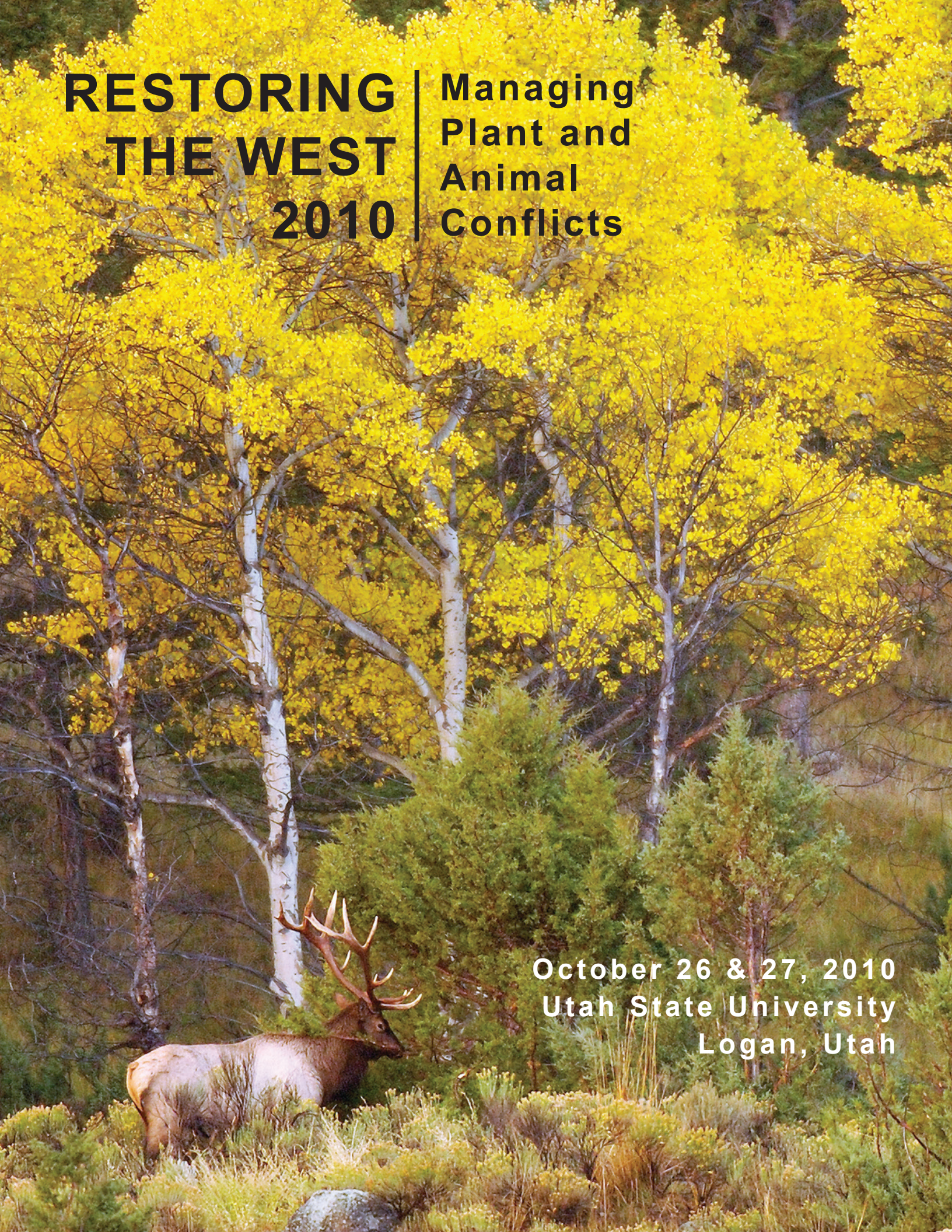
RESTORING THE WEST 2010
Managing Plant and Animal Conflicts
October 26 & 27, 2010
Utah State University
Logan, Utah

Conference Organizing Committee

Darren McAvoy
USU Forestry Extension

Mike Kuhns
USU Forestry Extension

Ron Ryel
USU Department of Wildland Resources

Paul Rogers
USU Department of Wildland Resources and Western Aspen Alliance

Frank Howe
Utah Division of Wildlife Resources University Liaison

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USU Department of Wildland Resources, USU College of Natural Resources, USU Ecology Center, USU Extension Forestry, Western Aspen Alliance, Utah Division of Wildlife Resources, USDA Forest Service State & Private Forestry, Wyoming Game and Fish Department

Agenda

Tuesday, October 26 USU Eccles Conference Center Auditorium	
7:30 to 9:00 am	Registration Open
7:30 to 9:30 am	Coffee and Beverages
8:30 to 8:35 am	*Welcome,* **Darren McAvoy**, Extension Forestry Associate, Utah State University
8:35 to 9:35 am	Keynote speaker: **Fred Provenza**, Emeritus Professor, Department of Wildland Resources, Utah State University – *The Web of Life: How Behavior Links Soil, Plants, Animals, and People with the Landscapes We Inhabit*
9:35 to 10:30 am	Keynote speaker: **Terry Bowyer,** Professor and Chair of Biological Science, Idaho State University, Pocatello, Idaho – *Large Herbivores and Plants: Consequences of Interactions and Feedbacks*
10:30 to 11:00 am	**Break**
11:00 to 11:30 am	**Alan Clark,** Assistant Director, Utah Division of Wildlife Resources, Salt Lake City, Utah – *Management Plans – Managing Big Game in Balance with Available Habitat*
11:30 to 12:00	**Jim Davis,** Utah Division of Wildlife Resources, Provo, Utah – *Perceptions of Wildlife and Rangelands; It's Not as Simple as We Think*
12:00 to 1:30 pm	**Posters and Lunch (provided)**
1:30 to 2:00 pm	**Marty Vavra,** Starkey Ungulate Ecology Team Leader, PNW Station Forestry and Range Sciences Lab, La Grande, Oregon – *Ungulate Herbivory as a Chronic Disturbance Agent on Western Landscapes*
2:00 to 2:30 pm	**Daryl Lutz,** Regional Wildlife Manager, Wyoming Game and Fish Department, Casper, Wyoming – *Wyoming's Big Game Population Management – Trials, Tribulations, and Other Considerations*
2:30 to 3:00 pm	**Therese Johnson,** Biologist, Rocky Mountain National Park, Estes Park, Colorado – *Managing Elk in the Absence of an Intact Ecosystem: Challenges in Rocky Mountain National Park*
3:00 to 3:30 pm	**Break**
3:30 to 4:00 pm	**Jessica Clement,** The Colorado Forest Restoration Institute, Colorado State University, Fort Collins, Colorado – *Landscape Restoration: Wicked Stuff*
4:00 to 4:30 pm	**James Catlin,** Project Coordinator**,** Wild Utah Project, Salt Lake City, Utah – *Designing Adaptation for Habitat and Its Users in the Face of Climate Change*
4:30 to 5:00 pm	**Frank Howe,** Utah Division of Wildlife Resources, University Liaison and Assistant Professor, Department of Wildland Resources, Utah State University, Logan, Utah – *Audience comments, moderated discussion and synthesis*
5:30 to 7:30	**Evening Reception at Café Sabor (600 W Center St., Logan), Appetizers Provided**

