



Poster Session Monday 1 Abstracts



Poster Session Monday 1: Poster Pod 1, Poster 1

EXTENSION SURVEY OF WYOMING RANCHERS REVEALS INSIGHT FOR PREDATOR-LIVESTOCK INTERACTIONS

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ABSTRACT

Predator-livestock interactions are a major concern for both agriculture and conservation globally and Wyoming, USA provides an insightful state-level case study due to the presence of a suite of carnivores. Using survey data from 274 ranches in Wyoming, we used information theory to model how ranch attributes and large carnivores influenced the timing, duration, and severity of livestock predation. We then used constrained ordination to understand how 1) landscape, weather, and animal features influence predation and 2) how livestock behavior and nonlethal loss relate to ranch attributes and large carnivores. In addition, we rated the efficacy of predation mitigation strategies for foxes, dogs, coyotes, wolves, bobcats, and birds (buzzards, eagles, hawks, ravens). Timing, duration, and severity of livestock predation were generally not explained by ranch size or number of counties but were explained by livestock type, livestock parturition (either timing or duration), and documented large carnivore loss. When asked about mitigation efficacy, ranchers reported efficacy of mitigation varied by predator species, mitigation strategy, and lethality of strategies, but not livestock type. Ranchers perceive they were most effective at mitigating predation by foxes and coyotes, moderately effective at mitigating large carnivores, and the least effective at mitigating bird predation. Ranchers also reported that avian predators seem to be the most challenging predator type. The general perception was lethal mitigation strategies were more effective than non-lethal strategies, with guard animals showing the most potential among the non-lethal options. Understanding predator-livestock interactions relative to ranch and rangeland features, parturition, large carnivore exposure, and losses that extend beyond mortalities can assist in developing novel strategies to mitigate lethal and nonlethal losses. As predator-livestock conflicts continue effective mitigation strategies are needed to ensure profitable and sustainable livestock production.



Poster Session Monday 1: Poster Pod 1, Poster 2

WILD HORSES: VALUES AND ATTITUDES TOWARDS MANAGEMENT METHODS

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ABSTRACT: MS STUDENT

Since its creation, the Wild and Free Roaming Horse and Burro Act of 1971 has been a source of conflict and controversy on American rangelands. Studies in other regions and countries have found that divergent values of wild horses held by different groups influence similar conflicts. However, the role of values and their influence on attitudes towards wild horse management methods has not been studied in relation to conflicts over wild horse management in the western United States. We interviewed Bureau of Land Management (BLM) employees, BLM permittees, and wild horse advocates in northwestern Colorado to identify and describe values each group associates with wild horses and explore how these values are related to attitudes towards different wild horse management methods. With rising wild horse populations, paralleled by increasing conflict and media attention, this study contributes to understanding the role of values and attitudes in wild horse management controversies in the western United States.



Poster Session Monday 1: Poster Pod 1, Poster 3

EVALUATING KNOWLEDGE, ATTITUDES, AND PERCEPTIONS OF RANCHERS AND BLM MANAGERS OR SPECIALISTS

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ABSTRACT

The Bureau of Land Management manages approximately 245 million acres in the United States, the majority of which are in the western half of the country. Numerous conflicts in Nevada, Oregon, Utah, and Arizona, since 2010 have resulted in fatality, armed militias, several incarcerations, and lawsuits facing the federal government. Following a preliminary needs assessment conducted in Box Elder County, Utah, and a comprehensive review of the literature, further research was needed to understand BLM professional and rancher perceptions regarding BLM policies and procedures. The study specifically looked at attitudes, perception and knowledge concerning the implementation of range improvement projects to potentially address conflicts and relationship issues between ranchers and BLM professionals. A needs assessment model was used to frame the research.

Two similar questionnaires, one for BLM professional and the other for permittees (ranchers) using federal land managed by the BLM, were developed by the researcher. The questionnaire was divided into four sections: participant characteristics; perceptions concerning BLM policies; knowledge questions related to BLM policies; and attitudes concerning federal land ownership and BLM policies. The rancher questionnaire was mailed to 182 ranchers and netted a 37.2% response rate. The BLM questionnaire was emailed to 15 BLM professionals in the Salt Lake Field office and netted an 84.6% response rate. Results were analyzed using descriptive and appropriate correlation statistics. Rancher interventions should include a) when to submit rangeland improvement projects, b) what could result in a temporary reduction in AUMs on a grazing allotment c) where to access online NEPA documents, and d) who makes final land management decisions for the BLM. BLM professionals' interventions could include the steps required for planning a juniper removal project, and when to submit a new waterline or fenceline request. Ranchers' background has minimal influence on their perception.



Poster Session Monday 1: Poster Pod 1, Poster 4

PUBLIC LAND GRAZING AND NEPA: A MULTIMEDIA EDUCATIONAL PROGRAM FOR ARIZONA COOPERATIVE EXTENSION AND BEYOND

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ABSTRACT

Ten years ago, the Rangelands Partnership (RP), an initiative of 19 western land grant universities including the University of Arizona (UA), developed a series of webpages and educational resources on public land grazing issues, including NEPA. These resources were made available via the Global Rangelands/Rangelands West websites. Over the last decade, the ecological, economic, and social debates surrounding these issues have changed as has our understanding and management of public lands grazing. In response, our team is developing a new collection of online resources to provide up-to-date information to producers and the public. The new topic page features improved design and delivery of information using videos, images, figures, and other multimedia. This poster will describe the following completed and continuing tasks and activities including: 1) Conducting a comprehensive review of the current public lands topic on the Global Rangelands/Rangelands West websites, 2) Completing research for updating topics using current science communication approaches and tools, 3) Coordinating with web designers to develop a “site map” plan to link content into a “learning module” design, 4) Conducting video interviews with extension and agency personnel, and ranchers to demonstrate how public land laws and policies impact the livelihoods of those who manage livestock on public lands, 5) Carrying out peer review of new materials and resources by RP members and Arizona Cooperative Extension faculty (on-campus and in several Arizona counties) to ensure the content brings science to bear on real world problems, 6) Rigorously testing the new web design for utility and navigation, and 7) Announcing the availability of new resources through social media, newsletters, and conference activities. In addition to the poster, we will have laptops available to allow conference participants to explore the new website.



Poster Session Monday 1: Poster Pod 1, Poster 5

RE-INTERPRETATION OF ROBINSON ET AL. 2019: PATTERNS OF RANGELAND PRODUCTIVITY AND LAND OWNERSHIP: IMPLICATIONS FOR CONSERVATION AND MANAGEMENT. ECOLOGICAL APPLICATIONS, 29(3), E01862

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ABSTRACT

In this Ecological Application's Communication, Robinson et al. (2019) compare the satellite derived net primary productivity (NPP) of US rangelands under tribal, private, and public land ownership. The authors conclude that privately owned rangelands were more than twice as productive for total and average NPP as tribal and public lands. The authors compared production at 3 spatial extents by these 3 land ownerships including the continental US, three regional administrative areas, e.g., the Western states, and by Bailey's Level II ecoregions. Bailey's ecoregions are homogenous low variance units that are stratified by precipitation, temperature, and topography and are thus appropriate replicates for studies at large spatial scales. Administrative extents, e.g., states or land ownership boundaries are characterized by inherent heterogeneity and high variance of landscapes at large spatial scales. Thus, Stoms & Hargrove (2000) have called administrative landscape comparisons: "Apples to Oranges" situations. Consequently, in this study ecoregions X land ownership is the only legitimate comparison. This changes the interpretation of the results where the authors show: Tribal NPP ~ Private NPP > Public NPP or tribal lands exhibit productivity similar to NPP on private lands. Additionally, this interpretation may change as Tribal lands actually have 3 types of ownerships 1) allotments held in trust by the US Government that will eventually become 2) privately owned allotments, and 3) government trust land or Tribal lands. Nonetheless, this is a surprising result as the forced removal of Native Americans to the reservation system suggests that the best most arable lands were not the lands allocated to these peoples.



Poster Session Monday 1: Poster Pod 1, Poster 6

WILDISH: MUSTANG OF THE AMERICAN WEST

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ABSTRACT

I am developing a podcast series investigating the controversies and human stories surrounding wild horses and burros in the American West. I partnered with *ThinkRadio* and Alan Wartes Media. According to the Bureau of Land Management (BLM), wild horses and burros are grossly overpopulated in the West. A majority of herds reside in remote landscapes managed by BLM, and a smaller portion of herds roam United States Forest Service (USFS) lands and Native American lands, including the Navajo Nation. Drought, climate change impacts, and shared grazing between horses, burros, and livestock continue to degrade historic rangeland ecology. Management solutions are desperately needed, but stakeholders' ideas for solutions fluctuate across a large spectrum. Conflict is intense. To stakeholders, it is common knowledge that the general public knows no or very little information about wild horses and burros in the U.S. The goal of this project, increasing public awareness, will ameliorate this situation. I have traveled the West and collected genuine stakeholder interviews and stories. Our podcast series will be entertaining and informative: two hallmarks of impactful science communication. A high-quality podcast has never been done on this issue.



Poster Session Monday 1: Poster Pod 2, Poster 7

RANGE RESEEDING AND PASTORALISTS RESILIENCE TO CLIMATE VARIABILITY

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ABSTRACT: MS STUDENT

Pastoralism supports livelihoods on less productive land across Africa and other parts of the world. The pastoral culture has social systems that support populations by ensuring that animals efficiently convert limited ecological resources into sustenance. Socio-economic changes, population increase and climate variability including frequent and prolonged droughts are shrinking grazing lands and making forage availability less predictable. This among other challenges are affecting the resilience of pastoralists. The objective of my research is to examine range reseeding as a sustainable rangeland management practice that enhances pastoralists' resilience by reducing their vulnerability to climate variability. The environmental and socio-economic benefits from range reseeding have the potential to improve pastoralists livelihoods by making them more food secure, prosperous and resilient. To determine pastoralists resilience, we evaluate dry season grazing and other tradable outputs created by range reseeding as proxies for resilience. Land size, herd size, fence types, inherited skill and affordability were identified as factors that affect range reseeding potential. Survey data was collected from 193 households representing two pastoral communities from Baringo, Kenya. Though still in its preliminary stages, the researcher has established that the diverse options of field utilization decrease over time. Fields reseeded within the last five years were used for more income generation activities than those that were reseeded over five years ago. This could be attributed to a number of reasons among them grazing management decisions, fence type and grass species characteristics. Those who used their fields for multiple uses year round or intensively pursued commercial production of tradeable outputs did not engage in other income generating activities like formal employment. This shows that reseeding associated benefits were capable of sustaining livelihoods. Investing in extension services to teach sustainable rangeland management practices to pastoralists may help improve their resilience to climate variability.



Poster Session Monday 1: Poster Pod 2, Poster 8

ADDRESSING BARRIERS TO PROACTIVE RESTORATION FOR AT-RISK SAGEBRUSH COMMUNITIES: A CAUSAL LAYERED ANALYSIS

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ABSTRACT: Ph. D STUDENT

Restoration success of degraded rangelands often depends on the location's resilience to disturbance and resistance to invasive annual grasses. Rather than try to restore sagebrush plant communities after they are degraded by exotic annual grasses, we are studying the feasibility of proactive restoration in communities at risk of crossing degradation thresholds. These communities may lack native perennial grasses and forbs, but they are not dominated by exotic annual grasses. When developing any new management tool, it is important to consider its management feasibility. Accordingly, we studied institutional factors within land management agencies that could affect the adoption and use of a specific proactive restoration approach: out-planting grass and forb seedlings into sagebrush stands before they are dominated by cheatgrass, *Bromus tectorum*. Rangeland managers from eight federal and state agencies across the Great Basin were contacted regarding their perceived feasibility of these practices, and under what conditions the practices might be incorporated in their vegetation management toolkit. Twelve in-depth interviews were conducted, and the responses were analyzed using the qualitative method of Causal Layered Analysis, an approach to assessing factors that determine alternative future scenarios. Preliminary results are presented. In the most superficial (litany) layer, cost, cost-effectiveness, and scale were prominent; the systemic causal layer (economic and political contexts) was framed by policy and bureaucracy limitations as well as technical barriers to implementation; in the worldview layer, lack of a proactive management tradition within agencies was identified as a principal barrier. Finally, in the deepest (myth/metaphor) layer, what appears as the central mythos is that human intervention (management) is necessary to protect ecosystem services disrupted as a result of human activity. Based on the different obstacles found at each level of analysis, we offer suggested ways to overcome the barriers detected.



