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Item No. 1 of 1

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THE EFFECTS OF NUTRITION AND HABITAT QUALITY ON DECLINING WILDLIFE POPULATIONS

NON-TECHNICAL SUMMARY: Mule deer and elk are popular for hunting and viewing, whereas pygmy rabbits are on the federal endangered species list, thus their recovery is mandated by federal law. By examining the effects of nutrition and habitat quality on several species of wildlife of concern in the inland northwest, we will assist state and federal agencies (WDFW and USFWS) in formulating management objectives and actions that will reverse downward trends in these important species.

OBJECTIVES: 1. Mule deer Objective 1: Determine the effects of digestible energy intake and body fat composition on lactation, calf growth, and estrus in mule deer. Objective 2: Develop quantitative body condition and reproductive indices for mule deer that may be applied in the field to assess body condition on live, free-ranging animals. Objective 3: Assess the habitat quality and potential of seasonal ranges to meet the nutritional needs of lactating female mule deer, influence reproduction, and provide general seasonal nutrition requirements of mule deer. Objective 4: Validate current models that assess habitat suitability for mule deer in Washington. Objective 5: Examine the effects of food heterogeneity on foraging behavior and movements among patches by mule deer. 2. Elk Objective 1. Describe the seasonal availability, production and nutritional quality produced by the mitigation fields, and to compare biomass and quality among the ages and years Objective 2. Compare food habits, diet selection, and nutritional quality of diets consumed by elk using mitigation fields as part of their range with those that have no access to the fields within their home range. Objective 3. Compare nutritional status and reproduction of elk that use mitigation fields and that do not. Objective 4. Relate nutritive value of habitat across a heterogeneous landscape in Blue Mountains, Oregon, with elk movements 3. Pygmy rabbits Objective 1. Determine reproductive behavior of pygmy rabbits, including mating, pregnancy, and lactation. Objective 2. Compare reproduction and survival among Columbia Basin pygmy rabbits and pygmy rabbits from currently unlisted populations in Idaho. Objective 3. Develop suitable techniques reintroducing pygmy rabbits to their native habitat in Washington Objective 4. Determine the nutritional requirements of pygmy rabbits and their tolerance for plant fiber and plant secondary

compounds, especially monoterpenes Objective 5. Determine home range, habitat selection, mortality, reproduction and food habits of badgers in eastern Washington. 4. Blue duiker antelope Objective 1. Determine protein and energy requirements and tolerances for fiber and plant secondary chemicals of duikers Objective 2. Determine quality of native African fruits and forages for blue duikers.

APPROACH: 1. Mule deer We will conduct summer-fall feeding trials with 30 lactating females and fawns. Female mule deer will be captured as fawns, hand-reared and trained to experimental protocol in the new Wild Ungulate Facility at Steffan Center on WSU campus. We will examine the correlation between common condition indices that may be used on live mule deer with direct measurement of total body fat. We will determine seasonal food habits of mule deer by collect fecal pellets seasonally throughout the study area and analyze to identify common forage species using microhistological analysis. Mule deer will be offered hand-constructed patches of forages that vary in bite size, fiber content, and patch size, spread throughout a large enclosure at the Wild Ungulate Facility at different interpatch distances. Using videocameras and tape recorders, we will monitor bite size, intake rate, travel speed, and residence time in patches. 2. Roosevelt elk We will measure available plant biomass in spring, summer, fall and winter by clipping vegetation within 20 randomly selected plots in each of the 5 mitigation fields seasonally for 2 years. We will create a Geographic Information System coverage for the areas traversed within the home range of 30 radiocollared elk. To determine the effects of mitigation fields on fitness of elk, WDFW will capture 15 elk who use mitigation fields. We will measure nutritional condition using ultrasonography (Cook 2000) and body condition scoring and determine pregnancy status using ultrasonography. We will measure nutritive value of habitats across a heterogeneous landscape within the Blue Mountains Ecological Province of Northeast Oregon. 3. Pygmy rabbits Using a digital video recorder, we will monitor breeding chases and copulations of pygmy rabbits. We will conduct a survival analysis and predict population growth of captive pygmy rabbits. We will conduct pilot releases of captive rabbits into suitable habitat in Idaho and Washington. We will compare movements, behavior and survival among different release times, different pre-release and release treatments. We will conduct a series of digestion trials with pelleted and natural forages to determine energy and protein digestibility of food. We will capture 15-30 badgers using foothold and cage traps at night and monitored at least every 12 hours. Telonics IMP/400/L transmitters will be implanted and animals will be relocated and monitored. 4. Blue duiker antelope We will collect native forages used by blue duikers and other herbivores in Africa and conduct in vivo digestion trials with 4 male blue duikers housed at Small Mammal Research Facility at Steffan Center at WSU. We have obtained 2 species of native figs eaten by wild duikers from Uganda. We plan to assess the digestibility and passage rate of these forages using the methods described in Objective 1.