Agenda, continued

Wednesday, October 27 USU Eccles Conference Center Auditorium	
8:00 to 9:00 am	Coffee and Beverages, Registration Open
8:30 to 8:35 am	*Welcome,* **Darren McAvoy,** Extension Forestry Associate, Utah State University
8:35 to 9:35 am	Keynote Address: **Bill Ripple,** Professor of Forest Resources, College of Forestry, Oregon State University, Corvallis, Oregon – *Using Large Carnivores for Restoring Western Ecosystems*
9:35 to 10:15 am	Keynote Address: **James Peek,** Emeritus Professor of Wildlife Resources, Department of Fish and Wildlife Resources, University of Idaho, Moscow, Idaho – *What Does the Historical Record and Our Knowledge of Rangeland Ecology Suggest About Future Trends in Deer and Elk Populations?*
10:15 to 10:45 am	**Break**
10:45 to 11:15 am	**Tara Teel,** Assistant Professor, Human Dimensions in Natural Resources Unit, Colorado State University – *A Foundation for Conflict: Wildlife Values in the West*
11:15 to 11:45 pm	**John Squires**, Research Wildlife Biologist, Rocky Mountain Research Station, Missoula, Montana – *Distribution and Habitat-use of Canada Lynx in Montana and Wyoming: Issues and Challenges to Management*
11:45 to 12:15	**Danielle K. Chi**, Regional Wildlife Program Leader, Intermountain Region, USDA Forest Service, Ogden, Utah – *Conserving Canada Lynx: Progress and Challenges in the Intermountain West*
12:15 to 1:30 pm	**Lunch (provided)**
1:30 to 2:00 pm	**Mary O'Brien,** Utah Forests Program Manager, Grand Canyon Trust, Castle Valley, Utah – *Elk, Cattle, Beaver and Willow – Interactions on the Dixie and Fishlake National Forests*
2:00 to 2:30 pm	**Michael Bodenchuk**, Texas State Director of Wildlife Services, USDA-APHIS-Wildlife Services, San Antonio, Texas – *Predation Impacts on Native Species and Vegetative Communities*
2:30 to 3:00 pm	**Mary Lou Fairweather,** Plant Pathologist, Arizona Zone of Forest Health Protection, Southwestern Region, USDA Forest Service, Flagstaff, Arizona – *A Century of Browse Impacts and the Decline and Dieback of Aspen in Arizona*
3:00 to 3:30 pm	**Break**
3:30 to 4:00 pm	**Terry Messmer,** Professor, Extension Specialist, Department of Wildland Resources, Utah State University, Logan, Utah – *Integrating Resources at the Landscape Scale to Achieve Sage-grouse Health*
4:00 to 4:30 pm	**Sandra L. Jacobson,** Wildlife Biologist, Pacific Southwest Research Station, USDA Forest Service, Bend, Oregon and **Patricia Cramer**, Research Assistant Professor, Department of Wildland Resources, Utah State University, Logan, Utah – *How Highways Reduce Habitat Effectiveness in Western Forests and Sage-steppe Habitats: Challenges and Solutions*
4:30 to 5:00 pm	**Ron Ryel,** Associate Professor, Department of Wildland Resources, Utah State University, Logan, Utah – *Audience comments, synthesis and wrap-up*
5:00 pm	Adjourn

Speaker Abstracts

In order of presentation;
presenting author in italics

The Web of Life: How Behavior Links Soil, Plants, Animals, and People with the Landscapes We Inhabit

Fred Provenza, Utah State University, Logan, UT

All life, from microbes in the soil that sustains the life of plants to animals including people, is interconnected and interdependent upon continuous inputs and transfers of solar energy and matter. Bodies are in essence societies of cells and organs that continually interact one with another and with the biophysical environments in which they live. Arthur Koestler coined the term "holon" for interrelationships involving parts and wholes, and he stressed that each holon has two conflicting propensities: an integrative propensity to function as part of the larger whole, and a self-assertive propensity to safeguard its individual autonomy. Within a body or a social system, each cell or individual must affirm its individuality to maintain the functioning of the system, but it must also yield to the demands of the whole to make the system viable. These two tendencies are opposite but complementary. In a healthy system – cell, individual, society, or ecosystem – there is a balance between integration and self-assertion. This balance is not static but consists by necessity of a dynamic interplay between the two complementary tendencies, which makes the whole system flexible and open to constant change.

While our Western culture teaches us to think and behave in linear, hierarchical ways, no one central force controls these outcomes on landscapes, only a large number of holons, all interacting and adapting to each other and to their local environments as they all move and change. Ultimately, complex patterns emerge from the local interactions of all of the parts. Complex Adaptive Systems thus display emergent properties that arise from the virtually unending number of interactions occurring as the parts of the system interact one with another as a function of history, necessity, and chance. Due to the complexity of these interactions, any modifications we make to the system will produce results we cannot anticipate or predict in advance. We must continually adapt to ever-changing social and biophysical environments. That means participating in creating the here-and-now and realizing that 'things never were the way they were and they never will be again.' In our attempts to recreate the past (which is history and mostly mystery) and predict the future (which is mystery and soon-to-be history) we miss the mystery and wonder of the moment, which is all we ever really have…

Contact: Fred Provenza, Department of Wildland Resources, Utah State University, 5230 Old Main Hill, Logan, UT 84322-5230, USA; phone: (435) 797-1604, email: fred.provenza@usu.edu

Fred Provenza is originally from Colorado where he began his career working on a ranch near Salida. He worked on the ranch while earning a B.S. Degree in Wildlife Biology from Colorado State University. At Utah State University, he earned M.S. and Ph.D. degrees in Range Science. He joined the faculty there in 1982 and is currently a Professor Emeritus in the Department of Wildland Resources. He has been author or co-author of over 225 publications in peer-reviewed journals and books. He has received awards for research, teaching, and mentoring students. He received the two most prestigious awards given by Utah State University: in 1999, the Outstanding Graduate Mentor Award and in 2008, the D. Wynne Thorne Award for exceptional achievements in research. These awards represent the efforts of well-over 75 graduate students, post-doctoral students, visiting scientists and other colleagues he has worked with over the past 30 years.

Large Herbivores and Plants: Consequences of Interactions and Feedbacks

Terry Bowyer, Idaho State University, Pocatello, ID, Kelley M. Stewart, University of Nevada Reno, Reno, NV and John G. Kie*,* Idaho State University, Pocatello, ID

We review basic interactions among plants and large, herbivorous mammals. We begin with traditional views of plant-animal interactions, including the restructuring of plant communities based on high population density of animals, their foraging behavior, and resulting shifts in plant species composition. We examine feedbacks from reduced forage availability and quality resulting from increased population density on the dietary niche breadth of large herbivores. We also consider effects on nutritional condition of large herbivores and subsequent effects on their population dynamics. We follow this review with a description of positive effects of large herbivores on plants and their ability to serve as a keystone species, including the processes of herbivore optimization, and enhanced nutrient cycling. Herbivores are not randomly distributed across the landscape and factors that influence their local densities have profound effects on ecosystem structure and function. We discuss factors that hold potential to alter the distribution of large herbivores, including reasons underpinning sexual segregation, selection of birth sites, and risk of predation. Finally, we discuss how our knowledge related to the distribution and population dynamics of large herbivores could aid in management actions.

Contact: Terry Bowyer, Department of Biological Sciences, Idaho State University, 921 South 8th Avenue, Stop 8007, Pocatello, ID 83209-8007, USA; phone: (208) 282-4082, email: bowyterr@isu.edu

Dr. R. Terry Bowyer is a Professor in The Department of Biological Sciences at Idaho State University. He joined the faculty at ISU in 2004 following 18 years at the Institute of Arctic Biology, and Department of Biology and Wildlife at the University of Alaska Fairbanks. He is a Fellow of the American Association for the Advancement of Science, The Arctic Institute of North America, and The Wildlife Society. He has received the Arthur S. Einarsen Award from the Northwest Section of The Wildlife Society, The Distinguished Moose Biologists Award, and the C. Hart Merriam Award from the American Society of Mammalogists. His research interests include the ecology and behavior of large mammals, and he has published extensively on sexual segregation and birth-site selection in ungulates. He, his wife Karolyn, and 2 black Labrador retrievers (Pepper and Otis) reside on a small farm in Blackfoot, Idaho.

Management Plans – Managing Big Game in Balance with Available Habitat

Alan Clark, Utah Division of Wildlife Resources, Salt Lake City, UT

Since 1994, Utah State law (23-16-7) requires the Division to prepare a management plan for each deer and elk unit in the state. In developing the plan, the Division must consult with public land managers, private landowners, sportsmen, and ranchers. Management plans must have target herd size objectives. In establishing these objectives, the Division and Board must consider the carrying capacity and land ownership; and seek to balance multiple uses for the range. Once the plans are approved by the Wildlife Board the Division is required to manage each herd unit in accordance with the plan. Since the law was passed, several changes have been made to the plans and the process to improve the final product and insure participation by the public. A statewide species plan is adopted to guide the development of the unit plans. An assessment of each unit is completed that uses available habitat information to evaluate carrying capacity. Each plan also identifies opportunities for habitat projects to improve the carrying capacity and address habitat projects. Each unit plan is developed in conjunction with a local committee for public input and then the plans are presented to our regional advisory councils prior to consideration by the Wildlife Board. Once adopted, we require our management recommendations for harvest (primarily antlerless) of elk and deer to be consistent with the plans. Private landowners are provided with numerous opportunities to benefit financially from the deer and elk herds. The Division strives to make wildlife valuable to all people and this approach to managing deer and elk is consistent with that philosophy.

Contact: Alan Clark, Utah Division of Wildlife Resources, PO Box 145610, 1594 West North Temple, Salt Lake City, UT 84114-5610, USA; phone: (801) 538-4734, email: alangclark@utah.gov

Alan received his bachelor's degree in Wildlife Science at the University of Maine and his Master's in Wildlife Management Degree from Virginia Tech. He went on to spend the next 23 years with the Maine Department of Inland Fisheries and Wildlife In 1996, Alan joined the Utah Division of Wildlife Resources as the wildlife planning manager. In 1998, Alan became the Wildlife Section Chief with the Division. In this position, he and his Salt Lake staff were responsible for all terrestrial wildlife programs in Utah from black-footed ferrets and Mexican Spotted Owls to sage grouse, cougars and big game. In October of 2006, Alan was selected to the position of Assistant Director with the Division supervising the five regions and the three management sections (Aquatics, Habitat, and Wildlife). Alan has been married to his wife Linda for 38 years. He has two living daughters and 4 grandchildren. He is interested in all things outdoors. He serves as President of the local water company in Erda and is a licensed water system operator.