Poster Session Monday 1: Poster Pod 2, Poster 9

IMPROVING DROUGHT PREPAREDNESS FOR UTAH RANGE LIVESTOCK SYSTEMS

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ABSTRACT

Drought is a big challenge for Utah. Efforts to improve drought preparedness are important. This research provides a retrospective view of the past 20 years and then looks to the future. Research elements include: (1) analysis of drought-management tactics by ranchers using an innovation-adoption framework; (2) updating probabilities of drought years; and (3) gathering insights from Extension and federal range management professionals concerning drought issues. Research methods include social surveys, analysis of precipitation records 2000-2018, and key informant interviews. Statistics focused on logistic regression. A survey of 429 randomly selected ranch households revealed 3,133 non-adoption decisions concerning use of 14 commonly recommended drought-management tactics. About 44% of all non-adoption decisions indicated that the drought management tactic in question was incompatible with priority needs of the operation. Other reasons for non-adoption included complexity, high cost, and low observability of the tactic. Regression analyses indicated that adoption of some drought management tactics was positively associated with a person being more business oriented or having a pro-active attitude about crisis management. Adoption of other tactics was negatively associated with advancing producer age and pending retirements. Empirical analysis of drought records revealed that drought risk in Utah is now pronounced; the probability of one drought year is 0.53, while probabilities of two- or three-year droughts are 0.28 and 0.15, respectively. Range professionals expressed concerns that Utah ranchers: (1) are not as drought vigilant as they should be; (2) are highly variable in terms of risk management skills; and (3) most barely survived a one-year drought in 2018. Education—from new online platforms to classroom and individualized one-on-one delivery—is needed among all stakeholders to improve drought preparedness. Policy changes that enhance producer access to drought forage reserves on public lands are desirable, but unlikely to occur anytime soon.



Poster Session Monday 1: Poster Pod 2, Poster 10

THE GLOBAL EFFORT TO DESIGNATE A UN INTERNATIONAL YEAR OF RANGELANDS AND PASTORALISTS

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ABSTRACT

A growing worldwide network acknowledges that the condition and productivity of the world's rangelands and grasslands are critical to a sustainable future for people everywhere. Unhealthy and unproductive rangelands and grasslands destabilize countries, endanger national security, compromise economic productivity, and rob our youngest generation of opportunities for a prosperous future. To increase knowledge and understanding of these unique ecosystems and the people and animals who rely on them, an initiative to gain a United Nations-designated International Year of Rangelands and Pastoralists (IYRP) was introduced in 2016. This poster will document the status on this effort, provide the "whys" for an IYRP, and suggest how others can become involved. Specifically, numerous organizations have been working to gain an IYRP through a formalized Support Group. This Group, represented by international organizations such as SRM, NGOs, academia, and community groups, sustains the effort by actively engaging with colleagues and interested parties around the world. It has coordinated numerous meetings and events and has worked with members to gain the support of their respective governments for an IYRP. These activities are documented on the website: <https://globalrangelands.org/international-year-rangelands-and-pastoralists-initiative>.

Most recently, the Government of Mongolia presented a formal request for an IYRP designation at an open session of the October 2018 FAO Committee on Agriculture (COAG) meeting. Subsequently, Mongolia, with the support of numerous internal ministries as well as more than 20 countries and organizations, successfully submitted a proposal for an IYRP to COAG in July 2019 requesting that the resolution be put on the agenda for the 2020 COAG Meeting - the necessary next step in the designation process. The proposal also must be endorsed at the 2021 FAO Conference and finally by the UN General Assembly. If these hurdles are successfully overcome, then an IYRP will likely be designated for 2027!



Poster Session Monday 1: Poster Pod 2, Poster 11

USING FIRST FOODS TO GUIDE ECOSYSTEM MANAGEMENT

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ABSTRACT

First Foods have sustained tribal people since time immemorial and the relationship between First Foods and the Tribes is essential to the ongoing culture of the Confederated Tribes of the Umatilla Indian Reservation (CTUIR). The First Foods serve a fundamental role in the health, well-being, and cultural identity of the Tribes and are considered to constitute the minimum ecological products necessary to sustain CTUIR subsistence and cultural needs. Recently, the Department of Natural Resources of the CTUIR adopted a mission based on First Foods: “To protect, restore, and enhance the First Foods - water, salmon, deer, cous, and huckleberry - for the perpetual cultural, economic, and sovereign benefit of the CTUIR...” In order to assist in applying this mission to natural resource management decisions, the CTUIR created a vision statement: *Our vision for upland landscapes is to ensure healthy, resilient and dynamic upland ecosystems capable of providing First Foods that sustain the continuity of the Tribe’s culture.* The primary goals of this vision are to: 1) articulate CTUIR’s vision for upland resource management, 2) serve as the foundation for planning and managing upland ecosystems and resources, and 3) serve as a resource for non-Tribal land managers, policy makers, and other stakeholders to better understand the importance of First Foods and provide a framework to consider and incorporate First Foods concepts into their management activities within CTUIR’s ceded territory. The vision highlights desired ecological characteristics of upland ecosystems and provides a framework for planning, management and restoration efforts. We will present the CTUIR upland vision and identify key ecosystem attributes critical to the sustained natural production of culturally important resources across upland ecosystems within the CTUIR's ceded lands.



Poster Session Monday 1: Poster Pod 2, Poster 12

DROUGHT ADAPTATION FOR RANGELAND LIVESTOCK PRODUCERS: LESSONS FROM CALIFORNIA'S HISTORIC DROUGHT.

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ABSTRACT: MS STUDENT

Rangelands represent the largest land use type across the western United States. While these landscapes have been historically shaped by patterns of low and variable precipitation, between 2012-2015 California experienced conditions that were warmer and drier than any period during the previous 1200 years. Evidence is rapidly mounting that these co-occurring periods of precipitation deficit and warm temperatures are likely to increase over the next century and will result in levels of drought intensity and duration rivaling those in the paleoclimate record. Because ranching and rangelands are fundamentally dependent on seasonal precipitation (as opposed to stored or ground water), these systems are among the first to experience impacts of drought. This threat poses an unmatched risk to California's \$4.2-billion-dollar rangeland livestock industry. Consequently, understanding how to adapt California rangeland livestock production to anthropogenic drought and enabling producers to sustain economic and environmental viability in the face of climate change represents one of the most serious research and extension challenges of our time. We conducted telephone interviews with 48 rangeland beef cattle, sheep, and goat operations to ascertain the impacts of California's 1200-year drought and to evaluate the strategies that these operations used to cope with drought conditions. These interviews provide a first look at the drought preparation and mitigation strategies that actually worked (and some that did not) for California ranchers. Using the Adaptive Decision Making framework as a guide, we will assess the management capacity of ranchers and how individual suites of adaptive strategies influence overall drought adaptation and ranch resilience. Specifically, we will assess the influence of multi-species grazing and land resource base on individual adaptive capacity. We will present preliminary results from this assessment.



Poster Session Monday 1: Poster Pod 3, Poster 13

MANAGEMENT OF HERBAGE ALLOWANCE LEADS TO DIVERSE RESULT OF STOCKING RATE, BUT IMPROVE ANIMAL PRODUCTIVITY

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ABSTRACT: MS STUDENT

Management of herbage allowance (HA) is essential to improve animal productivity, but at year and farm scale it could be related to lower, equal or higher stocking rate. Based on experimental information of control of HA, with multiparous and primiparous cows where the mean HA were 5 and 3 kg DM/kg BW, with seasonal variation of, 5, 5, 6, and 3 and 2, 2, 4 and 3 in High and Low for Spring, Summer, Autumn and Winter, interventions in commercial systems were applied. At farms, the focus was to improve the animal productivity by enhancing the growing of heifers and steers, the cow-calf system, and fattening steers by HA management. Results of stocking rate were diverse, with farms decreasing, maintaining and increasing it throughout the interventions, but in most of the cases under study the animal productivity and economic output was increased. Results in animal productivity can be explained by greater energy intake of the animals as HA increased, spatial optimization of herbage mass and animal requirements was done, and temporal energy requirements was also matched (e.g. moment and duration of breeding season) with temporal grow of native pasture. All together those tools allow to improve animal productivity from 10 to 50%, and economic output was improved even 36 times (from 2 to 72 USD/ha in one case). The dialog between grazing experiments and the beef systems confirm the experimental evidence that greater HA increase system productivity, but the impact at farm scale seems to be even greater than estimated previously.



Poster Session Monday 1: Poster Pod 3, Poster 14

CHANGING IDENTITIES AND LIVELIHOODS OF NORTHEASTERN COLORADO LIVESTOCK PRODUCERS: A GROUNDED THEORY STUDY

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ABSTRACT: Ph. D STUDENT

Rangeland systems in Northeastern (NE) Colorado are undergoing linked land-use, livelihood, and identity transitions. As factors such as urbanization influence land-use changes, ranchers may lose their livelihood strategy of extensive livestock production and subsequently their rural identity. This research investigates social change in the context of land-use transition through an examination of linked livelihood and identity changes. By identity we mean how an individual classifies themselves with respect to occupation (i.e. a rancher or farmer), as well as how they behave in relation to what they believe others with their shared identity consider appropriate (i.e. subjective social norms). Thus, the livestock producers' identities inherently link to their decisions about resource management. Despite empirical evidence that identity influences decision-making and theories that recognize identity as a predictor of behavior, researchers have often overlooked the influence of identity on behavior. To remedy this gap, I conducted a grounded theory study using participant observation and semi-structured interviews. Using a modified grounded theory approach, I open coded field notes and interview transcripts using the constant comparator method. In my sample, producer identities extend beyond rancher or farmer to roles such as steward and grass farmer. Producers often participate in multiple, sometimes conflicting social roles that affect decision-making. These identities reflect history, place, and values. I find that individuals with shifting or multiple identities (i.e. farmer and rancher) integrate diverse livelihood strategies in response to the changing socio-cultural and ecological landscape. This research contributes to the rancher decision-making literature by refining concepts of identities for greater application in quantitative research, such as clarifying the norms of stewards versus conservationists. This more complex understanding of producer identities and their relationship to livelihood strategies, calls for extension, researchers, and policy makers to develop strategies to meet the varying needs of a diverse and shifting group of producers.



Poster Session Monday 1: Poster Pod 3, Poster 15

ECOLOGICAL INTENSIFICATION IN COW-CALF SYSTEMS BASED ON NATURAL GRASSLANDS IN URUGUAY: RESULTS OF A CO-INNOVATION PROCESS

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ABSTRACT: Ph. D STUDENT

In Uruguay, livestock systems have social, economic and cultural relevance. Most farms are family farms with cow-calf systems grazing on natural grasslands. These farms have low productivity ($72,2 \pm 53,3$ kg ha⁻¹), explained by high grazing intensity and the lack of implementation of management techniques in the herd. There is increasing evidence of negative effects of these systems on the environment greenhouse gas emissions. To help farmers to cope with the challenges of increasing family income and improving ecosystem services provided by grasslands, we proposed an ecological intensification strategy: improving the production, utilization, and conversion of grasslands forage, without the use of external inputs. To implement ecological intensification principles, we used co-innovation as a tool to foster learning by actors towards adaptive management in complex systems. For three years we worked together a team of scientists, four extension agents and farmers' families of 24 farms located in two regions of Uruguay. The sequence of the co-innovation work at farm level was: diagnosis, participatory elaboration (extension agent and farmer and his family) of a production plan and its implementation. On average, the farms in the northern region, improved beef production by 32% and sheepmeat and wool increased by 16%, while net income increased around 100%. The farms in the eastern region increased beef production by around 15% and net income by 45%, on average. Main management changes implemented were differential forage allowance according to cow body condition and physiological stage, setting the matting period starting in spring and restricting it to 90-120 days, temporary weaning, definitive weaning early in autumn and diagnosis of ovarian activity in the middle of the mating period and pregnancy diagnosis in autumn. Co-innovation was a good tool for intervention on complex systems as are the cow-calf systems on grassland and develop social learning.



