Plenary Session

October 11, 2022

Plenary Overview

Inspired by discussions among agency biologists, researchers, and academics about challenges in integrating nutrition into ungulate management, the theme of the Plenary Session for the 2021 Deer and Elk Workshop was Integrating Nutrition into Deer and Elk Management: Why, What, and How? The five plenary speakers were chosen to provide insights into why wildlife agencies should monitor nutritional status of ungulate populations, which aspects of nutrition are most important to monitor, and how they can implement monitoring and management actions to enhance nutrition of deer and elk populations.

Plenary Speaker Profiles

Tom Stephenson

Dr. Tom Stephenson is a wildlife supervisor with the California Department of Fish and Wildlife and Program Leader for Sierra Nevada bighorn sheep recovery. He also currently leads a number of research projects on mule deer and bighorn sheep nutrition and carnivore demography in the Sierra Nevada. Tom has affiliate/adjunct faculty appointments with Utah State University and University of Wyoming. Prior to moving to Bishop 20 years ago, Tom was a wildlife researcher with Alaska Fish and Game and studied moose and caribou nutrition and wolf reproduction.

David Hewitt

Dr. David Hewitt is Executive Director of Caesar Kleberg Wildlife Research Institute. He grew up in northern Colorado and earned degrees in wildlife biology from Colorado State University, Washington State University, and Virginia Tech with his graduate research focusing on wildlife nutrition. He has studied white-tailed and mule deer in the highly variable rangelands of Texas for 20 years.

Mark Hurley

Dr. Mark Hurley is a Principal Wildlife Research Biologist for the Idaho Department of Fish and Game. Mark received his PhD from the University of Montana and has worked for Idaho Department of Fish and Game for 29 years, first as a management biologist, then as field or supervisory biologist positions in the research program for the last 25 years. His primary research focus is ungulate ecology, emphasizing the influence of weather and predation on mule deer population dynamics, and developing tools to better manage wildlife populations.

Rachel Cook

Dr. Rachel Cook is a large ungulate ecologist with NCASI whose primary research interests are linking plant communities and ungulate foraging responses to individual and population performance. For the past 2+ decades, partnered with her husband (Dr. John Cook), they have worked to develop strategies that integrate findings from captive-animal research of physiology, nutrition, and bioenergetics with wild-animal field research in ways that capitalize on the strengths of both.

Michael Wisdom

Dr. Michael Wisdom is a research wildlife biologist with the Pacific Northwest Research Station of the Forest Service in La Grande, Oregon. He has been involved with research and management of elk, mule deer, and other wildlife in the western U.S. during the past 40 years, and has collaborated on management applications of deer and elk research throughout his career.

Charles DeYoung

Dr. Charles A. DeYoung was instrumental in establishing the Caesar Kleberg Wildlife Research Institute (CKWRI) at Texas A&M University, Kingsville and served as its first Director from 1981–1983. Charlie received his bachelor's degree in Wildlife Science at Texas A&M University, College Station, Master's degree in Biology at Texas A&I University, and Ph.D. in Range Science at Colorado State University. Charlie served as the first Stuart W. Stedman Chair for White-tailed Deer Research from 2001–2006. He currently has a part-time appointment with the CKWRI and continues to perform research on white-tailed deer in south Texas.

Plenary Abstracts

Nutritional condition, population performance, and animal-indicated nutritional carrying capacity

Thomas R. Stephenson, Sierra Nevada Bighorn Sheep Recovery Program, California Department of Fish and Wildlife, Bishop, CA
Kevin L. Monteith, Wyoming Cooperative Fish and Wildlife Research Unit, Department of Zoology and Physiology, University of Wyoming, Laramie, WY 82071

We expanded a unique approach to quantify nutritional status in free- ranging ungulates that establishes a direct link between populations and their habitats. Body fat integrates energy gain and loss as determined by factors such as forage supply, competition for food among conspecifics, winter severity, and reproduction. Consequently, body fat in free-ranging animals is an optimal measure of nutritional

condition and represents how animals balance the energetics of their environment. Energy from forage and fat, in conjunction with protein stores, is the currency that drives growth and reproduction in animals. We present data from mule deer that couples life-history traits and nutrition. We used ultrasonography and body condition scoring to estimate body fat across its full range, which we then analyzed with vital rates estimated from radio-collared individuals. We estimated population size and the finite rate of population growth (λ). The physiological limits of total body fat in the mule deer sampled varied between 0.5 and 26%. We review the dynamics of fat and protein reserves and their allocation in a risk sensitive context. Mean body fat of adult female mule deer in March in the Sierra Nevada of California ranged from 2.6% to 8.7% across herds and years. November mean body fat in females varied between 8.4 and 11%. Nutritional condition was related to the probability of pregnancy, survival of young, age at first reproduction, adult survival, and population growth rates in wild populations. The relationship between body fat and population growth rate supports the potential to assess the proximity of a population to its nutritional carrying capacity (NCC) that we term animal-indicated NCC.