Perceptions of Wildlife and Rangelands; It's Not as Simple as We Think

Jim Davis, Utah Division of Wildlife Resources, Provo, UT

Since there has been a Utah Fish and Game (now Utah State Division of Wildlife Resources), there has been both perceived and factual problems related to many wildlife issues throughout the years. Many instances of these controversial conflicts were associated with big-game species. For years the Division has been involved in a series of investigations to determine if there was a critically valid problem with some of the big game ranges. Some of these investigations included clipping studies (paired baskets) determining if late spring use by elk throughout much of the state was excessively high before cattle came onto the sites. These studies occurred from the north slope of the Uinta Mountains to Elk Ridge in southeastern Utah. It was determined that early elk use on average was about 11%, where cattle use was around 68%. It was determined that drought was having more of an effect on forage production than early elk use. Another investigation involved the sagebrush die-off in Beef Basin. Agency personnel and the permittee had determined that it was excessive big game use causing the downward sagebrush trend. Therefore, special doe hunts were used to lower the deer numbers. Because of the low deer population, there have only been limited entry hunts since then. There was no livestock use and season of use adjustment as it remained the same throughout the years, except for a two year rest. This was done too late to save the sagebrush within this low lying area. Through years of monitoring this area, it was shown that big game use was not the real problem, but excessive use by livestock coupled with drought. Another investigation was involved in a problem with excessive big game use on a very small population of birch leaf mahogany in the central mountains of Utah. This population occurred about 2,000 feet above its normal elevational range. This was an instance of how a small outlier population was trying to be used as the major criteria for the management of big game populations in the area. In another investigational study, it was with regard to the Book Cliff initiative. Here there was a perception by a permittee that there was excessive use of the range by elk. After increasing permanent transects in the Book Cliffs from about 18 to almost 60 in three years, it was determined that elk use was not excessive. In another investigation, there was a perception of excessive use by elk and deer on sagebrush on a bench area south of Panguitch. It was determined after careful monitoring of the area, that there was not excessive use of the sagebrush within the area. However, with the drought and only a little more than 1 cm of annual growth, it appeared the plants were being heavily hedged. There was actually very little evidence of use being made of the browse resource by wildlife. Another investigation involved the trends for winter sagebrush range in Utah. Here it was thought that the downward trends were mostly because of excessive use. After many years of monitoring these communities, it was determined that utilization was not the major negative variable affecting the trend for sagebrush, but climate change coupled with drought in association with weedy herbaceous species. Attention will be focused on how these factors have affected Wyoming big sagebrush more than mountain big sagebrush. The Palmer Drought index value was its highest for most of the state in 2002 than at any time since 1950. This high value coincided

with a state wide die-off of sagebrush and aspen. The sagebrush population at lower elevations has decreased on average by 50% or more. In the last 20 or more years, it has been noticed that most pinyon trees associated with the low elevation p-j woodlands have died, especially those on south and west aspects. How much of an effect has climate change, coupled with drought had on aspen that occupies its lower elevational range? This would even be more apparent on south and west aspects.

Contact: Jim Davis, Utah Division of Wildlife Resources, 735 North 500 East, Provo, UT 84606-1865, USA; phone: (801) 361-9113, email: jimdavis@utah.gov

Jim has worked on vegetation and wildlife studies with the Division of Wildlife Resources since 1973. He was assistant project leader for Restoring Big Game Range in Utah from 1977-1991 at the USFS Shrub Sciences Lab in Provo with Perry Plummer. Jim was then project leader for Utah Range Trend Studies from 1991-2009 where the project report format was changed to make it more user friendly for the different agencies which utilize the information in these annual reports. The Desirable Components Index (DCI) was also developed at this time to assist wildlife managers in managing the changing wildlife populations to reflect more realistic habitat conditions in their management recommendations. He also established alternate funding in 1992 mainly from the USFS and BLM to improve the projects funding base. Jim is currently doing special projects with the Division's habitat section. He received his Ph.D. in Range Ecology from Brigham Young University and has been adjunct faculty since 1994 serving on numerous graduate committees on projects involving wildlife issues.

Ungulate Herbivory as a Chronic Disturbance Agent on Western Landscapes

Marty Vavra, USDA Forest Service, Pacific Northwest Research Station, La Grande, OR

In the western United States, foraging by wild ungulates has not been recognized as an ecological force as evidenced by the lack of its mention in land management plans. Ungulate herbivory has the potential to influence nutrient cycling, net primary production, and act as a chronic disturbance agent, thereby influencing ecosystem patterns and processes. Ungulates can alter forest successional pathways and disturbance regimes as validated in recent research conducted in northeastern Oregon. Identifying how ungulate herbivory influences composition and structure of forest understories following disturbance is critical to successful forest management. Potential impacts to biodiversity have not been addressed. Additionally, herbivory-induced changes in the understory may affect productivity of native ungulate herds and the degree of interspecific competition among ungulates. The issue of scale is very important when considering management and planning of successional dynamics for habitats that cross land ownerships. Unfortunately, private landowners, state government agencies, and federal agencies each manage landscapes at different temporal and spatial scales. These scales of management may or may not align with the scales at which interactions between herbivores and plants play out. Conflicting management actions may be counterproductive to the management of ungulates. Timber harvest or the lack thereof, human disturbance (road density, off-road recreation), and livestock grazing may positively or negatively impact animal distributions across landscapes. The overarching challenge facing managers is to develop information systems through which multi-species management can be planned so as to demonstrably contribute to long-term ecosystem sustainability.

Contact: Marty Vavra, USDA Forest Service, PNW Station Forestry and Range Sciences Lab, 1401 Gekeler Lane, La Grande, OR 97850, USA; phone: (541) 962-6561, email: mvavra@fs.fed.us

Thirty-nine years of experience working with range livestock grazing systems, livestock/wildlife relationships, and ungulate ecology in Eastern Oregon. Previously was Professor of Rangeland Resources and Superintendent Eastern Oregon Agricultural Research Center, Burns and Union, Oregon State University. Currently Rangeland Scientist and Leader Starkey Ungulate Ecology Team, Forestry and Range Sciences Lab, PNW Research

Station, Forest Service, La Grande, OR. Research emphases include the effects of ungulates on the processes, structure and composition of plant communities and ecosystems with emphasis on post disturbance plant succession; nutritional ecology of ungulates; livestock/wildlife relationships; ungulate behavior; livestock grazing management; and the influences of forest and range management practices on ungulates.

Wyoming's Big Game Population Management – Trials, Tribulations, and Other Considerations

Daryl Lutz, Wyoming Game and Fish Department, Casper, WY

Big game (for purposes here - pronghorn, mule deer and elk) population management in Wyoming is driven by a "management by objective" paradigm. Population objectives are based on desired numbers of animals after the hunting season or "postseason". Objectives are a bio/socio/political management targets agreed to by the Department, landowners, hunters and other "publics", and Federal land management agencies (i.e., BLM and USFS). Pronghorn numbers in Wyoming continue to do quite well, while mule deer struggle and elk are thriving with the exception of herds adjacent to the park where calf survival is decreased. Elk management is driven primarily by population size with only little consideration to habitat. The Department struggles to adequately increase elk harvest, despite liberal season structures, for a variety reasons. Considerations for other species such as sage-grouse and lynx can complicate efforts to improve important wildlife habitats including sage-brush and aspen and associated communities. The Department is including more habitat information when considering changes to population objectives and recommended hunting seasons. The Mule Deer Initiative directs the Department in the development of management plans for key herds. Finally, an analysis of sage-brush productivity and use by pronghorn is considered.

Contact: Daryl Lutz, Casper Regional Office, Wyoming Game and Fish Department, 3030 Energy Lane, Casper, WY, 82604, USA; phone:(307) 473-3400, email: Daryl.Lutz@wgf.state.wy.us

Daryl graduated with a Bachelor's degree in Wildlife Management and Conservation from the University of Wyoming and a Master's degree in Wildlife Biology from Humboldt State University in Northern California. Daryl has been dedicated to Wyoming's wildlife and to the Wyoming Game and Fish Department for 23 years. During his career he has served as a Habitat Project Biologist, the Brucellosis-Feedground-Habitat Biologist, staff Wildlife Biologist, District Wildlife Biologist, and now as a Wildlife Biologist Supervisor. His primary focus is the "balancing act" between wildlife population sustainability and socio/political expectations. He is the Chairman of the Department's Mule Deer Working Group and represents Wyoming on the Western Association of Fish and Wildlife Agency's Mule Deer Committee. While away from the office, Daryl enjoys his family and of course nearly anything out-of-doors including hunting, fishing, snowmobiling, and skiing.