Poster Session Monday 1: Poster Pod 3, Poster 16

THE CENTRAL ROLE OF GRASS COVER IN SUSTAINABILITY AND RESILIENCE IN SOCIAL AND NATURAL SYSTEMS IN THE NEBRASKA SANDHILLS

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ABSTRACT

The Sandhills in north-central Nebraska cover over a quarter of the state and comprise the largest stabilized sand dune formation in the Western Hemisphere. With fragile, grass-stabilized sand dunes vulnerable to large scale movement and a dominant human land use, cattle grazing, that depends on vegetation cover and forage, the region has an intimate connection between the natural and social systems. Thus, the Sandhills are an excellent system in which to study social-ecological resilience. We are using remote sensing, biodiversity surveys, ethnographic analyses, artistic representation and philosophical/theological theory to understand the processes and narratives underpinning social-ecological resilience. The specific question we asked in this phase of the project was: what are the most direct links between the ecological patterns in climate- and landscape-induced variation in grass cover and specific elements in communication and culture that reflect those patterns? To answer this, we measured variation in grass cover in wet vs. dry years and over a complex landscape of dry dunes vs. subirrigated lowlands. We then conducted interviews with landowners in which they reflected on these patterns and noted common phrases, concepts and themes. Satellite and drone-based imagery documented a much more consistent grass cover in subirrigated meadows of the Sandhills than nearby upland dunes. Some years (e.g. 2012, the driest in the past four decades) and some portions of the landscape (e.g. upland dunes) especially exemplify a loss of vegetation cover that landowners consistently referred to as harbingers of “losing their place”. When queried more about this phrase, it became clear that this phrase is not simply a loss of a physical home and livelihood but refers to a loss of identity and a cultural dislocation. Because of the high stakes of “losing their place”, residents in this region may have identified thresholds and resilience strategies that shed light on general mechanisms by which communities can adapt to climate extremes and environmental change.



Poster Session Monday 1: Poster Pod 3, Poster 17

RANGELAND RESILIENCE THROUGH CARBON SEQUESTRATION: COMMUNITY NEEDS DIRECTING RESEARCH

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ABSTRACT: MS STUDENT

Land management of rangelands can play an important role in climate change mitigation by influencing soil carbon (C) storage. Soil amendments, such as adding compost, has been shown to increase soil C storage while simultaneously increasing plant productivity and soil water holding capacity (WHC), factors that provide immediate benefits to ranchers. Research to date has mainly focused on temperate annual grasslands however little is known if arid, cold climate, high-elevation rangelands respond similarly. Our objective was to determine the effect an application of 2 inches of locally sourced biosolid compost has on soils on plant productivity, soil WHC and C. Research sites were set up at 4 separate ranches in Gunnison, CO, an arid, cold climate, high elevation region. Within each site, two treatments were established (control and compost addition) with 5 replicate plots within each treatment. Throughout the growing season, we monitored soil moisture and plant productivity. In the fall of 2019, samples were collected to measure the expected changes in C:N ratios, C stocks, pH, available nitrogen, fungal infection rates, and the WHC of the soils. Preliminary analysis at one of the four sites showed an increase in plant biomass in the treatment compared to the control. Throughout the growing season all treatment sites maintained higher soil moisture levels than the control. If our treatment does show a change in C stocks, we hope it could inform the start of a C capture policy. Incentivizing producers to implement practices to store more C as a form of climate mitigation with the co-benefit of improved drought resiliency.



Poster Session Monday 1: Poster Pod 3, Poster 18

OUTREACH ON GRAZING LANDS TO ENHANCE ECONOMIC ANALYSIS (COST BENEFITS) FOR CONSERVATION CHANGES

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ABSTRACT

The National Grazing Lands Coalition and The Matrix Assessment Group conducted a 3-year outreach/education/demonstration project on how a variety of management and conservation practices impact pasture and range productivity, economics, and sustainability. The project assessed the role economics plays on producer decisions about conservation program participation, on the design of grazing management systems and to what extent multispecies management influences economic performance. Data was collected in additional areas including program participation, use of conservation management practices, costs and returns of programs and practices, productive capacity, socio-economic factors and producers' opinions about conservation issues. The goal of this project was to determine whether agricultural producers are motivated by economics when considering implementing conservation programs and management practices on their farms/ranches. Producers in six regions provided data to identify economic linkages, namely costs and benefits, for conservation programs and practices that were either planned, in progress or completed by agricultural producers. Producers did not provide enough cost and benefit data to develop an investment analyses; however, they readily provided descriptions of costs but were not able to delineate actual total costs for projects. The situation became a challenge for project investigators, and as a result, developed an extremely useful process that producers view as a valuable management tool for the future. The Ag Sustainability Process (ASP) with the Sustainability Assessment Matrix (SAM) as its foundation includes performance evaluation (productivity and financial performance) of conservation programs and practices. Producers will have the appropriate economic data to complete investment analyses that will result in better management decisions about conservation programs and practices that might benefit their operations. Beneficiaries of this project have always been farmers and ranchers across the U.S. Producers now have access to a wealth of information characterizing what their fellow producers are doing in terms of developing sustainable farms and ranches in their region and other regions of the U.S. They now have a process available that will improve their management decision making to evaluate conservation alternatives more carefully.



Poster Session Monday 1: Poster Pod 4, Poster 19

PASSING ON THE GRIT: WOMEN'S STORIES ON THE RANGE

Amanda Botsford*¹; ¹Western Colorado University

ABSTRACT

Women's voices are underrepresented in rangeland management. Young women considering careers in agriculture rarely have access to women mentors and therefore can fail to see ranching as a viable career. In this project, I plan to interview women ranchers in the Gunnison Valley to gain an understanding of their lived experiences working on rangelands and what a women's perspective brings to rangeland management. My intent is to understand how they overcome adversity and empower other women through education and stewardship of the land. Preliminary interviews show that women do not see the work they do as different from that of a man's. Interviews suggest that a woman's role in ranching is varied and many women carry many hats on a working ranch. My goal for this project is to add to the limited body of research surrounding a women's perspective in ranching and elevate a woman's experience in rangeland communities.



Poster Session Monday 1: Poster Pod 4, Poster 20

SCALING BIG DATA ON RANGELANDS: ADVANCES IN REAL-TIME ASSESSMENT OF LIVESTOCK FORAGING BEHAVIOR

Edward J. Raynor*¹, Sheri Spiegel², David Augustine³, Raoul K. Boughton⁴, Patrick E. Clark⁵, Kathy J. Soder⁶; ¹USDA - ARS, Fort Collins, CO, ²USDA-ARS Jornada Experimental Range, Las Cruces, NM, ³USDA-ARS, Fort Collins, CO, ⁴University of Florida, Ona, FL, ⁵USDA Agricultural Research Service, Boise, ID, ⁶USDA-ARS, University Park, PA

ABSTRACT

Precision livestock management is essential to the sustainable intensification of livestock production, a land use that dominates 40% of the Earth's surface. We contend that approaches which improve management can synergistically intensify production with neutral to positive environmental effects and address social concerns about the impacts of grazing on extensive rangeland landscapes. Recent technological advances have begun to empower livestock managers by providing more rapid, near-real-time monitoring of livestock locations and behavior by providing means to track and predict changes in forage resources across broad landscapes, and by enhancing the means to manipulate livestock distribution remotely. Here, we highlight three technological advances: 1) traditional livestock tracking methods (GPS technology), 2) real-time rangeland resource utilization (daily livestock foraging effort and growth rates), and 3) fine-scale measurements of foraging behavior (automatic jaw-movement recorders) to inform management decisions by graziers and other land managers. We demonstrate the use of these approaches across USDA Long-Term Agroecosystem Research (LTAR) Network sites, describe the challenges inherent in conducting research across multiple climatic regions, and identify how this work can inform large-scale questions about rangeland ecology and management. We highlight examples of coordinated cross-site implementation of technological advances and provide inter-regional contrasts of how management actions may lead to optimization of rangeland utilization on a national scale.



Poster Session Monday 1: Poster Pod 4, Poster 21

A COMPARISON OF CATTLE GRAZING DIVERSE, SHORTGRASS PASTURES USING TWO DIFFERENT GRAZING STRATEGIES

Larry D. Fritzler*, Tim Steffens, David Lust, Marty Rhoades; West Texas A&M University, Canyon, TX

ABSTRACT: MS STUDENT

This study used Near-infrared Reflectance Spectroscopy (NIRS) to compare, forage disappearance, fecal crude protein (FCP), and digestible organic matter (FDOM) between mature, lactating pairs, grazing continuously (CG) or at a high stocking density with weekly moves (HSD), given the same average stocking rate of 3.96 acres pair-1month-1. Fecal collections occurred five different weeks in both CG and HSD. HSD collections were on the second and seventh day of a paddock grazing period. Within a HSD treatment FCP and FDOM were compared between the first half and the second half of the grazing interval for that paddock. The FCP and FDOM were compared between treatments at similar points during the grazing season and during the respective grazing periods. We compared the standing forage using the dry weight ranked method (DWR) before and after grazing to estimate standing crop, forage disappearance and regrowth in the HSD treatment. Serial enclosure cages were used to measure forage disappearance and regrowth at four intervals during the grazing season in CG treatments while DWR was used to estimate standing crop at the beginning and end of the study. Composite forage samples by species were analyzed using NIRS for CP and Total Digestible Nutrients (TDN). TDN was adjusted to DOM to compare FDOM to DOM of forages. We will report data on diet quality, forage utilization, and grazing distribution between treatments over time.



Poster Session Monday 1: Poster Pod 4, Poster 22

DEVELOPING A TECHNIQUE TO ESTIMATE WHO GRAZED WHAT

Brandon K. Mayer*¹, Andrew M. Antaya¹, Sarah Noelle¹, Judith Dyess², George Ruyle¹;
¹University of Arizona, Tucson, AZ, ²Forest Service, Tucson, AZ

ABSTRACT: MS STUDENT

Rangelands support a variety of grazing animals, and managers often need to determine forage demands for a mix of species. However, where livestock and wildlife cohabitate, differentiating between grazer impacts is sometime contested, and may create conflict between stakeholders and land managers. An evidence-based means of differentiating the level of use among species could reduce contention and improve management decisions. Camera traps are used to automate monitoring and provide data useful for assessing population characteristics such as occupancy by different grazing animals. Expanding on this technique, camera traps can collect a time-lapsed census of a large area and provide detailed measures of grazing activity for the entire grazing season. These measurements include animal species frequency of occurrence over that time period. Paired with vegetation measurements, the allocation of grazing time to a specific species can help partition resource use. During the summer of 2019, this technique was applied to examine grazing interactions among cattle and elk within critical habitat of the New Mexico meadow jumping mouse in New Mexico's Lincoln National Forest. Using a proportional approach, forage removal was differentiated to distinguish species-specific grazing impact.



