The Montana-Wyoming Collaborative Bighorn Sheep Research Program

ROBERT A. GARROTT, *Fish and Wildlife Ecology and Management Program, Ecology Department, Montana State University, Bozeman, MT, USA 59717; rgarrott@montana.edu*
P.J. WHITE, *National Park Service, Yellowstone National Park, Mammoth, WY, USA*
DOUGLAS E. MCWHIRTER, *Wyoming Game and Fish Department, Cody, WY, USA 82414*
WILLIAM H. EDWARDS, *Wyoming Game and Fish Department, Wildlife Health Laboratory, Laramie, WY, USA 82071*
KELLY PROFFITT, *Montana Fish Wildlife and Parks, Bozeman, MT, USA 59717*
JENNIFER RAMSEY, *Montana Fish Wildlife and Parks, Bozeman, MT, USA 59717*
MARY WOOD, *Wyoming Game and Fish Department, Wildlife Health Laboratory, Laramie, WY, USA 82071*
EMILY ALMBERG, *Montana Fish Wildlife and Parks, Bozeman, MT, USA 59717*
JAY J. ROTELLA, *Fish and Wildlife Ecology and Management Program, Ecology Department, Montana State University, Bozeman, MT, USA 59717*

ABSTRACT Managers routinely make decisions on bighorn sheep population augmentation and restoration, harvest, habitat management, disease prevention and response, and other conservation actions without adequate knowledge of the drivers of demographic processes that inform management of many of the more successfully restored ungulate species. Two complementary long-term research programs have been initiated in Montana and Wyoming to help address the need for a better understanding of bighorn sheep ecology. These studies are designed on the premise that research insights that are broadly applicable for management and conservation are best obtained by addressing the same questions in multiple populations representing the range of variation realized by the species of interest. The studies were initiated in the Greater Yellowstone Ecosystem in 2009 and expanded to include bighorn populations throughout Montana in 2014. As of spring 2016, 17 bighorn herds were incorporated in the studies, which will continue until at least 2019. We selected herds to capture a wide range of variability in disease history, environmental settings, and herd attributes. We expected doing so would maximize variation in adult survival, recruitment, and population dynamics among herds. A multi-disciplinary team of agency biologists, academics, and graduate students are conducting the integrated studies that include investigations of health/physiology, spatial ecology, disease, genetics, and population dynamics (Fig. 1). A total of 476 animals (primarily ewes) have been captured via baited drop nets, ground-based chemical immobilization, and helicopter net gunning. Traditional physiological assessments including body weight, skeletal length, ultrasound rump fat measurements, body condition scores, and serum metabolite and hormone assays have been used to assess health, pregnancy, and body condition. We are also exploring the utility of nuclear magnetic resonance spectroscopy (NMR), an emerging technology in human medicine, in an attempt to develop a 'health panel' of metabolites and hormones that can provide a richer assessment of physiological status of ungulate populations. We have successfully developed NMR methods to identify and quantify a library of 53 biological molecules associated with a wide variety of physiological processes from <100 µl of serum. We are now evaluating associations between these data and reproduction, nutrition, body composition, and other physiological conditions. Genetic samples were also obtained from animals using FTA gene cards, whole blood, and/or tissue samples. High quality DNA is being

extracted from these samples, and is being used with the Ovine HD Single Nucleotide Polymorphism (SNP) array, with ~24,000 genetic markers informative for bighorn sheep, to address a variety of population- and individual-level genetic questions important for management. Preliminary findings suggest that levels of relatedness and inbreeding among herds are associated with management history. We are assessing pathogen communities hosted by each study population using Western Association of Fish and Wildlife Agencies (WAFWA) Wildlife Health Committee monitoring recommendations. In addition, we are collecting replicate swab samples from individual animals and using numerous diagnostic protocols to evaluate detection probabilities to help inform the development of more effective pathogen sampling protocols and interpretation of the resulting data. Telemetry is a tool that provides many ecological insights into spatial ecology, habitat selection, and demography and we have a goal of instrumenting a minimum of 20-30 adult ewes in each study population. We employ a dual collar strategy, instrumenting each animal with a GPS Store-on-board collar and a micro-VHF collar. The GPS collar collects fine spatial and temporal scale location data for ~2 years while the micro-VHF collar remains dormant. When the GPS collar falls off the animal at a preset time for collar recovery and data retrieval the micro-VHF begins to transmit, permitting an additional 4-5 years of monitoring for survival and coarse-scale movement data. As of spring 2016 we have instrumented 379 bighorn sheep and recovered the GPS data from approximately 190 of these animals. During the winter of 2016-17 we plan to capture and sample an additional 250 animals in Montana and Wyoming herds and instrument 160 of these animals with telemetry collars.

Biennial Symposium of the Northern Wild Sheep and Goat Council 20:62-64.

KEYWORDS bighorn sheep, disease, genetics, health, Montana, *Ovis canadensis*, population dynamics, spatial ecology, Wyoming, Yellowstone National Park

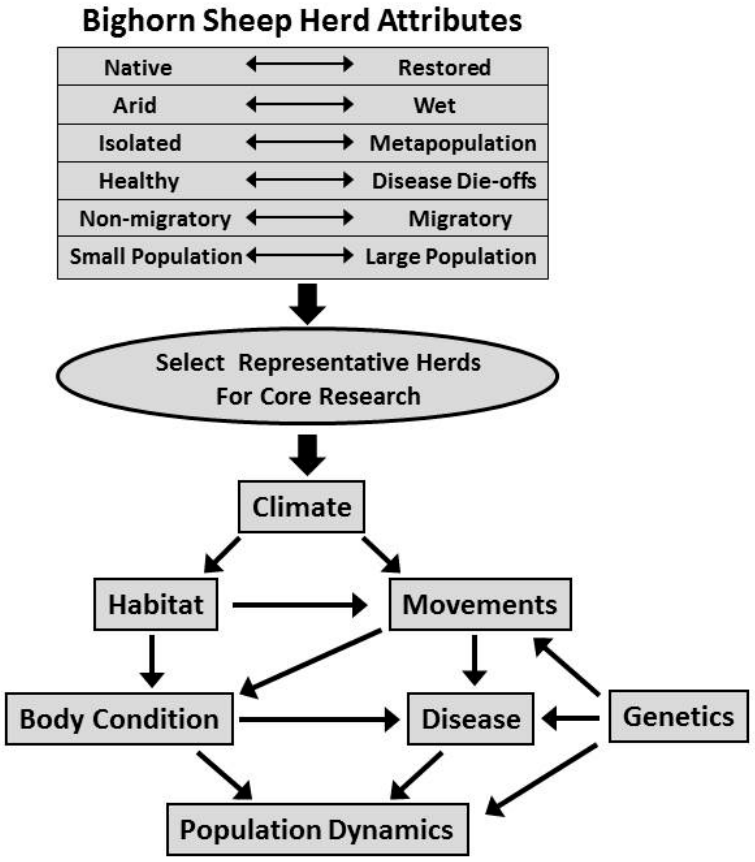

Figure 1. A conceptual diagram of the Montana-Wyoming bighorn sheep research program.