Managing Elk in the Absence of an Intact Ecosystem: Challenges in Rocky Mountain National Park

Therese Johnson, Rocky Mountain National Park, Estes Park, CO

Following a seven year research phase and four year interagency planning process, Rocky Mountain National Park recently began implementing an Elk and Vegetation Management Plan. Though specific management approaches generate significant controversy and public debate, there is broad consensus among varied stakeholders that some action to reduce elk numbers and redistribute the population is needed. Lack of a full complement of native predators and development outside the park are key stressors that contribute to the overabundant and habituated elk population, resulting in significant declines in aspen and willow habitat that support high biodiversity. There are constraints to restoring predators in the region and hunting is not

appropriate in the park, so other management strategies are needed to work toward ecosystem restoration. Plan implementation focuses on adaptively using a combination of conservation tools, including redistributing and culling elk, fencing, and various techniques for restoring aspen and willow. The elk population and vegetation conditions are monitored and results are used to guide adaptive management as needed to meet measurable objectives. Long term success will require management flexibility and persistence, as well as continued public support.

Contact: Therese Johnson, Rocky Mountain National Park, Estes Park, CO 80517, USA; phone: (970) 586-1262, email: Therese_Johnson@nps.gov

Therese earned a B.S. in Wildlife Biology in 1985 and M.S. in Rangeland Ecosystem Science in 1995, both from Colorado State University. She has worked for the National Park Service in various parks since 1983, working on a wide range of natural resource issues, including management of threatened/endangered and exotic species, vegetation and wildlife management and monitoring, air and water quality, and ecosystem restoration. For the past 17 years Therese has been a biologist at Rocky Mountain National Park, where her primary focus is on elk management issues. From 1994 through 2002 she coordinated research and modeling on the elk population, aspen, willow and beaver populations in the park, followed by leading an interagency planning team in developing an Elk and Vegetation Management Plan/Environmental Impact Statement from 2003-2007. Since 2008 Therese has focused on implementation of the plan and associated monitoring.

Landscape Restoration: Wicked Stuff

Jessica Clement, Colorado State University, Fort Collins, CO

There is ample evidence in the social psychological literature of the importance of wildlife and wildlife issues to the American and Western public (Clement and Cheng 2010, Teel and Manfredo 2009). The importance of wildlife is an overriding factor in many policy decisions, e.g. the Wyoming Range Legacy Act of 2007 or the Arctic National Wildlife Refuge discourse. The idea of "restoring" a landscape or watershed can mean many things to many people but it is an important avenue to combine multiple stakeholders in addressing multiple issues in a cohesive manner over a large landscape. This is a tall order – a "wicked", complex, interconnected proposition. Collaborative learning, as most of us know, is a public process for science and information transference and absorption. Creating methods where science and information can be heard, understood and trusted can lead to sustainable collaborative decision making processes for large landscape scale efforts. What do we need for collaborative learning to work? And what does this mean for scientists and agency professionals? I will share some experiences from my work with the Colorado Forest Restoration Institute and finish with some policy thoughts.

Contact: Jessica Clement, Colorado Forest Restoration Institute, Colorado State University, 132 Forestry Building, 1001 West Drive, Fort Collins, CO 80523-1401, USA; phone: (970) 491-2104, email: Jessica.Clement@ColoState.edu

Born in the Netherlands, Jessica has studied, researched and taught at Colorado State University and Colorado Mountain College in ecology, natural resource management and human dimensions in natural resources for the last twenty years. Before that she worked in several countries in journalism and other media related subjects and has served as Assistant Dean at Colorado Mountain College. As Research Associate and now Co-Director in the Colorado Forest Restoration Institute at Colorado State University, she is in charge of the administration of the Institute and leads all programs related to ecological and social capacity monitoring, support for place-based collaboration, and science-policy discourses. Jessica also advises and works with national forests, wildlife refuges and wildlife agencies in Colorado, Wyoming and Montana, and is exploring the intersections between landscape restoration and resilience, rural community economic capacity and climate change.

Designing Adaptation for Habitat and its Users in the Face of Climate Change

James Catlin and Allison Jones, Wild Utah Project, Salt Lake City, UT

National interest has brought new resources to scientists and land managers to design and implement new approaches to rangeland management and monitoring that can help rangeland systems better respond to pending changes in our climate. This presentation explores the relationship of ecosystem assessments that assess habitat resilience, the role of rangeland ecological condition in adaptation to climate change, and an update on agency progress in this area. Climate change analysis predicts range shifts for plant communities and dependent wildlife. These analyses show a number of wildlife and specific plant species that are shifting up in elevation and moving to the north. The degree of these shifts may be influenced by restoring habitat resilience. Maximizing the chances of our western rangelands to achieve resiliency in the face of climate change may call for a review and, if needed, some modification of land managers' assessment tools and management programs. This presentation will examine the opportunities and challenges that we face in this area.

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Jim Catlin, project coordinator and native Utahan, has been active in public land issues for more than 30 years. His PhD from the University of California at Berkeley focused on GIS and land use planning. His MS in regional land use planning at the University of Utah analyzed Wasatch Front air quality. In 1996, under the guidance of The Wildlands Project (now called the Wildlands Network), Jim founded the Wild Utah Project to support the work of other Utah conservation partners. In addition to overseeing data collection and analysis necessary for reserve design projects in Utah, Jim provides GIS support and scientific analysis for Utah environmental organizations.

Audience comments, moderated discussion and synthesis

Frank Howe, Utah Division of Wildlife Resources, Utah State University, Logan, UT

Contact: Frank P. Howe, Utah Division of Wildlife Resources, 1594 West North Temple, Suite 2110, Salt Lake City, UT 84114-6301, USA; phone: (801) 244-4329 (C), (435) 797-8523, email: frankhowe@utah.gov

Dr. Frank P. Howe, is the University Liaison for the Utah Division of Wildlife Resources and serves as an Assistant Professor in the Wildland Resources Department at Utah State University; is also Adjunct Faculty in the Plant and Wildlife Sciences Department at Brigham Young University. Dr. Howe works with UDWR staff, Utah's universities, and various partners to create applied ecology research projects related directly to current issues in wildlife management and ecology. Many of these issues revolve around plant and wildlife interactions including bison and cattle interactions with range habitats on the Henry Mountains, response of sage-grouse to shrubsteppe restoration, avian community relationships to riparian habitats, and the habitat characteristics of Lewis's Woodpeckers in aspen. Frank has Bachelor's degrees in Biology and Anthropology from St. Cloud State University in Minnesota, an MS in Wildlife Science from South Dakota State University and a Ph.D. in Wildlife Biology from Colorado State University. He has served in various positions with UDWR since 1992. He enjoys long walks on the beach and a glass or two of wine by the fireplace.

Using Large Carnivores for Restoring Western Ecosystems

Bill Ripple, Oregon State University, Corvallis, OR

Following the extirpation of large predators in the American West, increased ungulate herbivory appears to have profound effects on both terrestrial and aquatic ecosystems. I summarize the 20th century effects in five western national parks. In these parks, the loss of large predators allowed large herbivores to heavily impact riparian plant communities, thus leading to a loss of biodiversity. Only in Yellowstone National Park, where wolves (*Canis lupus*) have been reintroduced, it appears that impacts to plant communities are being reversed. The reintroduction of wolves in other areas of the west could initiate trophic cascades and ecosystem restoration.

Contact: Bill Ripple, Department of Forest Ecosystems and Society, 314 Richardson Hall, Oregon State University, Corvallis, OR 97331-5704, USA; phone: (541) 737-3056, email: bill.ripple@oregonstate.edu

Dr. Ripple has been a professor at Oregon State University since 1988, where he earned his PhD in 1984. He has spent the last 13 years studying predator, prey and plant relationships in western North America. His research has shown that the presence and absence of large predators is linked to the structure, function, and/or biodiversity of ecosystems in diverse biomes. He has published 75 scientific journal articles of which 35 of them are on the topic of large predators and trophic cascades.

What Does the Historical Record and Our Knowledge of Rangeland Ecology Suggest about Future Trends in Deer and Elk Populations?

James M. Peek, University of Idaho, Moscow, ID

I hypothesize that over the past 60 to 70 years, North America experienced higher populations of deer (*Odocoileus hemionus*, *O. virginianus*) and elk (*Cervus canadensis*) than previously occurred, including prior to 1500 AD. The hypothesis is defended using information on aboriginal populations, observations by the Lewis and Clark Expedition, and assumptions concerning habitat conditions and grazing influences. If the hypothesis approximates reality, we may ultimately experience lower densities of these species as more attention is given to long-term habitat sustainability and biodiversity, coupled with climate change and increases in predators.