Density dependence, nutrition, and white-tailed deer management in southern Texas

David G. Hewitt, Caesar Kleberg Wildlife Research Institute, Texas A&M University Kingsville, Kingsville, TX
Charles A. DeYoung, Caesar Kleberg Wildlife Research Institute, Texas A&M University Kingsville, Kingsville, TX
Timothy E. Fulbright, Caesar Kleberg Wildlife Research Institute, Texas A&M University Kingsville, Kingsville, TX
Don A. Draeger, Comanche Ranch, Carrizo Springs, TX
David B. Wester, Caesar Kleberg Wildlife Research Institute, Texas A&M University Kingsville, Kingsville, TX

A cornerstone of deer and elk management is the relationship between animal density and productivity of those animal populations. If deer or elk have low body weights, poor reproduction or recruitment, or high mortality rates, ungulate managers often increase harvest of females to reduce population density. The rationale is that smaller populations reduce foraging pressure, thereby improving diet quality of the remaining animals and increasing their productivity. However, not all populations respond strongly to such manipulations. We conducted a large-scale, long-term replicated study of white-tailed deer nutrition and density dependent responses in semi-arid rangelands of southern Texas. Our study used twelve 80-ha enclosures, lasted 9 years, and tested 3 deer densities (12, 31, and 50 deer/km^2) and natural and enhanced nutrition. We measured demographic and morphological responses of deer, deer diets in low and high-density enclosures, and vegetation responses to different deer density. Enhancing nutrition with pelleted feed caused a strong response in all demographic and morphologic parameters we studied, demonstrating that these deer populations are nutritionally limited. Fawn production, population growth rate, and male body size, but no other parameters, declined with increases in deer density. Deer diets and diet quality did not differ between low- and high-density enclosures, nor was there a decrease in preferred deer forages or shrub biomass with changes in deer density. We conclude that there is evidence for density-dependent population responses but that that they occur at high deer densities and that the effects are unlikely to be important in management except after multi-year population increases after several years of above average rainfall. We hypothesize the density-dependent responses we documented occurred because at high deer density, social interactions relegated some deer to areas with poor-quality forage, thus allowing for density dependence without changes in vegetation. Vegetation is not heavily influenced by deer browsing because shrubs have defenses to reducing browsing impacts,

forbs are absent during drought and are abundant but ephemeral during wet periods, and diverse forage resources including many mast species enable deer to change forage classes as conditions change, thereby periodically reducing foraging pressure at different times for each forage class. Our results suggest that deer managers in southern Texas 1) rarely need to harvest of female deer, 2) can manage deer populations over a broad range of deer densities without damaging vegetation, and 3) should not harvest female deer during drought to reduce deer density. Increasing harvest during drought does little to protect vegetation and delays recovery of the deer population once the drought is over.

Using remote-sensed data to monitor mule deer population performance

Mark Hurley, Idaho Department of Fish and Game, Coeur d'Alene, ID
Josh Nowak, Speedgoat Wildlife Solutions, Missoula, MT
Paul Lukacs, Speedgoat Wildlife Solutions, Missoula, MT
Scott Bergen, Idaho Department of Fish and Game, Pocatello, ID
Shane Roberts, Idaho Department of Fish and Game, Boise, ID

Juvenile survival is highly variable in ungulate populations and often drives the dynamics of mule deer (*Odocoileus hemionus*) populations. This vital rate is needed to reliably assess population dynamics for harvest management but difficult and costly to estimate with common wildlife management methods. To address this problem, we developed models to predict overwinter survival of mule deer fawns under a large range of habitat quality, weather, and predation regimes without capturing and collaring six-month old fawns. We used data from 2003–2013 to develop overwinter survival models for 2,529 radio-collared fawns within 11 Idaho Population Management Units (PMU) using remotely sensed and modeled measures of summer plant productivity (NDVI) and winter snow conditions (MODIS Snow and SNODAS). These Bayesian hierarchical models included covariates at the appropriate spatial and temporal resolutions for several levels (individual, capture site, PMU, and ecotype) to capture spatiotemporal variation in overwinter survival. We evaluated the predictive capacity of models using both internal and external (out-of-sample) validation procedures comparing non-parametric Kaplan-Meier (KM) survival estimates with estimates from Bayesian hierarchical models. Statewide overwinter fawn survival ranged from 0.32–0.71 during 2003–2013, whereas individual PMU estimates varied to a greater extent (0.09–0.95), providing empirical coverage for the modeled estimates. Forage quality in late summer/fall increased winter mule deer survival, whereas early and late winter snow cover decreased survival. Internal validation revealed models predicted KM survival quite well (R_2 = 0.78–0.82). Because our goal was to predict overwinter survival of mule deer in the future, we also evaluated our models by withholding 2 years of data and predicting those years with each model. The best-supported predictive model was our simplest model with 3 covariates across all ecotypes. That model accounted for 71% of the variance in withheld years, yielding a model with general application to different landscapes with varied predator communities, climate, and plant nutrition of the Intermountain West.