Poster Session Monday 1: Poster Pod 4, Poster 23

GRAZING BEHAVIOR OF CATTLE IN UPLAND SANDHILLS AND SUB-IRRIGATED MEADOW ENVIRONMENTS

Travis M. Millikan*¹, Mitchell Stephenson², Joslyn Beard³, Travis Mulliniks³; ¹Chadron State College, Chadron, NE, ²University of Nebraska - Lincoln, Scottsbluff, NE, ³University of Nebraska - Lincoln, Lincoln, NE

ABSTRACT: UNDERGRADUATE STUDENT

The Sandhills of Nebraska provide a variable range of environments that play a role in determining the behavior of grazing animals over time and space. Our study focused on how different ecological sites (i.e., upland rangelands or sub-irrigated meadows) affected grazing behavior of 2-yr old beef cows with calves. In 2018, GPS collars were placed on two separate herds of 15 cattle at the Gudmundsen Sandhills Laboratory north near Whitman, Nebraska. One herd was placed in an upland rangeland site (400 acres) and the other herd in a sub-irrigated meadow site (36 acres). Location and grazing behavior data were taken every five minutes from the GPS collars from 15 June to 30 August. Visual observations of the grazing behavior of the herds (grazing, non-grazing, and walking) were recorded during the study period. We hypothesized that cattle in the sub-irrigated meadow site would spend less time grazing than cattle on the upland rangeland sites because of greater forage production and higher forage quality associated with meadow sites. Preliminary data analysis during the summer of 2018 indicated that cattle spent 11.2 ± 1.2 SD hrs grazing in the upland pasture and 10.0 ± 1.0 SD hrs on the meadow. Cattle on the upland pasture also walked 3.8 ± 0.5 SD km·d⁻¹ compared to 2.6 ± 0.2 SD km·d⁻¹ on the meadow. While these data represent only one year of data in a single replication, there is evidence that grazing behavior is affected by the characteristics of the pasture and resources available to animals.



Poster Session Monday 1: Poster Pod 4, Poster 24

THE EFFECTS OF FORAGE TYPE, STORAGE METHOD AND TIME ON NUTRIENT COMPOSITION

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ABSTRACT: UNDERGRADUATE STUDENT

Forage quality and storage conditions are important when feeding cattle to ensure nutritional requirements are met during winter months. This study examined two ways of storage; twine wrapped bales and plastic wrapped bales (haylage). This study focuses on how storage methods and time can impact the nutrient composition of different types of forages. Alfalfa and oat pea hay were sampled at three different time periods roughly sixty-five days apart. Samples were analyzed for crude protein, neutral detergent insoluble crude protein, Neutral Detergent Fiber Content (aNDFom and aNDF), nonfibrous carbohydrates, relative feed value, Acid Detergent Fiber Calculations (Total Digestible Nutrients-ADF, Net Energy Gain-ADF, Net Energy Maintenance-ADF, and Net Energy Lactation-ADF). Results determined that storage methods had no impact on crude protein or acid detergent fiber. Alfalfa had higher crude protein, relative feed value and nonfibrous carbohydrates, but lower acid detergent fiber when compared to oat pea. Nonfibrous carbohydrates and relative feed value were much greater in alfalfa haylage when compared to oat pea haylage. Therefore, this study demonstrated that storage method had little effect on the nutrient composition of the forages examined, suggesting that producers can choose the most economical storage method without sacrificing the nutrient quality of the forage.



Poster Session Monday 1: Poster Pod 5, Poster 25

THE GRAZING BEHAVIORS OF HEIFERS ON RANGELAND ARE NOT AFFECTED BY FEED EFFICIENCY

Nolan Craun*¹, Laura Goodman², Ryan Reuter², Karen R. Hickman², James Neel³; ¹Bureau of Land Management, Farmington, NM, ²Oklahoma State University, Stillwater, OK, ³Agricultural Research Service, El Reno, OK

ABSTRACT

Feed represents the single largest source of input costs in the beef industry. Residual feed intake (RFI) is the difference between an animal's actual feed intake and expected intake based on body weight and growth. Selection against RFI for improved feed efficiency has been proposed to reduce feed costs. Little research has been conducted evaluating the effect of RFI on beef cattle grazing in extensive environments. This study used global positioning system (GPS) collars to collect spatial data on 38 Angus and 5 Brahman x Angus heifers with known RFI values in a 69ha pasture in the south-central Great Plains. Heifers were categorized by RFI value: low-RFI (efficient), mid-RFI (average), and high-RFI (inefficient). Body weight and average daily gain were similar among RFI group. No differences were observed in the plant community electivity among RFI groups; the Johnsongrass community was most preferred and the woody community was most avoided among each RFI group. Diet quality results indicate heifers were selecting diets with a higher protein content (>5.8%) than the average warm-season grass plant community could provide, and diets did not differ among RFI group ($P \geq 0.60$). Only small differences in diet quality or selection at the plant family level were detected among RFI group. Similarly, differences among RFI groups were not detected when behaviors (24-hour, daytime, sunset to midnight, and midnight to sunrise distance travelled; water and shade use; area explored; and slope use) were compared. On average heifers travelled in excess of 6.3km per day. The culmination of these results indicates a selection against RFI for feed efficient beef cattle is unlikely to affect grazing distribution, diet quality and selection, and grazing behavior.



Poster Session Monday 1: Poster Pod 5, Poster 26

COMPARISON OF DIET SELECTION OF RANGEFED RARAMURI CRIOLLO COWS, HEIFERS AND STEERS DURING FIVE SEASONS

Flavie Audoin*¹, George Ruyle², Dennis Moroney³, Gary P. Nabhan⁴, Samuel R. Garcia², Larry D. Howery⁵, Derek W. Bailey⁶; ¹University of Arizona, School of Natural Resources and the Environment, Tucson, AZ, ²University of Arizona, Tucson, AZ, ³Cross U Cattle Company / 47 Ranch, McNeal, AZ, ⁴University of Arizona, Patagonia, AZ, ⁵The University of Arizona, Tucson, AZ, ⁶New Mexico State University, Las Cruces, NM

ABSTRACT: Ph. D STUDENT

For the past twenty-five years, drought has strongly affected the southwest United States and northwest Mexico; described as arid to semi-arid, with annual precipitation of less than 406.4 mm. Choosing cattle breeds which are adapted to this climate, and topography in order to maximize the feed resources without degrading them is an ongoing challenge in the region. The Criollo breed, originally from North Africa and Spain, and naturalized throughout the Americas for the past 500 years, is a type of cattle which seems to be well adapted to the drought conditions currently prevalent in the region. This study was conducted on the 47 Ranch in southeastern Arizona. In order to better understand landscape use and productivity, we estimated diet composition and the influence of gender and stage of production (mature cows, heifers and two-year-old steers), and how diet selection varied according to the season. We collected monthly fecal samples from July 2018 to October 2019. The samples were analyzed with NUTBAL and submitted for DNA analyses. Seasons analyzed included (fall [October-November], winter [December-February], spring [March-April], pre-monsoon [May-June], monsoon [July-September]). Full analyses of the data will be presented.



Poster Session Monday 1: Poster Pod 5, Poster 27

GRAZING BEHAVIOR OF RANGEFED RARAMURI CRIOLLO BULLS DURING FIVE SEASONS

Flavie Audoin*¹, George Ruyle², Dennis Moroney³, Gary P. Nabhan⁴, Samuel R. Garcia², Larry D. Howery⁵, Derek W. Bailey⁶; ¹University of Arizona, School of Natural Resources and the Environment, Tucson, AZ, ²University of Arizona, Tucson, AZ, ³Cross U Cattle Company / 47 Ranch, McNeal, AZ, ⁴University of Arizona, Patagonia, AZ, ⁵The University of Arizona, Tucson, AZ, ⁶New Mexico State University, Las Cruces, NM

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Poster Session Monday 1: Poster Pod 5, Poster 28

INFLUENCE OF RAINFALL EVENTS ON DRINKER VISITATION PATTERNS BY BEEF COWS ON DESERT RANGELAND

Shelemia Nyamuryekunge^{*1}, Adrienne Dawes¹, Matthew M. McIntosh¹, Andres F. Cibils¹, Richard E. Estell², Alfredo L. Gonzalez³, Sheri Spiegel⁴; ¹New Mexico State University, Las Cruces, NM, ²USDA-ARS-Jornada Experimental Range, Las Cruces, NM, ³Animal Scientist, Las Cruces, NM, ⁴USDA-ARS Jornada Experimental Range, Las Cruces, NM

ABSTRACT: Ph. D STUDENT

We sought to compare drinker visitation patterns of Angus x Hereford and Raramuri Criollo on days with precipitation events (PE, n= 13) vs days with no precipitation (NP, n= 106) in extensive Chihuahuan Desert pastures at the Jornada Experimental Range during summer and winter of 2016 and 2017. In all seasons and years, each breed (n = 11 cows/breed/season) grazed two adjacent pastures (1190, 1165 ha) separately for 4-weeks in a crossover design. Position of 7-9 randomly selected cows/breed/trial was logged every 10 min using Lotek 3300-LR GPS collars. Precipitation was recorded by a rain gauge 3 km away from our study pastures. We calculated time spent within 200, 100, and 50 m of a drinker per day for all trial dates (n= 119) and treated individual cows as experimental units. Breed did not influence time spent near the drinker. On days with PE, cows spent detectably less time within 200m (PE= 11.98 vs NP= 56.97 min, $P < 0.01$), 100m (PE= 6.47 vs NP= 31.86 min, $P < 0.01$), and 50m (PE= 2.92 vs NP= 9.63 min, $P < 0.01$) of the drinkers. Cows spent more time within 200m ($P=0.01$) and 100m ($P<0.01$) of the drinkers in summer vs. winter. We found no rainfall*breed nor rainfall*season*breed interaction. Our preliminary results suggest that precipitation events influence drinker visitation patterns regardless of breed or season likely due to the availability of ephemeral watering sources. A decreased need to travel to the drinker on days with precipitation events likely influences spatial distribution patterns of cattle. Further research is needed to determine how frequency and size of precipitation events shapes landscape use patterns of cattle on desert rangelands.



Poster Session Monday 1: Poster Pod 5, Poster 29

LATE-FALL LANDSCAPE USE BY HERITAGE VS CONVENTIONAL BEEF CATTLE ON COLORADO PLATEAU RANGELANDS: A CASE STUDY

Matthew M. McIntosh¹, Danielle M. Duni*¹, Andres F. Cibils¹, Richard E. Estell², Alfredo L. Gonzalez³, Shelemia Nyamuryekunge¹, Matthew Redd⁴, Michael C. Duniway⁵, Sheri Spiegel⁶; ¹New Mexico State University, Las Cruces, NM, ²USDA-ARS-Jornada Experimental Range, Las Cruces, NM, ³Animal Scientist, Las Cruces, NM, ⁴The Nature Conservancy, Canyonlands, UT, ⁵US Geological Survey, Moab, UT, ⁶USDA-ARS Jornada Experimental Range, Las Cruces, NM

ABSTRACT: UNDERGRADUATE STUDENT

Heritage livestock genetics may help improve sustainability of arid rangelands. We compared behavior and landscape use of Raramuri Criollo (RC; heritage) and Red Angus (RA) at the Dugout Ranch in Canyonlands, Utah. We used Lotek LITETRACK LR-GPS collars to track 3 RC and 3 RA cows that grazed in a mixed herd from November 16 – December 25, 2018. We used PROC MIXED in SAS 9.4 to analyze movement patterns (distance traveled, velocity, and path sinuosity [0=more sinuous; 1=straight]), use of riparian areas and upland slopes, as well as vegetation preference (using Ivlev's Electivity Index) during 40 d in a 3560-ha pasture. RC cows traveled farther per day (RC: 6.5 ± 1.4 ; RA 6.1 ± 2.1 km; $P < 0.01$) and during daytime hours (sunrise – sunset; RC: 3.9 ± 1.1 ; RA: 3.2 ± 1.0 km; $P < 0.01$) than their RA counterparts. RC cows also traveled faster during 24 h (RC: 1.6 ± 0.3 ; RA: 1.4 ± 0.5 m*min⁻¹; $P < 0.01$) and daytime hours (RC: 6.6 ± 2.1 ; RA: 5.2 ± 1.7 m*min⁻¹; $P < 0.01$) than RA, though RA moved faster during post-sunset hours (sunset – midnight; RC: 1.3 ± 0.9 ; RA: 1.5 ± 1.4 m*min⁻¹; $P < 0.01$). RC cows displayed more sinuous movement trajectories during all 24 h, daytime, and pre (midnight – sunrise) and post-sunset periods ($P < 0.01$). RC cows spent less time near riparian areas compared to their RA counterparts (RC: 143 ± 1.2 ; RA: 111.1 ± 2.0 m away from streams; $P < 0.01$). RC and RA cows did not differ in their use of slopes nor elevation ($P > 0.10$). RA cows showed a greater preference for riparian shrublands than their RC counterparts (RC: $E 0.23 \pm 0.0$; RA: $E 0.59 \pm 0.03$; $P < 0.01$). Our preliminary results suggest that RC and RA cows use rangelands of the Colorado Plateau differently.



