated to calf body mass in fall (Herfindal et al. 2006, Ericsson 2002), summer cloudiness (positively related to calf body mass (Bo and Hjeljord 1991), and cool summer temperatures (positively related to calf body mass (Herfindal et al. 2006)). In all cases where summer climatic conditions are correlated to either calf growth rates, age of first reproduction or subsequent adult female reproductive rates, summer forage quality (or in some cases availability) is assumed to be the mediator between climate and animal performance. Nevertheless, the correlations among climate, plant seasonality, and herbivore fitness are devoid of mechanistic understanding.

Much of the work that elucidates relationships between climate and ungulate population dynamics has been accomplished in relatively predator-free systems of northern Europe. In North America, where plant-herbivore-carnivore systems are relatively intact, known relationships between climate and ungulate populations are limited to relatively simple effects of winter weather on ungulate demographics and phenotypic traits, such as vulnerability to predation (Post and Stenseth 1998) or its effect on starvation, energetics and body condition (Parker et al 1999, Van Ballenberghe and Ballard 1997, Bender et al 2008). Little is known about the potential role of climate and summer nutrition on ungulate population regulation/limitation in these systems, but we clearly see the signature of bottom-up effects on moose productivity across many moose ranges in Alaska. These include large differences in twinning rates (7 to 67%), age of first reproduction (24 to >36 mo), and parturition rates (70 to 90%) (Boertje et al 2007), all of which are more likely influenced by summer nutritional conditions than winter (Post and Stenseth 1998, Cook et al 2001). Because interannual variation in twinning rates (e.g., 36% CV in Nelchina moose, 1994-2004), and often parturition rates, is high, it is likely that climate significantly influences these parameters through its effect on plant chemical phenology. Our comparative studies of plant chemical phenology across three important moose ranges over the past 8 years in south-central Alaska corroborate this hypothesis (McArt et al. 2009).

III. SUMMARY OF WORK COMPLETED ON JOBS <u>FOR LAST SEGMENT PERIOD ONLY</u>

JOB/ACTIVITY 1: Moose forage nitrogen and protein binding

Accomplishments: We completed our first year's sampling of forages in the Colville drainage and across the Nushagak-Togiak-Goodnews gradient for a total of 1200 samples. Chemical analyses of the forages are not complete.

JOB/ACTIVITY 2: Diets by fecal alkane analysis
Accomplishments: Approximately 130 fecal samples were collected and prepared for diet analysis.

JOB/ACTIVITY 3: Climate/utilization effects--potted willows
Accomplishments: We established 128 cuttings genetically identical cuttings of both *Salix pulchra* and *S. alaxensis* at the Matanuska Research Farm, and we applied treatments of 2 different soil temperatures, 2 levels of soil moisture, 2 levels of light, and 2 levels of fertility.

JOB/ACTIVITY 4: Hormonal link
Accomplishments: We completed a high energy-high protein trial with 4 adult female moose at the Palmer Moose Facility to begin assessing the sensitivity ghrelin, leptin, progesterone, estradiol, cortisol and insulin-like growth factor-1 (IGF-1) to diet and body condition and their potential effect on reproduction in moose. We have completed cortisol, leptin and IGF-1 assays. We will next conduct trials involving high energy-low protein, and low energy-high protein.

IV. PUBLICATIONS

None.

V. RECOMMENDATIONS FOR THIS PROJECT

Continue as planned.

Prepared by: William B. Collins

Date: 1 Sep 2010