PROGRESS: 2005/04 TO 2010/03

OUTPUTS: First, because their natural diets and digestive physiology differ from most grazing domestic ruminants, small browsing ruminants are difficult to keep healthy in captivity. Therefore, since 2002 we have published 5 articles that detail the nutritional physiology of blue duikers and mule deer, and their performance on a variety of natural and pelleted diets. Second, the pygmy rabbit, a unique species endemic to the Inland northwest, was placed on the federal Endangered Species List in 2003. We have published 4 articles that described our research on their reproductive, nutritional, and habitat ecology, and how they respond to environmental stressors such as cattle grazing and increased UVB radiation. In addition, we have developed successful captive breeding and husbandry techniques, described in a manuscript in process. Third, we have

explored the role of forage quality in mule deer declines and elk abundance in Washington. We developed methods for assessing body condition in the field, assessed fawn survival, and through a series of controlled pen experiments, quantified the effects of summer forage quality on pregnancy rates, litter size, and fawn growth in mule deer. Thus far this work has yielded 5 publications. Finally, we have explored habitat selection, foraging behavior, and nutrition of a number of North American wildlife species (e.g., pronghorn, badgers, moose, bears), both in response to requested needs by state and federal wildlife agencies, and to advance theoretical knowledge in nutritional ecology. This work has resulted in 12 publications. **PARTICIPANTS:** Since January 2010, the following people have participated in the work conducted under Lisa Shipley's ARC project. WSU graduate students include Troy Tollefson, Sarah McCusker, Kelsey Dalton, and Nick Paulson. WSU faculty include Kristin Johnson, Steve Parish, Rod Saylor, and Nairanjana Dasgupta. Faculty and graduate students from University of Idaho and Boise State University include Jason Dungan, Jennifer Forbey, Janet Rachlow, Gerry Wright. Biologists from Washington Department of Fish and Wildlife and Oregon Department of Fish and Wildlife include Dave Hays, Woody Myers, and Don Whittaker. Federal biologists from Bureau of Land Management include Joyce Whitney and Jason Lowe, and industry scientists from Land O'Lakes/Purina include Elizabeth Koustos and Mark Griffin. **TARGET AUDIENCES:** The target audience for this information is state and federal wildlife and natural resource managers, zoo nutritionists and managers, and herbivore ecologists. My students and I have given 19 presentations to university/scientific conferences, 7 to zoos/scientists, and 15 to managers/scientists during the 8 year project. Twenty-nine undergraduates participated in this work in the form of internships and undergraduate research experiences. **PROJECT MODIFICATIONS:** There were no major changes in approach, but the scope of the project increased over the 7 years, including a wider variety of species of concern.

IMPACT: 2005/04 TO 2010/03

First, our work with nutritional requirements and digestion in small browsers (e.g., duikers, mule deer) has led to large changes in the way zoos feed exotic browsers, many of which are species of conservation concern, including reducing protein and fruit, increasing browse, shifting from high starch, low fiber pellets to high fiber and low starch diets. A number of workshops have centered around this topic and featured our work, including a new publication called "Ruminant Browser Nutrition", and 4 students from my lab have served as wildlife nutritionists at zoos. Second, our work has provided critical information for restoring endangered pygmy rabbits in Washington. Our field and pen research elucidated important, previously unknown, aspects of pygmy rabbit life history, including reproduction and foraging, that has guided the development and testing of suitable captive breeding and husbandry and release techniques for pygmy rabbits, and evaluated the affect of environmental stressors (e.g., cattle grazing and UVB radiation) on wild pygmy rabbits. As a result, our work has guided the USFWS Recovery Plan and several federal legal decisions. Our work linking nutrition and habitat quality to animal movements and performance in a number of native wildlife species (e.g., elk, mule deer, pronghorn, badgers) that have suffered population declines in recent years has provided guidance to federal and state natural resource agencies in managing these species and their habitats. Finally we have developed and tested field methods for assessing the body condition of mule deer in the field and using Vaginal Implant Transmitters to locate fawns that are currently being used by biologists.

PUBLICATIONS (not previously reported): 2005/04 TO 2010/03

1. McCusker, S., L. A. Shipley, K. Johnson, S. Parish, T. Tollefson, M. Griffin, and E. Koustos. 2010.

Effects of starch and fiber in pelleted diets on behavior, physiology, and growth in mule deer (*Odocoileus hemionus*) fawns. *Journal of Animal Physiology and Animal Nutrition* (accepted 8/1/2010)

2. Dungan, J. D., L. A. Shipley, and R. G. Wright. 2010. Activity patterns, foraging ecology and summer range carrying capacity of moose in Rocky Mountain National Park, Colorado, *Alces* 74: 71-87.

3. Tollefson, T. L., L. A. Shipley, W. L. Myers, D. H. Keisler, and N. Dasgupta. 2010. The influence of summer and autumn nutrition on body condition and reproduction in lactating mule deer. *Journal of Wildlife Management* 74:974-986.

4. Shipley, L. A. 2010. Fifty years of food and foraging in moose: Lessons in ecology from a model Herbivore. *Alces* 46:1-13