Poster Session Monday 1: Poster Pod 5, Poster 30

THE PIOSPHERE, PREDICTING CATTLE DISTRIBUTIONS ACROSS A LANDSCAPE

Mike T. Anderson*; Open Range Consulting, Salt Lake City, UT

ABSTRACT

With climate change looming into the future an economical and consistent means of calculating available acres for cattle would be an effective tool providing a conduit for communication between resource managers. The term Piosphere put forth by Lange (1969) is a distinct ecological system determined by the existence of a watering point by the capacity of animals to forage away from that point. Further described by Thrash, I. & Darry, J.F. (1999). a Piosphere can be as simple as one isolated watering point in one uniform rangeland type or it may consist of multiple watering points across a wide range of elevations, within a mosaic of many different rangeland types. Using the Piosphere concept in concert with GIS applications Open Range Consulting has built a tool that predicts distributions of cattle across a landscape. This tool can provide an economical and consistent means of calculating available acres for cattle which in turn opens a suite of options or conversations for resource managers.



Poster Session Monday 1: Poster Pod 6, Poster 31

HUMBLED BY NATURE: A RANCHER'S MENTAL-MODEL OF ADAPTATION IN THE GREAT PLAINS

Jim Sturrock*¹, Hailey Wilmer²; ¹Lonesome Pines Land and Cattle, LLC, Grover, CO, ²USDA-ARS, 80526, CO

ABSTRACT

Ranchers in the Great Plains make decisions in complex social and ecological environments. While a great deal of research has studied rancher adaptation, an insider's or "emic" view rancher's mental models is less well understood. In this study a rancher and a researcher collaborate to document ten years of management on a Colorado ranch. Using data from repeated interviews, participatory mapping and records review, we describe a conceptual model for ranch decision-making. Then, we illustrate the spatial ecology of these decisions, via a participatory map. Finally, we show management, climate, and ecological records over ten years. This timeline illustrates how the rancher's management approach and relationship to the ecosystem changed over time from viewing himself as the "controller" of the ecological community to "member of it". We discuss how our results complement existing research about ranch systems adaptation by documenting how climate, weather, economic and ecological dynamics interacted with the rancher's own self-image and how management strategies changed over time. Our collaborative methodology and the resultant mental model may inform other first-generation ranchers seeking to develop adaptive management approaches, and researchers seeking to better understand the decision-making environments of their rancher collaborators.



Poster Session Monday 1: Poster Pod 6, Poster 32

IMPROVING ACCESS TO SPECIES HABITAT INFORMATION ON US GRAZING LANDS THROUGH THE PHONE APP LANDPKS

Tegan May*¹, Terri Schulz², Angela Dwyer³, Jennifer Timmer³, Jeffrey Herrick⁴; ¹The Nature Conservancy Colorado, Boulder, CO, ²The Nature Conservancy Colorado, Fort Collins, CO, ³Bird Conservancy of the Rockies, Fort Collins, CO, ⁴USDA-ARS Research Unit @ The Jornada, Las Cruces, NM

ABSTRACT

Grazing lands support a ranching livelihoods, clean air and water, and provide native habitat for wildlife. Publicly and privately managed lands are the key to maintaining large connected natural landscapes and improving resilience through compatible management. Ranchers manage for multiple goals, and many are becoming increasingly interested in including wildlife species needs. Access to reliable habitat information on which to base adaptive management actions is however limited and often requires consultation with experts. A need exists for clear descriptions of suitable habitat for different species, in language that is recognizable to ranchers and consistent with monitoring measurements they may already be collecting. The free, open source app, LandPKS (Land Potential Knowledge System; <https://landpotential.org/>) connects users with information about their land potential through the collection of basic soil and vegetation cover information. The addition of science-based habitat information translated into outcome descriptions, focusing on clearly identifiable features such as vegetation height, percent of bare ground and soil type is a valuable addition to existing app functionality. The app will provide acceptable ranges for habitat characteristics and a comparison to any collected data. A simple graphic provides visual representation of the habitat structure and vegetation community. Factsheets will be available to download and will provide additional information including activities to avoid and those that may improve habitat for each species. The project team has collated habitat information for the first 20 selected North American species from a variety of taxa and will be available on the app in 2020. The intent is to equip users with information so that, if desired, they have the information to adapt management for species habitat at their own discretion, in line with other ranch goals. Templates created will be relevant globally and allow the addition of other species in the future.



Poster Session Monday 1: Poster Pod 6, Poster 33

CHANGING GRAZING MANAGEMENT THROUGH RECIPROCAL WATERSHED AGREEMENTS IN THE *RIO GRANDE-VALLES CRUCENOS* OF BOLIVIA

Will Munger*¹, Claudia Radel¹, Zhao Ma², Johnathan Bauchet², Ricardo Godoy³, Laura Zanotti², Brooke McWherter², Meagan Rathjen²; ¹Utah State University, Logan, UT, ²Purdue University, West Lafayette, IN, ³Brandeis University, Boston, MA

ABSTRACT: Ph. D STUDENT

Conserving rangeland and forest watersheds is a critical strategy to both mitigating and adapting to climate change. Payment for Ecosystem Services (PES) programs create an incentive structure to support conservation in working landscapes used for grazing, agriculture, and forest products. These programs often have dual goals of conservation and reducing inequality, but a number of scholars have critiqued them for reproducing or even exacerbating social inequality. Our multi-year, mixed method study in the *Rio Grande-Valles Cruceños* watershed of Bolivia uses the experimental design of a randomized control trial, paired with quantitative surveys and qualitative interviews to understand how the nonprofit Natura Bolivia's Reciprocal Watershed Agreements, a PES-like program, is changing land management behavior and impacting both participants and nonparticipants. We compare conditional and unconditional agreements for differences in participation rates based on gender, asset base, and other variables and for differences in social outcomes, including program satisfaction, gender relations, and socioeconomic inequalities. Our preliminary findings indicate that there are multiple factors that influence participation including program design around conditionality, local field staff's community relationships, municipal technical-political alliances, and emerging imperatives to adapt agriculture to a changing climate. Our fieldwork suggests that analyses of conservation incentive structures need to expand their framework beyond market values alone and develop a nuanced approach for understanding the relationships formed among residents of natural-resource dependent communities, staff in conservation organizations, local government actors, watershed management strategies, and working landscapes.



Poster Session Monday 1: Poster Pod 6, Poster 34

FINDING NEEDLES IN HAYSTACKS: A SOFTWARE TOOL TO IMPROVE THE ACCESSIBILITY OF RANGE MANAGEMENT INFORMATION

Sean F. Di Stefano*, Jason W. Karl, Jeremy Kenyon; University of Idaho, Moscow, ID

ABSTRACT: Ph. D STUDENT

Ecologically and economically sound management of rangelands rests in the hands of well-informed land managers with access to applicable information of the highest quality. Producers, conservation planners and other rangeland stakeholders need to quickly locate and access relevant reference materials. Finding actionable information is challenging because materials are spread across the internet and search technologies currently do not tag information within sections of important technical references. An application that uses a thesaurus of range science terms to tag, annotate, and search a curated collection of technical references will help get the necessary and most applicable information to land managers. The last collection of terms that was created specifically for rangelands was published by the Society for Range Management in 1998. Much has changed in range science in the past 21 years and the field will continue to evolve with the needs and concerns of land managers. A targeted thesaurus for range science should reflect those changes and have the ability to be updated on a regular basis. In addition, establishing relationships between thesaurus terms can make relevant information more accessible. The thesaurus concepts and relationships are the basis for tagging and referencing source material in search applications. A search application of range science reference material that is tagged, annotated, and organized by a thesaurus of terms will make relevant information more accessible to land managers and will help them to consistently make information-based decisions that are supported by the most up-to-date knowledge in the field of range science. The described application and targeted thesaurus are being developed by the Rangeland Partnership through a NRCS Conservation Innovation Grant.



Poster Session Monday 1: Poster Pod 6, Poster 35

THE HUMBOLDT RANCH STORY

Gregg E. Simonds¹, Jesse Bratz², Eric D. Sant^{*3}; ¹Open Range Consulting, Park City Utah, UT, ²Humboldt Ranch, Winnemucca, NV, ³Open Range Consulting, Park City, UT

ABSTRACT

The Humboldt Ranch, located in North Central Nevada, is managed with time and timing of livestock grazing and has been over the last 18 years. Prior to this the Ranch was managed as season long grazing. The results of season long grazing were riparian areas that were barely functioning and sagebrush monocultures with limited understories. During the past 18 years extensive on-the-ground and remote sensing monitoring has occurred to document and quantify changes on the landscape. The resulting changes have been mixed with some portions of the Ranch, like riparian areas, showing significant improvement while other areas have been at the mercy of wildfire and have had negative effects.



Poster Session Monday 1: Poster Pod 6, Poster 36

MITIGATING WOLF LIVESTOCK DEPREDACTION

Donald J. Kaleta*; MOM and POP PRODUCTS CO, Rome, OH

ABSTRACT

As Wolf Depredation on Domestic Livestock escalates, throughout the World with the Wolves successful populations spread, the contentious anger between Livestock Producers and Conservationists does also grow. My published research Blog at WWW.FENCEFLAGWOLFTRAINING.COM is a tangible suggestion, with minimal cost, to mitigate the anger on both sides!



Poster Session Monday 1: Poster Pod 7, Poster 37

DEVELOPMENTAL MORPHOLOGY OF SIX GRASSES OF NORTH AMERICA

Leobardo Richarte, Carlos Villalobos*; Texas Tech University, Lubbock, TX

ABSTRACT

There has not been done a comparative developmental morphology study among short, mid and tall grasses in North America. The main objective of this study was to determine developmental morphology and tiller recruitment differences among these species which represent three of the major grasslands of North America. Developmental morphology and number of tillers per plant were evaluated once a month from July to November. An analysis of variance was performed at each evaluation date to determine significant differences in MSC among the grasses. Results of this study indicated significant differences in MSC among species at every evaluation time. KL showed the highest MSC values at every evaluation. There were no significant differences between AL and CI, but CII had lower MSC values than the other switchgrass types. BG and ST had the higher number of tillers and lower MSC values than the switchgrasses at each evaluation date. Early internode elongation and lack of fall regrowth in switchgrass were the main reasons for those differences. We concluded that there is a difference in developmental morphology and tiller recruitment pattern between switchgrasses and the short and mid-grass species. However, there were no differences between the short grass (BG) and the mid grass (ST), both of which seem to follow the same maturation and tiller recruitment pattern over the growing season.



Poster Session Monday 1: Poster Pod 7, Poster 38

SEASON AND INTENSITY OF DEFOLIATION IN BIOMASS PRODUCTION OF SHORT, MID AND TALL GRASSES

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ABSTRACT

Grazing schemes are an important tool to maintain a balance between cattle production and rangeland health. These schemes must be designed considering grazing animal type, topography, weather and vegetation species response to defoliation. Although, not all grass species respond in the same way to defoliations especially if they are defoliated earlier or later in the growing season. Differences in plant response after defoliation relates to the developmental morphology stage at which they are at defoliation time. Although this is a very important factor to consider, there is not enough information about it. The objective of this study was to identify the effects of moderate and heavy utilization on plant biomass allocation to the main plant structures in short, mid and tall grass species. This study was performed during the 2015 and 2016 growing seasons under field conditions. Species evaluated were blue grama, sideoats grama, switchgrass, as common species of the short, mid and tall grass prairie of North American, respectively. In addition, we used WW-B. Dahl as reference species due to its high productivity. Plants were clipped with 50% and 75% of the total aboveground biomass during the vegetative and reproductive phenological stages. At the end of the growing season total plant biomass was harvested and separated into aerial tillers, crown and roots. An analysis of variance was conducted per response variable to detect significant differences among the defoliations treatments combinations. Response variables in this study were aerial tiller, crown, roots and total biomass. There was a significant ($P < 0.05$) three-degree interaction between species, defoliation intensity and phenological plant stage for each response variable. Heavy utilization at plant's vegetative stage (75xVeg) was the treatment that significantly reduced biomass productions in all grass structures. In contrast, moderate utilization at plant's reproductive stage (50xRep) was the treatment combination that always produced similar values to control plants. In conclusion, biomass production in these species was significantly affected by our defoliations treatments. The effects on biomass production varied depending on the species, plant's morphological stage, and clipping intensity.