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Jim Peek retired in 1999 from the Department of Fish & Wildlife Resources at the University of Idaho. His research interests centered on ungulates and their habitats, with first publications in 1962 and continuing. He is currently working on a review of large predator management in North America for The Wildlife Society, an analysis of a 20-year record of plant production and mineral content from shrub-steppe in central Idaho, and a history of the Lochsa Elk Herd. He does not plan to retire fully until dementia becomes so severe he can't remember what he was supposed to be doing with these efforts, which, in retrospect, may not be far off.

A Foundation for Conflict: Wildlife Values in the West

Tara L. Teel, Colorado State University, Fort Collins, CO

Western states are going through a number of changes that have affected and will continue to affect natural resource management. Changes include population growth, changes in in-migration rates and land ownership patterns, increasing income and education levels, growth in technology, and urbanization. Using data from

a long-term research program entitled Wildlife Values in the West this talk will explore how some of these broad societal forces are shaping the composition of public values toward wildlife throughout the western region. Wildlife Values in the West is a project of the Western Association of Fish and Wildlife Agencies Human Dimensions Committee. It is a collaborative regional effort involving social science researchers from Colorado State University and representatives from participating state fish and wildlife agencies. Data for the first phase of this program, completed in 2005, were collected through administration of a mail survey to a sample of residents in 19 states (n = 12,673). Results and related implications from this 19-state effort will be discussed, including the impacts value shift may have on public acceptance of wildlife management strategies and on demand for participation in wildlife-related recreation activities. Findings provide a broad context to assist natural resource agencies in better understanding diverse publics and planning for the future of wildlife conservation in the west. Highlights of results from recent follow-up investigations will also be touched upon briefly to convey how values information, when collected in a spatially-explicit manner at finer degrees of resolution and paired with biological data, can offer a useful tool for managers attempting to deal with conservation challenges and public education at more local levels.

Contact: Tara Teel, Department of Human Dimensions of Natural Resources, Colorado State University, Fort Collins, CO 80523-1480, USA; phone: (970) 491-7729, email: tteel@lamar.colostate.edu

Tara Teel is an Associate Professor in the Department of Human Dimensions of Natural Resources at Colorado State University. She also currently serves as President of the Social Science Working Group of the Society for Conservation Biology. Her work focuses on improving conservation decision-making through understanding human thought and behavior and through building social science capacity among conservation professionals. She works closely with natural resource agencies in the application of social science to inform their planning, management, and communication efforts. Dr. Teel teaches courses at CSU in natural resources tourism, theory in human dimensions of natural resources, and survey research methods and statistics. She has also organized a number of human dimensions short courses and training programs for practitioners. She received her Ph.D. in Human Dimensions of Natural Resources from CSU, with emphasis in social psychology, and M.S. and B.S. degrees in Fisheries and Wildlife Management from Utah State University.

Distribution and Habitat-use of Canada Lynx in Montana and Wyoming: Issues and Challenges to Management

John Squires, USDA Forest Service, Rocky Mountain Research Station, Missoula, MT

Our understanding of lynx ecology in the Northern Rocky Mountains has improved significantly since federal listing in 2000. To investigate broad-scale habitat selection (Type 2 selection), we used logistic regression in a GIS framework to compare 59 used home ranges to a Monte Carlo simulation of 1,000 available home ranges within the available landscape. Lynx select home ranges in spruce-fir forests at mid-slope elevations 1435–1935 m in areas with low topographic roughness. We also studied resource use within home ranges (Type 3 selection) based on vegetation analysis of summer relocation points (1,260) and along 582 km of winter backtracks. Within home range during winter, lynx select mature spruce-fir forests with high horizontal cover, deep snow, and abundant snowshoe hares. Lynx are limited in their distribution in the contiguous US; northwestern Wyoming is the southern-most native population in North America. I discuss how the species' ecology frames the issues for management and conservation.

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John Squires is a Research Wildlife Biologist with the Rocky Mountain Research Station located in Missoula, MT. From 1991-97, he studied the seasonal changes in the habitat-use patterns of Northern Goshawks nesting

in Wyoming. Since 1997, John as a member of the RMRS's Missoula Wildlife Unit studies the ecology and conservation of Canada lynx and wolverine in the Northern Rocky Mountains. John also remains active in raptor conservation and management through a new study investigating ferruginous hawks and energy development.

Conserving Canada Lynx: Progress and Challenges in the Intermountain West

Danielle K. Chi, USDA Forest Service, Intermountain Region, Ogden, Utah

On March 24, 2000, the U.S. Fish and Wildlife Service (FWS) listed the contiguous United States Distinct Population Segment (DPS) of Canada lynx as a threatened species under the Endangered Species Act. In the final rule, the FWS concluded that the factor threatening Canada lynx in the U.S. was the inadequacy of existing regulatory mechanisms, specifically the lack of guidance for conservation of lynx in the National Forest Land and Resource Management Plans and the BLM Land Use Plans (LRMPs). In anticipation of the listing, the Forest Service (FS), BLM, National Park Service (NPS), and FWS developed the Lynx Conservation Assessment and Strategy (LCAS) which outlined measures intended to minimize or avoid adverse effects to lynx resulting from agency actions including, but not limited to management of timber, recreation, grazing, and roads and trails. The FS and BLM committed to considering direction in the LCAS through a Conservation Agreement, until relevant LRMPs had been amended or revised to include guidance for conservation of lynx. Since that time, numerous individual Forests have amended/revised their LRMP to address conservation of lynx as outlined in the LCAS. Further, several broad, geographically-based conservation strategies have been completed that have simultaneously amended the LRMPs of multiple Forests. This presentation describes progress and challenges in implementing one of these strategies, the Northern Rockies Lynx Management Direction, particularly in the southern portion of the planning area – Wyoming, Utah, and southern Idaho.

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Danielle Chi is the regional wildlife program leader for the Intermountain Region of the Forest Service in Ogden, Utah. She holds a Master's degree in psychology from San Diego State University, and a Ph.D. in wildlife biology from Utah State University. Her graduate research focused on carnivore behavior, particularly related to human-wildlife interactions. Prior to joining the Forest Service, she worked for the U.S. Fish and Wildlife Service in California dealing primarily with endangered species policy and implementation. She has been in her current position since 2005, and represents the Intermountain Region of the Forest Service as a member of the national Lynx Biology Team.

Elk, Cattle, Beaver and Willow – Interactions on the Dixie and Fishlake National Forests

Mary O'Brien, Grand Canyon Trust, Castle Valley, UT

The ecosystem services of dam-building beaver are manifold, and particularly so in the face of climate change in the Southwest. Beaver currently occupy a small proportion of formerly-occupied habitat on the Dixie and Fishlake NFs of southern Utah. Riparian assessments on the Dixie and Fishlake NFs during 2008-2010 have documented distinct recruitment deficits in willow, cottonwood, and aspen, with willow experiencing perhaps the greatest deficits. When beaver abandon or are removed from a site, willow recruitment may be prevented by excessive ungulate use, potentially precluding the return of beaver to that site.

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Mary O'Brien (PhD, Botany) serves as Utah Forests Program Manager for Grand Canyon Trust (2003-present). She has served as a staff scientist with conservation organizations since 1981, including Northwest Coalition for Alternatives to Pesticides, Environmental Law Alliance Worldwide, Environmental Research Foundation, and Hells Canyon Preservation Council. Her work has focused on alternatives to current management of toxics and public lands, and is author of Making Better Environmental Decisions: An Alternative to Risk Assessment (MIT Press, 2000).

Predation Impacts on Native Species and Vegetative Communities

Michael Bodenchuk, USDA-APHIS-Wildlife Services, San Antonio, TX

Predation affects native wildlife in both abundance and in habitat use. Non-native predators can overwhelm naive prey which have not developed adaptive strategies for predation avoidance. Even native predators can negatively affect prey in altered ecosystems. Because prey species make habitat selections based on the risk of predation, even restored vegetative communities may not be utilized if predation impacts habitat use negatively. Restoration of western systems may require management of native predators and the elimination of non-native predators to assure investments in habitat are worthwhile.

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Mike Bodenchuk is currently the State Director for the Texas Wildlife Services Program. He also served as the State Director for Wildlife Services in Utah from 1996 to 2006 and as a District Supervisor in Richfield Utah from 1993-1996. Mike attended New Mexico State University and graduated in 1979 with a degree in Wildlife Sciences. His professional Interests include predation and feral hog impacts and management.