While this modeling of fawn survival provides a solid ecological understanding of the drivers of winter fawn survival, it is just one step toward the application of this information to population monitoring and management. Idaho has collaborated with Speedgoat Wildlife Solutions to develop a flexible software program to assist managers in estimating annual populations of mule deer using a variety of data types. Speedgoat has improved the onerous process of developing population level covariates for fawn survival prediction with automated download and processing of snow and NDVI data. The predictions then feed a Bayesian integrated population model (IPM)—which includes other data such as adult survival, fawn ratios, and harvest—to produce annual estimates of population size and growth. The Bayes nature of the

IPM allows managers to explore their data applicability, importance, and accuracy of modeled estimates. This platform provides managers with an efficient process for using predicted survival estimates to estimate abundance for both harvest management planning and ecological insight.

Linking plant communities to large ungulate performance: the importance of fine-scale data

Rachel C. Cook, National Council for Air and Stream Improvement, La Grande, OR
John G. Cook, National Council for Air and Stream Improvement, La Grande, OR

Increasing evidence shows that many temperate and northern ungulate populations are experiencing nutritional limitations, particularly in summer and autumn, severe enough to impact reproduction, growth, and survival and/or to increase susceptibility to predation, disease, and parasites. The 100-dollar question is why? Are ungulate populations more limited by intake (forage quantity) or forage quality or both? More limited by energy or protein or both? More limited in winter than summer? More limited by density independent versus density dependent processes? The answers to these types of questions have important implications to how ungulate populations and their food sources are managed. Research strategies that integrate fine-scale forage quality and quantity data and captive-animal research of physiology, nutrition, diet selection, and bioenergetics with wild-animal field research facilitates linking site characteristics to plant communities and plant communities to ungulate foraging responses. In turn, these data provide the mechanism to link habitat conditions, and habitat change primarily through disturbance and succession, to performance of ungulate populations. We will showcase several case studies and explore why results from one ecological setting may not apply to another.

Using knowledge co-production to support integrated research-management partnerships: recent successes for elk

Michael J. Wisdom, United States Forest Service, La Grande, OR

Strict functional divisions between wildlife research and management can discourage an integrated research-management partnership for efficient knowledge gain of high management relevance. Research scientists traditionally focus on publications in refereed journals, but managers often need explicit tools to help inform and support their decisions. An under-used process to help integrate wildlife research and management is knowledge co-production, defined as the "process of producing usable or actionable science through collaboration between scientists and those who use science to make policy and management decisions." The process emphasizes the participation of scientists, managers, and stakeholders in the entire research cycle—from design to implementation, analyses, publication, and application—with management tools developed, tested, and implemented in parallel with conventional research steps. This process has been successfully used for elk modeling and management at ecoregional scales in western Oregon and Washington (11 million ha), northeast Oregon and southeast Washington (8 million ha), and north-central Idaho (4 million ha). Each collaboration was initiated by stakeholders, who recruited scientists and managers to partner in development of desired models and other management support tools based on long-term research. Use of knowledge co-production helped ensure that essential management needs were addressed, including: (1) use of model covariates representing habitat requirements that could be actively managed to meet habitat and population objectives; (2) integration of diverse data sources from multiple study areas and time periods to serve the broad, ecoregional inference space of interest; (3) commitment to an open, transparent approach, helping build credibility and ownership among scientists, managers, and stakeholders in the scientific process; and (4) planned development and use of technical guides and other tools to support management applications. Despite these benefits, knowledge co-production requires substantially more investment and time, with uncertain outcomes. The intractable nature of many contemporary resource management issues, however, often warrants innovative approaches for research and management of species of high ecological, economic, and social importance like deer and elk. In such cases, knowledge co-production may serve as a useful framework to help address key resource issues for broad inference and high management impact.