Poster Session Monday 1: Poster Pod 7, Poster 39

HERBIVORY DURING THE SEEDLING PHASE MAY INCREASE SURVIVAL IN SOME PERENNIAL GRASSES

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ABSTRACT

The sensitivity of adult perennial grasses to herbivory has been extensively researched. However, there is little corresponding study of defoliation during the seedling life stage. Seedling survival can determine the fate of restoration efforts and the shape of natural demographic processes. To determine the importance of herbivory in a field settings we conducted a controlled defoliation experiment using three perennial grasses (crested wheatgrass [*Agropyron cristatum* {(L.) Gaertn.], bluebunch wheatgrass [*Psuedoroegnaria spicata* {Pursh} Á. Love], Sandberg bluegrass [*Poa secunda* J Presl]). Species were fall-seeded at the Northern Great Basin Experimental Range, Oregon, in 1 m² plots randomly assigned to four blocks and five treatments (0%, 30%×1, 30%×2, 70%×1 or 70%×2 defoliation) [N=60]. In the spring, all seedlings reaching the 2-leaf stage in late March were tagged and treated [n=423]; seedlings receiving multiple defoliations were treated again 4 weeks later. Survival was tracked through the end of first and second growing seasons and assessed at the plot level using a Bayesian binomial model with informative priors. We found that Sandberg's bluegrass survival was unaffected by our defoliation treatments. In crested wheatgrass, repeated defoliation increased survival by 14% over undefoliated controls. Increases in crested wheatgrass survival persisted through the second growing season. No difference was found in bluebunch wheatgrass survival during the first growing season, but at the end of the second growing season, seedlings that had experienced a single defoliation were 10% more likely to have survived than controls. These findings could help inform decisions regarding which species to seed when herbivory is a concern.



Poster Session Monday 1: Poster Pod 7, Poster 40

EFFECT OF GRAZING ON PRODUCTION AND QUALITY OF PASTURE IN THE SOUTHEAST OF COAHUILA, MEXICO

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ABSTRACT: MS STUDENT

Cattle grazing is one of the most important disturbance agents in grasslands. It has been documented that overgrazing prevents the development of forage species. In degraded grasslands of arid regions, the application of livestock exclusion is useful because it can restore vegetation and conserve species diversity. A study of livestock exclusion and grazing was carried out to determine the effect on biomass production and protein content in a medium open grassland of southeast Coahuila. Forage sampling was carried out in the summer of 2018 and 2019. The data were analyzed using PROC GLM of SAS. In this case, biomass production revealed significant differences ($p < .0001$) between treatments (exclusion vs. grazing) from year to year. Being the site of exclusion with better productivity with averages of 947 ± 44 and 931 ± 21 kg of Ms / ha-1 in the years 2018 and 2019 respectively. While the grazing treatment was 754 ± 25 and 720 ± 32 kg of Ms / ha-1 for 2018 and 2019 respectively. The protein content did not reveal significant differences ($p > 0.05$) between the treatments in both years, the exclusion site in 2019 presented a better level with an average of $8.2 \pm 1.3\%$. The deficit in pasture management that has been done to date has led to the invasion of unproductive and nutritious species. The increase in biomass productivity in exclusion areas may be related to the recovery of vegetation and the presence of good quality forage species such as *Bouteloua gracilis* and *B. curtipendula*. If the pressure of overgrazing in the studied pasture continues, it could be replaced in the medium term by unproductive species. Preliminary results suggest that these ecosystems should be conserved for high natural values, for landscape diversity, and for being agostadero lands.



Poster Session Monday 1: Poster Pod 7, Poster 41

GRAZING AND ENVIRONMENT CHANGE CAN AFFECT PURPLE PRAIRIE CLOVER FREQUENCY: EVIDENCE FROM NORTH AMERICA PASTURE

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ABSTRACT: Ph. D STUDENT

Purple prairie clover (PPC, *Dalea prupurea* Vent.) is an important native perennial legume widely distributed across North America. The PPC is a nutritious forage that can be grazed by domestic livestock and wildlife and an important forb for prairie restoration and improving biodiversity. Research objective was to summarize and evaluate PPC frequency responses to deferred rotational and continuous grazing systems and two different native seed mixtures (7 species and 14 species) in the context of environment changes over the length of the study (9 years). The experimental data were divided into three different moisture types for the year: dry, wet and normal (according to grazing season precipitation, $P < 0.05$). Results found as the study duration increased, the PPC frequency was increased ($P < 0.001$). Grazing system and year was the only significant interaction ($P = 0.05$) and seed mixtures did not affect PPC frequency. In the dry years, the PPC frequency decreased as study duration and precipitations increased ($P < 0.05$). However, with increasing average annual temperatures and snow depths, the PPC frequency increased ($P < 0.05$). Further, in the dry years, the rotational grazing PPC frequency was higher than the continuous grazing system ($P < 0.05$), but only in the spring and summer grazing period. In the wet years, the PPC frequency increased with duration, average temperatures and precipitations ($P < 0.05$). In particular, the frequency of spring grazed PPC was higher than all other treatments. In normal years, the PPC frequency did not change with duration, temperatures, precipitations and snow depths ($P > 0.05$). Also, in the normal years, only the PPC frequency in spring rotational grazing was higher ($P < 0.05$) than the continuous grazing system. In conclusion, PPC frequency increased under spring deferred rotational grazing compared to the continuous grazing system, regardless of the environmental conditions. Selecting the right grazing management system with favorable environmental conditions can increase PPC in our rangelands.



Poster Session Monday 1: Poster Pod 7, Poster 42

ABOVE AND BELOW BIOMASS ALLOCATION IN SHORT, MID AND TALL GRASS SPECIES DURING DIFFERENT PHENOLOGICAL STATES

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ABSTRACT

There are three main morphological grass types, which dominate North America rangelands. Morphological differences among these grasses might influence biomass allocation patterns to the main grass structures (aerial tillers, crown and roots) as a result of resource limitation. The objective of this study was to identify biomass allocation patterns among plant structures in short, mid and tall grass species. This study was performed during the 2015 and 2016 growing seasons under field conditions. Species evaluated were blue grama, sideoats grama, switchgrass, as common species of the short, mixed and tallgrass prairie of North America, respectively. In addition, we used WW-B. Dahl as reference species due to its high productivity. Plants were established in 19-L pots and grew until biomass collection. Biomass was harvested during the vegetative, reproductive and post-reproductive phenological stages. Total plant biomass was separated into aerial tillers, crown and roots. An analysis of variance was conducted to detect differences in biomass allocation means amount among grass structures. There were significant differences in the amount of biomass allocated to each grass structure. Results showed that regardless of phenological stage, all grasses, besides switchgrass, allocated significantly higher biomass portions to the aerial tillers, followed by roots and finally crowns. Even though roots allocated higher biomass than crowns, there was no significant difference between them in most of the species. WW-B. Dahl was the species which produced significantly higher total biomass. Biomass differences between tall grass switchgrass and the mid grass sideoats grama were not as significant as we expected. Finally, blue grama presented the lower biomass production of all the species. In most of the cases biomass allocation patterns followed our hypothesis; however, switchgrass significantly allocated higher biomass to the belowground portion, even though it is a tall grass species, we expected higher biomass in the aboveground portion. Our results suggested that biomass accumulation in grass structures is a dynamic process affected by species and phenological stage.



Poster Session Monday 1: Poster Pod 8, Poster 43

EVALUATION OF CUTTING FREQUENCY ON YIELD AND NUTRITIONAL QUALITY OF HERBACEOUS FORAGE SPECIES IN ENCLOSURE OF BORANA RANGELANDS, SOUTHERN ETHIOPIA

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ABSTRACT

A study was carried out in the semi-arid environments of Borana rangelands, southern Ethiopia to determine the yield responses of grass and non-grass species to four cutting frequencies over a two years period. Four treatments of cutting frequencies i.e. cutting once after the end of main growing season (T1), cutting every week (T2), cutting every two weeks (T3) and cutting every three weeks (T4) were laid out in a randomized complete block design (RCBD) with three replications. Sampling herbaceous vegetation attributes was carried out in 2015 and 2016. In total, 37 different herbaceous species comprising of 15 grass species and 22 non-grass species were sampled. Cutting frequency had a highly significant effect ($P < 0.01$) on herbaceous biomass with yield decreasing as the number of cutting frequencies increased. Grass species composition, dried biomass and density were significantly affected ($P < 0.05$) by frequency of cutting being the highest for T1. However, non-grass species richness, diversity and evenness were significantly affected ($P < 0.05$) by treatments. Cutting grasses subsequently over years reduced species richness and diversity excepting when cut every three weeks which did not affect species richness but increased species diversity. Like grass, non-grass species richness was reduced when all the treatments were applied across subsequent years. Cutting both grass and non-grass species once after the end of main growing season (T1) enhanced percentages dry matter (DM), neutral detergent fiber (NDF), acid detergent fiber (ADF) and acid detergent lignin (ADL). Cutting both grass and non-grass species every week (T2) favored percentage crude protein (CP) and true invitro organic matter digestibility (TIVOMD). For short-term rangeland management, cutting once after main growing season per year can be recommended because of the high yield in herbaceous species composition, dried biomass, basal cover and density.



Poster Session Monday 1: Poster Pod 8, Poster 44

AUTUMN BCS AND POSTPARTUM HERBAGE ALLOWANCE ON PRODUCTIVE AND REPRODUCTIVE RESPONSES OF PRIMIPAROUS SPRING CALVING BEEF COWS GRAZING NATIVE GRASSLANDS

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ABSTRACT: MS STUDENT

Beef cows grazing native grasslands are subject to a great variability that affects the pre and/or postpartum nutrition. The objective of the study was to test the autumn BCS (aBCS)/second third of gestation and postpartum herbage allowance (HA; herbage mass: stocking rate, kg DM/kg LW) interaction in primiparous spring-calving beef cows. Treatments were 2 aBCS (HaBCS > 6, LaBCS ≤ 6) and two HA postpartum (HHA = 4 vs LHA = 2 kg DM/kg LW) (High-High = H-H n= 29; High-Low = H-L n= 27; Low-High = L-H n= 27; Low-Low = L-L n= 30). The BCS was 0.6 units greater prepartum in HaBCS than LaBCS ($P < 0.05$) and did not differ postpartum. The cows BCS tended to be greater in HHA compared to LHA at 85 days postpartum (DPP) ($P < 0.1$). aBCS did not affect LW and liveweight postpartum increased in HHA while did not change in LHA cows, and cows in HHA were heavier at 100 and 135 DPP compared to cows in LHA ($P < 0.05$). Cows of H-H, L-H, and H-L treatments had a greater probability of ovulation than L-L cows ($P < 0.1$). Early pregnancy was greater in HaBCS than LaBCS (0.58 vs 0.29 ± 0.07 ; $P < 0.05$) and in HHA compared to LHA (0.56 vs 0.31 ± 0.065 ; $P < 0.05$) Pregnancy rates were greater in HaBCS compared to LaBCS (0.98 vs 0.88 ± 0.03 ; $P < 0.05$). Cows in HHA had greater milk yield and heavier calves compared to LHA ($P < 0.05$) while aBCS did not affect calf weight and milk yield. A HaBCS had a greater reproductive response and attenuate the negative effect of LHA. An HHA improves the probability of ovulation and early pregnancy in LaBCS cows but were at the limit to did not overcome the effect of a LaBCS.