A Century of Browse Impacts and the Decline and Dieback of Aspen in Arizona

Mary Lou Fairweather, Arizona Zone of Forest Health Protection, Southwestern Region, USDA Forest Service, Flagstaff, AZ

For decades, domestic and wild ungulate browse impacts on aspen regeneration were implicated, along with fire suppression, in contributing to the reduction and structural changes of aspen forests across many regions of Arizona. At present, young aspen within these areas are typically found only behind fences or on steep slopes and rocky outcrops that are more difficult for ungulates to access. The fences are termed "elk exclosures", because they are built to keep out Rocky Mountain elk, which has become the dominant browser over the last 50 years. Although elk were not known to exist on the San Francisco Peaks in northern Arizona over the first half of the 20th Century, aspen recruitment was infrequent to nonexistent due to browse impacts by domestic livestock. However, the installation of fencing in the 1940s to prevent sheep damage to research plots resulted in a regenerated treatment block that is visibly noticeable today. The aspen here are healthier and appear to have suffered less damage from conifer succession and the severe drought of 2002-2003 than surrounding aspen forests. A nearby non-traditional aspen silviculture treatment, where trees greater than 8 inches in diameter at breast height were removed, allowed residual trees to become a stand of mature aspen that is not characteristic of the surrounding forests. These historic research projects help to demonstrate the long-term impacts of browse damage.

Contact: Mary Lou Fairweather, USDA Forest Service, Arizona Zone Forest Health Protection, Flagstaff, AZ 86001, USA; phone: (928) 556-2075, email: mfairweather@fs.fed.us

Mary Lou Fairweather has been a Plant Pathologist with the U.S. Forest Service for over 20 years. She currently works for the Arizona Zone of Forest Health Protection in Flagstaff, AZ. Her primary responsibility is providing technical assistance on forest diseases to land managers. Recent focus is on the agents involved in aspen dieback and decline, including impacts on aspen regeneration; dwarf mistletoe and root disease ecology and management; and training on hazard tree identification and mitigation. Education: B.S. Biology, Fort Lewis College, Durango, Colorado; M.S. Plant Pathology, University of Arizona

Integrating Resources at the Landscape Scale to Achieve Sage-grouse Health

Terry Messmer, Utah State University, Logan, UT

Sage-grouse (*Centrocercus* spp.) are restricted to the sagebrush (*Artemisia* spp.) rangelands of western North America. In Utah, all birds located north and west of the Colorado River are known as the greater sage-grouse (*C. urophasianus*). The Gunnison sage-grouse, (*C. minimus*) is found only in San Juan County. Both species have been designated by the U.S. Fish and Wildlife Service as candidate species for listing under the Endangered Species Act. True to form, when stakeholders become concerned about the welfare of a species, to include the human condition, they organize, plan, and implement actions. Such efforts are time consuming and resource intensive. Many fail because they don't fully identify and integrate resources at the appropriate scale. This is true whether it be in conservation or health care. In this presentation I define "sage-grouse health" and discuss the role of integrating both human and natural resources at the landscape scale to achieve it.

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Terry A. Messmer, Professor and Extension Wildlife Specialist, Associate Director for Extension and Outreach, Jack H. Berryman Institute, Department of Wildland Resources, Utah State University, Logan, Utah. He and his associates, graduate students, and technicians conduct research and extension programs that engage communities, elected officials, public and private agency administrators, managers and biologists. They work cooperatively with these partners to learn more about natural resource systems as they manage them. They take great pride in knowing that the knowledge generated by research, and information disseminated through extension programming is used to make management decisions. Their efforts, in addition to providing better information to decision makers, have renewed stakeholder appreciation for the role of science in management. The community-based partnerships they facilitate are changing the way Utah citizens view conservation. The impact of their efforts was recently recognized at the 23rd Annual Utah Rural Summit when they received the 2010 Rural Utah Award.

How Highways Reduce Habitat Effectiveness in Western Forests and Sage-steppe Habitats: Challenges and Solutions

Sandra L. Jacobson, USDA Forest Service, Pacific Southwest Research Station, Bend, OR and *Patricia Cramer,* Utah State University, Logan, UT

Land and wildlife managers can help reduce the impacts of road projects on wildlife habitat by engaging early and often in transportation planning. This talk touches on the long term, landscape scale impacts of highway projects on wildlife and habitat with lessons learned in forested and sagebrush/steppe habitats in OR, ID, AZ and UT. Highways are major linear features on the landscape that destroy wildlife habitat in large quantities, estimated nationally to affect acreage equivalent to the size of South Carolina. Highways directly reduce the amount of wildlife habitat on public lands through the pavement footprint, cut and fill slopes, and large safety clear zones. Highways indirectly reduce wildlife habitat by creating noisy environments that hinder the use

of otherwise suitable habitat adjacent to highways, by creating human access points, and by using vegetated medians which are mortality sinks. The barrier effect of highways substantially reduces effective use of suitable habitat far distant from the highway itself. Mortality, the most obvious effect of highways on wildlife, has been documented to limit populations or ranges of some species. We recommend effective mitigation solutions based on science and experience including wildlife crossing structures and fencing. As important as mitigation is the active engagement of resource agencies at key points in the transportation planning and highway project development phases, where minimization and avoidance of impacts are possible.

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Sandra Jacobson is a Wildlife Biologist for the USDA Forest Service's Pacific Southwest Research Station, where she specializes in transportation ecology and provides technical expertise and training nationally. Sandra has worked for the Forest Service since 1980, primarily in the National Forest System in California and Idaho. She is an invited charter member of the National Academy's Transportation Research Board Committee on Ecology and Transportation. Sandra served on the expert panel for the Congressionally-mandated report on animal/vehicle collisions, the Western Governors Association transportation task force for their Initiative on Wildlife Movement and Crucial Habitat, the UC Davis Road Ecology Center's Scientific Advisory Committee, and is a Steering Committee member for the International Conference on Ecology and Transportation.

Patty Cramer is a research assistant professor at Utah State University. She is currently researching wildlife and roads across Utah, along US 93 in Montana, and across Washington state. Dr. Cramer was co-author with John Bissonette on the National Academies' Research Project, 'Evaluation of the Use and Effectiveness of Wildlife Crossings.' This 4 year study helped us understand the state of the practice and science of mitigating roads for wildlife in North America. This month she received the Denver Zoo's Conservationist Award for 2010.

Audience comments, synthesis and wrap-up

*Ron Ryel***,** Utah State University, Logan, UT

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Ron Ryel is an associate professor in the Department of Wildland Resources at Utah State University. Trained as a plant physiological ecologist, his research interests focus on how plants, through physiology and structure, affect ecosystem function. His work has often been conducted in shrub-steppe and western aspen systems. He sees effectively linking science to management as a priority for managing landscapes and to that end was involved in forming the Restoring the West conference series here at USU, and the Western Aspen Alliance.

Poster Abstracts

In alphabetical order by presenting author's last name;
presenting author in italics

Understory Phenotypic Plasticity and Functional Diversity May Buffer Inter-annual Variations in Overstory Soil Resource Uptake

Ronald J. Ryel and *Lauren Ducas*, Wildland Resources and Ecology Center, Utah State University, Logan, UT

Background/Question/Methods

In ecosystems dominated by woody overstory vegetation coexisting with herbaceous understory vegetation, the stability of these systems may be linked to a more equitable distribution of biomass among species than is currently found for these systems due to anthropogenic alterations. In the montane aspen forest, the herbaceous component is hypothesized to enhance persistence of the woody component by acting as a stabilizer on the system through adjusting annual production to prevailing environmental conditions, especially soil moisture availability. For the herbaceous component, growth is highly variable from year to year, closely tracking resource availability. This variable growth dampens the magnitude of soil moisture oscillations experienced by the woody component. The stabilizing effect of the herbaceous understory may be lost if the understory is subject to removal by ungulate grazing. We address this question through a combination of field measurement of soil moisture, plant performance, annual biomass production, and soil moisture simulation modeling for aspen ecosystems subject to different grazing pressures ranging from no grazing to complete removal of the understory.

Results/Conclusions

Increased community functional diversity increases the amount of soil water available to the overstory after understory peak biomass. In 2007, soil moisture remaining in the top 0.5 m in an aspen-herbaceous community was 0.08 g/g and 0.04 g/g in an aspen-sagebrush community. The peak biomass of the herbaceous understory tracks snowpack size, related to soil moisture. With a 389.2 cm snowpack (2007), peak biomass was 76.4 g/m2; for a 656.2 cm snowpack (2008), understory biomass was 153.9 g/m2. Herbaceous understory growth appears to track annual resource availability and through its resource utilization pattern (exponential vs. uniform) may exert a protective, buffering effect on the woody overstory growth. Buffering of woody species growth combined with greater access to deep water resources when herbaceous species are dormant may provide greater persistence of woody species in these communities.

