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Project Details:
Project Title: Summer nutrition, disease, or predation? Quantifying causes of poor lamb survival in northwest Wyoming
Project Type: Research
Affiliate: University of Wyoming
Project Location: NW Wyoming
Project Description: Numerous bacterial pathogens exist across ranges occupied by bighorn sheep, and although the disease is polymicrobial, some have suggested that M. ovipneumoniae is the precursor to subsequent infections and clinical effects of the disease (Besser et al. 2013, Cassirer et al. 2018). Separation between domestics and wild sheep are a primary goal in avoiding exposure and subsequent epizootic dieoffs, but in many instances we now seek to manage herds that while exposure to domestics is eliminated or radically reduced, the pathogens responsible for epizootic dieoffs remain. Therefore, we seek to manage herds with chronically infected animals wherein epizootic dieoffs associated with pneumonia may still occur without any new exposure to domestics. Therefore, recurring dieoffs within chronically infected herds are likely dependent upon certain ecological or environmental conditions—understanding these interactions could yield management alternatives to help reduce the frequency of epizootics and dampen fluctuations in abundance. Although much work has been conducted to understand the role of disease in dynamics of bighorn sheep, it would seem some of the underlying and fundamental principles of population ecology have been discounted. For example, even in the presence of disease, populations are still subject to density-dependent limitation in forage as populations grow, predation, and for that matter, interactions may exist among density dependence, animal nutrition, predation, and disease. Indeed, immune function and nutrition may well be tightly linked and thereby, may lend some ecological and environmental context to when epizootic dieoffs may occur in chronically infected herds. Our aim is to explore the interface between nutrition and disease, while calibrating nutritional levels associated with animal-indicated nutritional carrying capacity (NCC) in bighorn sheep. In so doing, we will evaluate the proximity of 3 key sheep herds to NCC, and elucidate the interactions among density dependence, nutrition condition, chronic stress, demography, and disease susceptibility. Achieving these key objectives will aid in understanding how herd density, environmental conditions, and harvest management interact to affect proximity of populations to NCC and their susceptibility to pneumonia.
Project Problem: Given current observations, our aim is to continue to unravel the processes underpinning the dynamics of these herds by maintaining our longitudinal study design and increasing our efforts to understand contributions of summer ranges, and role of pathogens and predation especially in Dubois and Jackson. Importantly, our current objectives are completely driven and informed by what we have learned in the past 3 years of research, and are explicitly aimed at better understanding the contributions of summer nutrition, predation, and disease on survival of young sheep. Project objectives include: 1) Estimate nutritional carrying capacity (NCC) of bighorn sheep populations in Wyoming to assess the capacity of habitats to support sheep. a. Over the long term, a key goal of this effort is to calibrate nutritional models for bighorn sheep, by coupling data on nutritional condition, pregnancy, recruitment, adult survival, and ultimately, population growth to develop models of animal-indicated NCC for Wyoming sheep. This will provide managers with tools to assess the proximity of populations to NCC. 2) Assess survival and cause-specific mortality of adult female sheep in Jackson, Dubois, and Cody herds. a. We will assess factors that contribute to probability of survival (e.g., nutritional condition, body mass, age, reproductive status), and causes of mortality when it occurs (e.g., disease, predation, accident). To date, leading cause of mortality for adult females has been predation by mountain lions. 3) Assess survival and cause-specific mortality of newborn sheep in Whiskey and Jackson herds to provide a comparison of the relative roles of nutrition, habitat, predation, and disease on recruitment of young. a. We will determine survival and cause-specific mortality of neonatal sheep. b. We will assess factors that contribute to probability of survival of neonatal sheep, including but not limited to: birth mass, sex, birth date, litter size, habitat conditions, maternal nutritional condition, presence of respiratory pathogens, and maternal age. c. We will evaluate factors that contribute to the cause of mortality (e.g., disease, predators, malnutrition, accident), including but not limited to: birth mass, sex, birth date, litter size, habitat conditions, maternal nutritional condition, presence of respiratory pathogens, and maternal age. d. We will quantify the effects of nutrition, predation, and disease on survival and recruitment of young to identify which is most limiting to Whiskey and Jackson bighorn sheep. 4) Evaluate intrinsic and extrinsic factors affecting vital rates (i.e., pregnancy, seasonal survival, recruitment of young). a. We will evaluate the relationships between nutritional condition, body weight, presence of respiratory pathogens, and age on pregnancy and fetal rate of individual females in spring. b. Similarly, we will evaluate factors that affect probability of recruiting young to autumn including, nutritional condition in March, which may indicate the potential carryover effects of winter habitat conditions on subsequent population performance. c. We will quantify nutritional condition of females during autumn to provide a representative measure of summer habitat conditions, somatic cost of reproduction, and seasonal precipitation. 5) Assess longitudinal changes associated with disease,

nutrition, and immunocompetence. a. We will assess seasonal dynamics in nutritional condition and presence of respiratory pathogens to evaluate the interactive role between these two factors. 6) Evaluate diet, and forage quality (including micronutrients) and abundance during summer for animals in Whiskey and Jackson ranges. a. Jackson is a system where summer ranges appear to be of higher quality compared with Whiskey, yet similar pathogens exist in both herds. We will compare forage quality and quantity of sheep key forage species within diets between Whiskey and Jackson. 7) Evaluate the effects of naturally occurring browsing, intense browsing, and fire on forage quality (including micronutrients) and biomass of forage on summer range. a. We will install a series of small (1m x 1m) enclosures in representative habitat on summer ranges in Jackson and Dubois to assess the effects of foraging and fire on sheep habitat. In 3 separate treatments we will 1) excluding foraging, 2) simulate intense foraging via clipping and biomass removal, and 3) implement fire boxes as an assessment of a potential habitat treatment. Notably, our objectives correspond directly to needs outlined in The Wyoming Plan by the State-wide Bighorn/Sheep Domestic Sheep Interaction Working Group (2004). Specifically, that group expressed needs to monitor habitat selection and habitat NCC (pg 10), evaluate if poor nutrition contributes to disease susceptibility (pg 10), and determine if habitat improvements influence nutritional status of populations and thus influence NCC (pg 15). In addition, the group indicated that knowledge of carrying capacity was necessary to ensure sheep do not exceed the capacity of their habitat, and that understanding how habitat improvements modify nutrition and subsequently influence performance is necessary for sound management (Appendix K).
Problem Solution: Our aim is to take a multi-pronged approach to address multiple causal factors contributing to population dynamics of bighorn sheep in northwest Wyoming, and how that broadly will aid in future management of chronically infected sheep herds. Specifically, we will quantify the relative contributions of nutrition, disease, and predation on population performance, and assess the current state of forage on summer ranges. Our approach is to continue our longitudinal monitoring of adult females from each of the 3 herds, which will yield valuable information on nutritional status and reproduction as females transition from one season to the next. We will link data on nutrition and reproduction to patterns of pathogen presence over time. With this next phase of the work however, we apply increased efforts to understand contributions of summer nutrition and disease to lamb survival by monitoring summer diet, forage quality, and survival, and cause-specific mortality of lambs in the Dubois and Jackson herds.

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Cost To Be Funded

Equipment			$
Services	15000		$458550
Publishing	2000		$7000
Monitoring	8000		$219245
Supplies			$500880
Other			$285855
Totals $	25000		$1471530

Other Organizations:
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Organization 2: WGBGLC
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Organization 4: WSF

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2 attachments

SheepNutritionDiseasePredation_Proposal_20180410.pdf
140K

BHSupdate_Fall2019.pdf
2511K