Poster Session Monday 1: Poster Pod 8, Poster 45

SHEEP GRAZING FOR THE CONSERVATION OF BIODIVERSITY IN DRY GRASSLANDS IN THE ITALIAN ALPS

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ABSTRACT

The European LIFE Program promotes the development and implementation of the European Union (EU) environmental policy by financing innovative projects aimed at the conservation of biodiversity. In 2013, the program funded the LIFE Xero-Grazing project to promote the conservation and restoration of two grassland formations classified as priority habitats by the EU's Habitat Directive: "Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*), important orchid sites" and "Sub-Pannonic steppic grasslands". These dry grasslands are valuable all over Europe due to their rarity and the richness in orchids and other rare species. However, they are also vulnerable to vegetation changes (i.e. tree and shrub encroachment) that usually follow the interruption of agro-pastoral activities. To improve the status of these habitats and species, the LIFE Xero-Grazing project has implemented conservation grazing in a protected area of the south-western Italian Alps abandoned since the 1950'. A flock of sheep and all equipment necessary for grazing were bought thanks to European funds. In the period 2014-2019, botanists and pastoralists working on the project carried out 541 vegetation surveys on 129 permanent observation stations to monitor yearly the effects of grazing on plant species composition. Moreover, in 2015, they investigated plant-species selection by sheep by means of post-grazing surveys and animal GPS tracking. The aims were, respectively, to identify habitats and plant species, assess their grazing value, and compare the effects of different aspects of grazing (e.g. spring and fall grazing, night penning areas), and to understand animal preferences and grazing spatial patterns depending on stocking density. Results confirmed the remarkable species richness and number of rare species of the habitats. They also confirmed that sheep grazing is an effective tool for the conservation of abandoned and shrub- and tree-encroached dry grasslands.



Poster Session Monday 1: Poster Pod 8, Poster 46

SUPPLEMENTATION STRATEGIES TO ENHANCE INTAKE OF ROMERILLO (*CHILIOTRICHUM DIFFUSUM*) BY SHEEP IN SOUTHERN PATAGONIA

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ABSTRACT

Romerillo (*Chiliotrichum diffusum*) is an unpalatable and invasive shrub occurring in over 1 M ha of rangelands in southern Chile, which constraints livestock operations and reduces biodiversity. Low nutrient content and the presence hydrolyzable tannins (HT) explain the low palatability of the shrub. We determined whether supplemental macronutrients (Exp. 1) or polyethylene glycol (PEG; Exp. 2), a polymer that reduces bioavailability of tannins, enhance intake of romerillo by sheep. In Exp. 1, 28 yearling ewes were penned individually and randomly assigned to 4 groups (7 ewes/group) in a split-plot design, where they received during 10 min./d supplements high in energy (HE; corn), high in protein (HP, canola meal), or a choice between HE and HP (CH). A Control (C) group was not supplemented. Subsequently, all ewes had *ad libitum* amounts of freshly cut romerillo for 7 h/d, and finally 1% BW of grass hay. Intake of romerillo was HP > C > HE (8.4, 6.3, 4.5 g/Kg BW, respectively; P < 0.05), and ewes in CH selected a 67:33 proportion of corn:canola meal, consuming amounts of romerillo (6.8 g/Kg BW) that did not differ from HP. In Exp. 2, 32 yearling ewes were assigned to a 2x2 factorial design (8 ewes/group), with PEG (1-yes, 2-no) and Supplement (1-HP; 2-Mix selected by ewes in Exp. 1) as factors. PEG did not affect romerillo (3.4% HT) intake (P > 0.05), but ewes supplemented with HP showed the greatest intakes of romerillo (6.6 g/Kg BW; P < 0.0002). Thus, protein supplementation or choices between energy- and protein-dense supplements have the potential to enhance use of romerillo by ewes in southern Patagonia. In contrast, energy-dense supplements reduced intake of romerillo relative to unsupplemented animals, and PEG did not influence intake, likely due to the chemistry and structure of the tannins present in the shrub.



Poster Session Monday 1: Poster Pod 8, Poster 47

ANALYSIS OF IN-SEASON REGROWTH ON CALIFORNIA ANNUAL RANGELAND VEGETATION FOR LIVESTOCK CARRYING CAPACITY

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ABSTRACT

Carrying capacity for livestock grazing on California annual rangelands has generally been calculated by total production known to occur at the end of a growing season in a typical climatic year, minus the recommended residual dry matter for a given location. However, the vegetation found on these types of rangelands can experience regrowth after clipping or grazing in relation to in season climatic conditions. What appears to be unknown is if the amount of regrowth is commensurate with previously calculated total production and/or if the regrowth post grazing (or clipping) has an additive effect on total production. To determine this, cages have been placed at a variety of locations in the northern Sacramento valley. The locations have various ecotypes and soil types. Plots within the cages are clipped four times a year, but individual plots are clipped at varying intervals to simulate changes in frequency of grazing that the vegetation may experience depending on types of management. The results of the clippings were then compared to a control plot (unclipped until the end of the season) to determine if there is a difference in production across the season. The preliminary results of this study show that the regrowth plots tended to either exceed or were equal to production of the control plots. This study will be carried out for at least 2 more years. We hope to determine if the amount of regrowth within a season on annual rangelands influences the carrying capacity on the annual rangelands found in California.



Poster Session Monday 1: Poster Pod 8, Poster 48

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Poster Session Monday 1: Poster Pod 9, Poster 49

USFS VACANT ALLOTMENT CASE STUDY: EMERSON ALLOTMENT, WARNER MOUNTAIN RANGER DISTRICT CALIFORNIA

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ABSTRACT

The Emerson allotment on the Modoc National Forest is located on the southeast side of the Warner Mountain Ranger District in Modoc County, California. The Warner Mountains begin in northeastern California and stretch into southern Oregon. The Emerson allotment has three pastures totaling 1150 acres ranging in elevation from 5000-9000 feet. There are many small and moderately sized spring-fed meadows throughout the allotment. Public land grazing is essential to the local rural economy as Modoc County is over 70% public land. Emerson is one of the 209 vacant allotments in United States Forest Service (USFS) Region 5 (California) out of 696 total allotments. Of those 209 vacant allotments, 179 do not have current National Environmental Protection Act (NEPA) clearance, including this one. The Emerson allotment was historically used for cattle grazing but has not been grazed since 2012. Grazing has been reduced on USFS land from 1980 to 2010 by 49% in part due to allotments being left vacant. There are a variety of reasons why allotments are left vacant but one of the biggest reasons is the need for current NEPA and data collection to support the NEPA process. We began collecting data on the Emerson allotment in August 2019 and will continue through 2021. We are looking at forage and browse production, plant vigor, topography, species richness including forb diversity, and adequate water and infrastructure. Several objectives guide our research including ecological considerations of grazing, best class of livestock to utilize the allotment, season of use, concerns for designated wilderness, and fine fuels reduction and wildfire mitigation. We are building off work completed by colleagues from UC Rangelands on annual and long-term use of USFS meadows in California.



Poster Session Monday 1: Poster Pod 9, Poster 50

VEGETATION AND ARTHROPOD COMMUNITY RESPONSE TO LONG-TERM GRAZING EXCLUSION AND DEFERRED GRAZING IN SOUTH BRAZIL.

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ABSTRACT

Grazing exclusion may lead to biodiversity loss and homogenization of species-rich and heterogeneous grassland ecosystems, and these effects may cascade to higher trophic levels and ecosystem properties. To date, there is no empirical evidence for the effects of alleviating the disturbance regime in grassland ecosystems. Using data of the first four years of a long-term experiment, with randomized block experimental design in native grasslands of southern Brazil, we examined the effects of three grazing treatments on plant and arthropod communities. The evaluated treatments were: (i) deferred grazing, (ii) grazing exclusion and (iii) a control under traditional continuous grazing, which were applied to 70 x 70 m experimental plots, in six regionally distributed blocks. We assessed the plant community responses regarding taxonomic and functional diversity (life-forms) in separate spatial components: alpha (1 x 1 m subplots), beta, and gamma (70 x 70 m plots), as well as the cascading effects on arthropod high-taxa. By estimating effect sizes (treatments vs. control) by bootstrap resampling, both deferred grazing and grazing exclusion mostly increased vegetation height, plant biomass and standing dead biomass. The effect of grazing exclusion on plant taxonomic diversity was negative. Conversely, deferred grazing increased plant taxonomic diversity, but both deferred grazing and exclusion reduced plant functional diversity. Reduced grazing pressure in both treatments promoted the break of dominance by prostrate species, followed by fast homogenization of vegetation structure towards dominance of ligneous and erect species. These changes in the plant community led to increases in high-taxa richness and abundance of vegetation-dwelling arthropod groups under both treatments but had no detectable effects on epigeic arthropods. Our results indicate that decision-making regarding the conservation of southern Brazil grasslands should include both intensive and alleviated levels of grazing management, but not complete grazing exclusion, to maximize conservation results when considering plant and arthropod communities.



Poster Session Monday 1: Poster Pod 9, Poster 51

EFFECT OF GRAZING STRATEGIES ON BOTANICAL COMPOSITION IN THE NEBRASKA SANDHILLS

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ABSTRACT

Implementation of management intensive grazing strategies requires significant monetary and labor input by land managers, justified with the expectation of increases in desirable plants, production, and harvest efficiency leading to increases in carrying capacity. Conflicting results in the literature makes further study of the impacts of grazing period length and intensity of management on rangeland vegetation necessary; therefore, a grazing study was conducted from 2010 to 2018 on upland range at the Barta Brothers Ranch (BBR) in the Nebraska Sandhills to determine the effects of grazing period length and intensity on botanical composition. Treatments represented three grazing period lengths consistent with grazing strategies used in the Nebraska Sandhills: 1) a 150-day grazing period corresponding to season-long continuous grazing, 2) a 37-day average grazing period corresponding to a four-pasture deferred rotation, and 3) a 3-day grazing period corresponding to a 50-pasture rotation. Treatments were applied at a moderate stocking rate ($1.85 \text{ AUM} \cdot \text{ha}^{-1}$) based on long-term research conducted at BBR, and at a stocking rate 1.5 times the moderate rate ($2.77 \text{ AUM} \cdot \text{ha}^{-1}$). Frequency of occurrence data were collected and the 35 most frequently occurring plant species were grouped into high, medium, or low forage value (considers growth form, production, abundance, growth potential, and palatability) and the grasses were also grouped into cool- or warm-season. From 2010 to 2018, high forage value cool-season and low forage value warm-season grasses as well as high and medium forage value forbs increased on the study site; however, the change in frequency of the forage value groups over the 8 years did not differ among the 3 grazing period lengths and the 2 stocking rates. We concluded that the principal plant species on upland range in the Nebraska Sandhills were not affected by the commonly-used grazing period lengths at 2 stocking rates.



Poster Session Monday 1: Poster Pod 9, Poster 52

FINE FUELS MANAGEMENT TO IMPROVE WYOMING BIG SAGEBRUSH PLANT COMMUNITIES USING DORMANT SEASON GRAZING

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ABSTRACT: MS STUDENT

The invasive annual grass, medusahead (*Teaniatherum caput-medusae*), dominates secondary succession in many sagebrush steppe plant communities, ultimately degrading wildlife habitat, decreasing forage available to livestock, and increasing the frequency of wildfire. Medusahead, a winter annual, germinates and sprouts in the fall, providing forage for livestock when perennial bunchgrasses are dormant. The focus of our research is to measure the impacts of grazing treatments on medusahead across four treatments: 1) no livestock grazing (control), 2) traditional grazing between May and September, 3) dormant season grazing from October to February, and 4) traditional plus dormant season grazing where livestock graze during both seasons. Our specific objective is to promote healthy and functional landscapes within the sagebrush steppe of southeastern Oregon by one, reducing fine fuel loads to lower fire risk, and two, promote perennial bunchgrasses by taking advantage of phenological differences between perennial and invasive annual grasses. The research is taking place on the Vale District Bureau of Land Management Three Fingers allotment 80 km southwest of Boise, ID. Vegetative cover and density data was collected in June 2018 and 2019 and will continue to be collected over the next three years. From 2018 to 2019, annual grass cover increased by 10% in the control treatment; across all grazing treatments the average increase was 13%. Introduced perennial grass cover also increased by 5-10% in three of the four treatments, with no measured change in the dormant season only treatment. Native perennial grass cover remained $\pm 3\%$ across all treatments. Perennial grass density from 2018 to 2019 decreased by 2-3 plants/m² in all three grazing treatments and remained the same in the control. Findings from this research will contribute to our understanding of dormant season grazing as a means to reduce medusahead and improve rangeland health across the sagebrush steppe.