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Modeling Exotic Plant Colonization and Occupancy within Riparian Areas of the Interior Colombia River and Upper Missouri River Basins, USA

David M. Evans[1], Robert Al-Chokhachy[2], and Peter Ebertowski[3]
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Exotic plant invasions into riparian areas often result in vegetation composition shifts, altered stream function, and cascading effects to biota at multiple scales. Current land management practices tend to increase the susceptibility of riparian areas to exotic plant invasions. In this study, we examined the colonization and occupancy patterns of three highly aggressive, invasive plant species common to the Interior Columbia River and Upper Missouri River Basins: cheatgrass (*Bromus tectorum* L.), Canada thistle (*Cirsium arvense* L.,

Scop.), and spotted knapweed (*Centaurea stoebe* L.). We used repeat data from vegetation surveys realized at 194 reference and 897 managed steams within our study area and incorporated landscape, disturbance, and climatic covariates into our models. We converted our repeat data to presence-absence data and used Program MARK to model colonization, occupancy, and detection with both open (sites with inter-annual repeat data) and closed (sites with intra-annual repeat data) populations. The species differed widely in occupancy rates: spotted knapweed was the least pervasive with an estimate of 0.06 (SE = 0.02). Canada thistle and cheatgrass estimates were lower at reference streams, with estimates of 0.27 (SE = 0.07) and 0.5 (SE = 0.05), respectively, and higher at managed sites (Canada thistle = 0.36, SE = 0.05; cheatgrass = .14, SE = 0.04). Colonization rates were generally low, except for cheatgrass in the reference sites (~ 0.1, SE = 0.07). Detection rates were similar for spotted knapweed and Canada thistle (~ 0.42), and much lower for cheatgrass (0.22). The top occupancy models (i.e. with lowest AIC values) were driven by percent shrub (+), temperature (+), percent grazing (spotted knapweed (-), cheatgrass (+)), road densities (+), and management class. Top colonization models were driven by percent shrub (+), precipitation (-), percent burned (+), and management class. Although management activities (i.e. percent grazing, road densities) were generally correlated positively to occupancy of invasive plants, spotted knapweed occupancy was negatively correlated with percent grazing. This suggests that spotted knapweed may be utilized by livestock (esp. sheep) or wildlife. The prevalence of Canada thistle and colonization ability of cheat grass in reference sites is disquieting. Susceptible landscapes include higher percent shrub and grass cover types and higher temperatures, typical of xeric steppe systems at low elevations. Moist forested systems at higher elevations may be less prone to exotic plant invasions. Many previous studies evaluating the status and trends of plant species have failed to incorporate low detection rates into their models. Occupancy modeling offers an alternative strategy to logistic modeling because it can account for low detection rates.

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Ecological Tradeoffs in Western Aspen

Richie Gardner, Utah State University, Logan, UT

Quaking aspen (*Populus tremuloides*) is the most widely distributed tree species in North America (Little, 1971), and in western landscapes it provides habitat for a disproportionately high number of animal species. Aspen reproduce sexually via seed and asexually via vegetative underground rhizomes. The result of these two methods of reproduction is a collage of cohesive, multi-stem clones of varying sizes. Aspen clones within populations are extremely diverse with respect to genetic traits, including growth rates and chemical defenses. The long-term maintenance of such remarkable diversity is puzzling, and is likely due to a complex set of varying selective pressures, interactions among clones, and ecophysiological tradeoffs. Aspen can protect itself from insect herbivory via foliar chemical defenses (phenolic glycosides and condensed tannins) and tolerance (i.e. robust regrowth / resilience). The variance in both traits has a strong genetic component. Ecological theory suggests that tradeoffs may exist between chemical resistance and resilience among species and individuals within species, and that resistance and resilience represent contrasting strategies for adapting to herbivory. Using molecular tools we identified related ramets within distinct clones. We sampled these ramets for phytochemistry and growth (measured dendrochronologically). Our results indicate evidence of a trade-off between growth and two phenolics (salicortin and tremulacin). Condensed tannins displayed a positive relationship with increased growth. Understanding how distinct clones of aspen persist on landscapes may allow us to make more informed management decisions. It may become common for forest land managers to consider genetic diversity of aspen stands to promote long-term persistence of aspen forest cover type in the Intermountain West.

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Mitigating Elk Browsing of Aspen Regeneration on Blue Valley Ranch

John Kossler, Blue Valley Ranch, Kremmling, CO

Over 550,000 acres of Colorado's aspen (*Populus tremuloides*) cover-type have been impacted by the Sudden Aspen Decline (SAD) phenomenon. Additionally, an estimated 1.9 million acres of lodgepole pine (*Pinus contorta*) in Colorado have been affected by the exponential spread of Rocky Mountain pine beetle (*Dendroctonus ponderosae*). Both of these phenomena have severely impacted forests on Blue Valley Ranch in Grand County, CO, and efforts to initiate forest regeneration have included thinning, clear-cutting and dozing over 1,600 acres of forest over the past 6 years. Aspen is the first species to respond to timber treatments, but elk browsing has suppressed aspen regeneration in treatments of both pure aspen stands and lodgepole pine. To mitigate severe browsing on aspen, the ranch has constructed small enclosures around selected aspen clones, totalling 82 miles of wildlife fence enclosing 250 acres. The ranch also allows public cow-hunters access to the ranch, at no cost, for management hunts, and has harvested over 550 cows in fifteen years. During the 2009 growing season, non-permanent, fixed radius plots were used to determine aspen regeneration and extent of browsing. Aspen regeneration in 1 year old, unfenced dozer treatments was highly variable, ranging from 6,200 stems/acre to nearly 22,000 stems/acre, with browsing occurring on 22-53% of new suckers after only one growing season. Elk browsing on aspen regeneration occurred on 0% of aspen suckers in treated, fenced stands, and over 90% of suckers in untreated, unfenced stands. Elk impacts on forest regeneration remain a significant issue for Blue Valley Ranch and present a challenge in managing for healthy elk populations as well as successful forest regeneration over spatial scales that extend beyond ranch boundaries.

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Vulnerability of Quaking Aspen and Avian Communities to Global Climate Change

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Quaking aspen populations are declining in much of the Intermountain West due to altered fire regimes, competition with conifers, herbivory, drought, disease, and insect outbreaks. Aspen stands typically support higher bird biodiversity and abundance than surrounding habitat types, and maintaining current distribution and abundance of several bird species in the northern Great Basin is likely tied to the persistence of aspen in the landscape. This project will examine the effects of climate change on aspen and associated bird communities by coupling empirical models of avian-habitat relationships with landscape simulations of vegetation community and disturbance dynamics under various climate change scenarios.

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Colorado Plateau Native Plant Initiative – 2010 Progress in Native Plant Materials Development

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The Colorado Plateau Native Plant Initiative (CPNPI) was established as a part of the Bureau of Land Management's Native Plant Materials Development Program. Nationally, this program recognizes six steps in developing a reliable supply and appropriate use of native plant materials in efforts to restore degraded ecosystems. These include: 1) Native Seed Collection; 2) Evaluation and Development; 3) Field Establishment; 4) Seed Production by Private Growers; 5) Seed Storage; and 6) Restoration of Native Plant Communities. Of these, the CPNPI is focused on Steps 1-5 in order to make genetically appropriate native plant materials available so agencies and partners can achieve Step #6, the restoration of native plant communities.

In 2010, CPNPI and its partners have made progress in each of these five steps. Step 1: Native seed collections of key [or priority] species were made in each of the seven ecological sections of the Colorado Plateau by six teams during the 2010 field season. Two teams alone have made more than 80 total collections of 35-40 individual species from four ecological subsections of the Colorado Plateau. These materials will be used by researchers to meet Step 2 goals. Step 2: CPNPI has developed a partnership with U.S. Geological Survey, Southwest Biological Science Center in Flagstaff, Arizona to establish a research program focused on native plant materials of the Colorado Plateau. In addition, evaluation and development of native seed has continued through efforts of the Uncompahgre Partnership and the U.S. Forest Service. Common garden studies of six species collected from locations across the Colorado Plateau continue on four study sites in Utah, from the Ashley National Forest in the north, to the Dixie National Forest in the south. Efforts are in place to establish additional study sites that represent the ecological diversity within the Colorado Plateau. Step 3: Seed of 13 species has been made available, again through the Uncompahgre Partnership, to commercial growers. Fields are currently planted to increase native seed and improve the availability of these species for commercial development. Step 4: Three species have been comprehensively evaluated and developed and are now commercially available through this effort. CPNPI is working on building a more stable native seed market through encouraging ongoing restoration efforts and through attempts to utilize the best available purchasing and contracting protocols. Step 5: The Utah State Office of the BLM has contributed to the expansion of the Utah Division of Wildlife Resources seed storage facility in Ephraim, Utah. In addition, the national office of the BLM is providing funding for a new seed storage facility to be built in Ely, Nevada. A Five-Year Strategy and Action Plan, which defines the vision, goals, objectives and action items is available on the CPNPI web page, as is a progress report for 2009; a progress report for 2010 will be available in December 2010 (http://www.blm.gov/ut/st/en/prog/more/Colorado_Plateau/Colorado_Plateau_Native_Plant_ Initiative.html).

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Using Remote Sensing to Understand Spatiotemporal Landscape Dynamics of Aspen Decline in Southern Utah's Cedar Mountain

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Extensive mortality of quaking aspen (*Populus tremuloides* Michx.) has been observed around southern Utah's Cedar Mountain over the past decade, inciting concern among land owners and natural resource managers alike. This decline is thought to have increased during the opening decade of the 21st Century and to be correlated with drought. This study attempted to clarify various spatiotemporal aspects of the aspen decline through remote sensing. The main objective was to determine the extent of aspen coverage on the Cedar Mountain area in 1985 and to document how aspen coverage has changed over time. To accomplish this, binary

models of aspen presence-absence were created for the years 1985, 1990, 1995, 2001, 2005, and 2008 using classification and regression tree (CART) modeling. The six reflective bands of the Landsat Thematic Mapper and various topographic variables derived from digital elevation models were used as predictor variables. A post-classification comparison technique was used to spatially detect change between consecutive time periods. This study also examined aspen status across landscape position to ascertain whether aspen mortality has been more prominent on xeric sites. This was accomplished through a zonal statistics analysis using the topographic variables of slope, elevation, and aspect. All three variables were found to be significantly different between live and dead aspen. A climatic regression analysis showed that aspen mortality correlates weakly with both summer and winter precipitation. Lag periods between onset of drought and observed decline were longer for winter than summer droughts. This study suggests that water stress has exacerbated aspen mortality on Cedar Mountain, but decline has remained relatively stable over the extent of the study period.

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Plant Responses to Herbivory: Effects on Biodiversity

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Large, vertebrate herbivores act as keystone species in plant communities and have the ability to affect biodiversity primarily through foraging activities. Low levels of herbivory have been documented to increase plant productivity, whereas herbivory by very high densities of ungulates has led to devastation of plant communities worldwide. We created two population densities of North American elk (*Cervus elaphus*), one at very low density (4 elk/km2) and one at very high density (20 elk/km2) near the carrying capacity of the environment. We observed changes in net aboveground primary productivity (NAPP) consistent with the hypothesis of herbivore optimization. We hypothesized that species diversity of plants would also be related to changes in population density of large herbivores in a manner consistent with herbivore optimization. Species diversity of the plant community was not significantly related to population density of elk. We suspected that this outcome occurred because forage plants in this ecosystem were especially resilient to herbivory. We observed, however, a positive, linear relationship between net aboveground primary productivity and plant species diversity. Those areas that had the highest productivity also had the greatest species diversity of plants. Consequently, population density of these herbivores had indirect effects on plant species diversity in this ecosystem by changing productivity of the plant community thereby driving changes in plant species diversity.

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Nutritional and Chemical Factors Shaping the "Foodscape" of Two Sagebrush Dietary Specialists: Pygmy Rabbits and Sage Grouse

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Herbivory is a foraging strategy that poses special challenges because plants often invest in plant secondary metabolites (PSMs) which can decrease digestibility or have toxic consequences. Selection of plants with the lowest concentrations of PSMs and highest crude protein content allows herbivores to limit the intake of potentially toxic PSMs and meet nutritional demands. Field observations have demonstrated that pygmy rabbits (*Brachylagus idahoensis*) and greater sage grouse (*Centrocercus urophasianus*) selectively forage on specific sagebrush plants more than others within a foraging patch. We are using these systems to investigate which nutritional and chemical factors influence foraging decisions in the winter and develop a predictive model for diet selection of sagebrush in these animals. We identified and collected pairs of sagebrush with high and low levels of browsing at active pygmy rabbit burrows and sage grouse foraging sites. We are using modeling to determine whether nutritional components such as total and digestible crude protein or chemical components such as monoterpene or phenolic concentration explain diet selection by free-ranging pygmy rabbits and sage grouse. Our study tests the explanatory power for many variables to determine which ones best explain selection of certain sagebrush plants by both pygmy rabbits and sage grouse. We are currently using diet selection models to identify areas of preferred, higher quality sagebrush across the landscape, termed "foodscapes". Understanding the factors driving diet selection by sagebrush obligates like pygmy rabbits and sage grouse will help wildlife professionals better manage habitats for these species.

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Habitat Characteristics and Occupancy Rates of Lewis's Woodpecker in Aspen

Amy Vande Voort, Utah State University, Logan, UT, and Dr. Frank P. Howe, Utah State University, Logan, UT

Lewis's woodpeckers (*Melanerpes lewis*) are generally associated with open ponderosa pine (*Pinus ponderosa*), open riparian, and burned pine habitats in the West; however, this species has been found to nest in aspen (*Populus tremuloides*) stands in Utah. This project describes the habitat characteristics of Lewis's woodpecker nest sites in aspen and analyzes how well aspen stand characteristics predict Lewis's woodpecker occupancy. I surveyed for Lewis's woodpeckers at previously occupied nesting locations in aspen and took habitat measurements at nest sites following a modified James and Shugart method. Forest Inventory and Analysis (FIA) type plots were also set up at nest sites and stand level characteristics were measured. I used Program SAS to obtain means and standard errors for the habitat measurements; results were used to determine which FIA plots in Utah appear to contain habitat characteristics similar to those measured on my plots. Criteria used to select suitable FIA plots were percent canopy cover less than 46%, tree height greater than 15 feet, and diameter at base height greater than 11 inches. I next conducted occupancy surveys at FIA plots predicted to contain "suitable" and "non-suitable" Lewis's woodpecker habitat in order to field validate the habitat model. The extent to which Lewis's woodpecker occupancy (Ψ) varies with stand characteristics in aspen habitats will also be determined. Stand characteristics to be analyzed include percent canopy cover, stand size, tree height, percent vegetation cover, and vegetation height. Program MARK was used to analyze occupancy data using a single species, single season model. The data for aspen habitat will be used to aid in future occupancy surveys for Lewis's woodpeckers in Utah and can also assist forest managers in aspen restoration projects.

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Monitoring of Elk, and other Ungulate, Impacts to Aspen and Mountain Mahogany on the Jarbidge Ranger District of the Humboldt-Toiyabe National Forest

Catherine Schnurrenberger, C.S. Ecological Surveys and Assessments, Truckee, CA and *Kyra Walton*, Humboldt-Toiyabe National Forest, Wells, NV

From 1990 to 1995 approximately 100 elk were reintroduced onto the Jarbidge Ranger District of the Humboldt-Toiyabe National Forest and surrounding lands located in northeastern Nevada. The current number of elk is approximately 1,100 head. To address possible impacts from the increased number of elk the USFS directed monitoring of Aspen and Mountain Mahogany plant communities. Monitoring included pellet counts of all ungulate users, stand structure data by age class, browse of accessible aspen and mountain mahogany, understory cover and composition and notes on pathogens, insect herbivory, and rubbing and/or biting of aspen and mountain mahogany by elk.

Stand structure data for Mountain Mahogany sites suggests that there has been little regeneration within these stands over the past 100 years. Mountain mahogany <2 meters tall do exhibit signs of past browse, which may be a result of livestock management more than 50 years ago. Pellet counts in Mountain Mahogany stands indicate that most current use is by elk and deer. Pellet count data for Aspen stands indicates that all sites currently receive high use by elk, however these areas exhibit different levels of browse on suckers, and different patterns of regeneration. Stand structure data suggests that past livestock grazing had an effect on survival of aspen suckers. At present sites with high current browse by elk and/or livestock have high sucker mortality, which will continue to affect survival of aspens to the pole age class. It seems that current stand structure is a consequence of both past grazing management and current wildlife management.

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What are the Effects of Bison on Cattle Winter Range in the Henry Mountains?

Ian M. Ware, Utah State University, Logan, UT, and Peter Adler, Utah State University, Logan, UT

The American Bison residing in the Henry Mountains are one of the last free-roaming, genetically pure herds of bison left in North America. Over the last decade, the herd of 400+ bison has used cattle winter range during summer, creating a conflict between the Utah Division of Wildlife Resources and ranchers. At the heart of this conflict is the question of whether bison are negatively impacting the rangeland resource. Our objective is to determine whether bison have altered the structure of the salt desert plant community in cattle winter range. We are conducting vegetation surveys to characterize plant species composition on three adjacent, geomorphologically similar mesas. One mesa is ungrazed, one grazed primarily by cattle during winter, and the third grazed by bison in summer and cattle in winter. Our comparison across these three mesas will show whether the combined effects of cattle and bison grazing have reduced the abundance of forage species. Complementary analysis of long-term BLM monitoring data may help us confirm that any spatial differences we document reflect temporal trends. Our work will help resolve the conflict between wildlife managers and ranchers over the limited winter range resource by replacing perceptions with data.

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