Poster Session Monday 1: Poster Pod 9, Poster 53

QUANTIFYING THE BENEFITS OF COLLABORATIVE ADAPTIVE MANAGEMENT IN RANGELAND SYSTEMS.

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ABSTRACT

Collaborative adaptive management (CAM) is hypothesized to benefit management of rangeland ecosystems. Despite the popularity of CAM, the presumed benefits have seldom been quantified. Here, we evaluate the contributions of an 11-member Stakeholder Group to livestock production during 2016-2018 in the semiarid shortgrass steppe of the western Great Plains. Our study provides clear evidence that in the absence of adaptive management, livestock weight gains decline approximately linearly with increasing stock density. These declines can only be partially offset via adaptive decision-making. Contributions attributed to CAM were persistently positive across the three years compared to a traditional non-adaptive grazing strategy. Absolute production increases of 0.10 to 0.28 kg/steer/day and relative increases of 16-49% for animal weight gains were attributed to CAM. This increased the economic value of individual steers by \$34.66 to \$55.54 over the 3-year period. CAM provided the adaptive capacity to flexibly match animal forage demand with the spatial and temporal heterogeneity in forage quantity and quality among ecological sites and years. The beneficial contributions of CAM to livestock production in a semiarid environment characterized by high intra- and inter-annual variability demonstrates the importance of science-management partnerships to sustainable rangeland management. Adaptive decision-making has significant benefits to livestock production but could not fully overcome the negative effects of management at high stock density.



Poster Session Monday 1: Poster Pod 9, Poster 54

RIPARIAN PROPER FUNCTIONING CONDITION ASSESSMENT TO SOUTH FORK OF THE TAMIR RIVER, MONGOLIA

Baldandugar Tsoggerel*¹, Sherman R. Swanson², Ganbaatar Erdenetsolmon¹, Otgonsuren Burenjargal¹, Namsraijav Tsegmid¹, Tuulaikhuu Baigal-Amar¹, D. Bulgamaa³; ¹Mongolia University of Life Science, Ulaanbaatar, Mongolia, ²University of Nevada, Reno, Reno, NV, ³Green Gold, Ulaanbaatar, Mongolia

ABSTRACT: UNDERGRADUATE STUDENT

We used riparian Proper Functioning Condition (PFC) assessment to provide a consistent approach for assessing the physical functioning of riparian-wetland areas by considering hydrology, vegetation, and soil/landform attributes at two locations occupied by nomadic herders on South Tamir River, Mongolia. The upper site is below the confluence with upstream tributary valleys was in Properly functioning condition (PFC) but at a low level of functionality. There were few woody stabilizers along the north bank which is rapidly eroding. While a gravel bar has much woody debris from upstream, little wood from the riparian woody plants along this reach is available to the river because it moved. The gravel bar was wide and accessible but lacked woody vegetation that had escaped browsing height. Vegetation could provide a veneer of fine soil above the gravel and sand base. The lower site is below the confluence of a newly re-watered alternate channel. It was nonfunctional (NF) with no woody stabilizers effective along the north or south banks and the south bank was rapidly eroding. A wide and accessible gravel bar lacked woody vegetation that had escaped browsing height, or even germinated seedlings. Transverse bars indicate unstable banks, an over-wide channel and accelerated sediment supply from upstream. These assessments indicate that riparian grazing management must change to avoid the problems observed along the lower reach of the South Fork of the Tamir River and to strengthen riparian functions that could create stability and multiple resource values. This change in grazing management must include periods of nonuse or possibly very light use that allows most or all of the establishing woody stabilizer species to escape browsing height. Additional density of woody stabilizers could be started with pole plantings on banks.



Poster Session Monday 1: Poster Pod 10, Poster 55

TARGETING THE SOIL SEEDBANK OF INVASIVE BROADLEAF WEEDS FACILITATES LONG-TERM RANGELAND RESTORATION

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ABSTRACT

Broadleaf weed management on rangelands remains a constant challenge faced by land managers. Herbicides often fail to provide long-term control of invasive broadleaves, even when adequate first-year control is achieved, due to weeds reinvading from the soil seedbank. Indaziflam is pre-emergent (PRE) herbicide with activity on both monocots and dicots. Indaziflam can provide 3+ years of winter annual grass control, yet there is limited information regarding the use of this herbicide for PRE control of broadleaf weed seedlings on rangeland sites. A field study was conducted to evaluate the performance of broadleaf herbicides, picloram and aminocyclopyrachlor, applied with and without indaziflam to control three broadleaf weed species. Nine herbicide treatments and one non-treated control were applied with a tractor boom sprayer to 0.8-hectare plots at two sites in March 2016. Plots consisted of dense downy brome (*Bromus tectorum*) cover (~80%) along with common mullein (*Verbascum thapsus*), Dalmatian toadflax (*Linaria dalmatica*), and diffuse knapweed (*Centaurea diffusa*) infestations. Downy brome, perennial grass, and forb biomass along with species richness and percent cover by weed species were collected 1 and 2 years after treatment (YAT). Every herbicide treatment reduced broadleaf weed cover 1 YAT, while only treatment combinations which included indaziflam continued to control all weed species 2 YAT. Increases in cool-season grass biomass occurred at both sites among treatments which included picloram plus indaziflam, while warm-season grass increases occurred in treatments containing aminocyclopyrachlor plus indaziflam. At 2 YAT, indaziflam treatments had greater species richness (12.3 species) compared to the nontreated (4.8 species). Using indaziflam in combination with broadleaf herbicides has the potential to provide multi-season weed control by managing the seedbank of both grass and broadleaf weeds, potentially allowing enough time for re-establishment of the native plant community.



Poster Session Monday 1: Poster Pod 10, Poster 56

A STUDY OF THE ALLELEPATHIC EFFECTS OF TWO SPECIES OF OLD WORLD BLUESTEM

Dean A. Stramel*; Fort Hays State University, Hays, KS

ABSTRACT: MS STUDENT

Invasive species have become a major ecological problem worldwide. Invasive plants are moving into new habitats and displacing native plants, often to the detriment of these native ecosystems. Two grasses commonly called Old World Bluestems, (OWBs), *Bothriochloa ischaemum* and *B. bladhii*, were introduced into the central and southern Great Plains in the last century and have become problematic invaders. Once established OWBs tend to eliminate, potentially through allelopathic mechanisms, all other plants, effectively becoming monocultures. Our research intends to study the allelopathic effects of these two species of OWB on the germination of each other's seeds and the seeds of one native grass, *Andropogon gerardii*. Leachate will be produced using whole plant tissues of each of the OWBs and the native grass. These leachates will then be added to seeds of each of the three species.

Combinations of seeds and leachates will be grown in a growth chamber to observe effects on germination of the seeds. We hypothesize that leachates of OWBs will inhibit the germination of the native species but will not inhibit the germination of each other's seeds. This study could lead to strategies for controlling the spread and establishment of OWBs and aid in restoration of native grasslands.



Poster Session Monday 1: Poster Pod 10, Poster 57

BUFFELGRASS (*CENCHRUS CILIARIS* L.) INVASION PATHWAYS ACROSS TEXAS

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ABSTRACT: Ph. D STUDENT

Introduced plant species have been an occurrence for millennia yet only within the last few centuries have geographic barriers due to improving global transportation and networks of commerce allowed widespread transportation of novel plants. Plants have been moved across continents, accidentally or intentionally, to improve settled areas. Buffelgrass (*Cenchrus ciliaris* L.) introductions have occurred worldwide since the late 19th century yet it only now with accelerated climatic change that somewhat restricted populations are expanding into newer habitats that are susceptible to their invasion. We are studying potential pathways and outcomes of buffelgrass invasion in Texas. Using the known location of buffelgrass clumps and patches in Texas, we created maps using available soil, vegetation and weather data provided by state and national agencies and analyzed them with MaxEnt habitat suitability models. We found that the model predicted present locations of buffelgrass and show a potential spread throughout most of the drier areas of the state, specifically the arid deserts and northern prairies of Texas, with potential avenues being the development of roads and other urban infrastructure that alters the local soil structure.



Poster Session Monday 1: Poster Pod 10, Poster 58

THE IMPACT OF NON-NATIVE PERENNIAL GRASSES ON GRASSLAND DIVERSITY AND FORAGE PRODUCTION

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ABSTRACT

Many higher elevation temperate grasslands are invaded with non-native, often rhizomatous, perennial grasses. Rhizomatous species can form dense patches, potentially impacting the composition and productivity of grasslands. We assessed the effect of two rhizomatous grasses, smooth brome (*Bromus inermis*) and Kentucky bluegrass (*Poa pratensis*), on plant biodiversity and forage productivity in a natural mesic grassland. We recorded cover of all species (1 m²) in three habitats (uninvaded, Kentucky bluegrass, smooth brome) at peak vegetative season, and harvested biomass by functional group in late summer. All treatments were replicated. Plant richness declined dramatically along a gradient from the uninvaded to smooth brome, the latter had a third less species. Species evenness (*ESimpson*) decreased along this same gradient. The reduction in evenness was due to increasing dominance and biomass of the target grass species, particularly the smooth brome. The forage quality (% nitrogen) did not differ between habitats but the higher productivity of Kentucky bluegrass, and smooth brome especially, meant that these habitats had more forage per unit area. Thus, the rhizomatous non-native species increased forage productivity but greatly reduced plant species richness and evenness at a local scale, extended to a larger scale this would impact ecosystem function and services.



Poster Session Monday 1: Poster Pod 10, Poster 59

MICROBIOMES OF GRASS RHIZOSPHERES AS POTENTIAL MECHANISMS OF INVASION

Scout M. Harrison*, Mitchell J. Greer; Fort Hays State University, Hays, KS

ABSTRACT: MS STUDENT

Old World Bluestem (OWB) is a name for a group of non-native, perennial, warm-season grasses from the genus *Bothriochloa*. OWBs were intentionally introduced to the Great Plains region from Asia, Europe, Russia, and Australia, and are now known to be aggressive invasive species, often outcompeting native grasses. This ability of OWBs to outcompete native grasses creates monospecific stands of OWBs, which negatively impact plant, mammal, and avian species richness, as well as arthropod biomass. Soil microbes are an integral part of these prairie environments, as they can have a major influence on plant communities. Microbes, such as bacteria and fungi, can act as parasites and decrease the health of plants, or act as nitrogen fixers or other mutualistic partner to plants, thus increasing their fitness. This study will analyze the rhizosphere microbial community of two native and two non-native grass (OWBs) species across the precipitation gradient in Kansas. We will use the number of operational taxonomic units (OTUs) to analyze microbial community variation between the four species of grass, and across the precipitation gradient using ANOVA. We will derive the OTUs using the 16S gene for bacteria, and large subunit ribosomal DNA for fungi. We expect microbial communities surrounding OWB root systems to have lower OTU richness than native grasses, and lower OTU richness moving westward across the precipitation gradient. Soil microbial community variation between invasive OWBs and native grasses could indicate the soil microbial community composition plays a role in plant invasion, which could potentially influence future management strategies.



Poster Session Monday 1: Poster Pod 10, Poster 60

EVALUATING THE EFFICACY OF VARIOUS HERBICIDES ON BULBOUS BLUEGRASS CONTROL

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ABSTRACT: MS STUDENT

Bulbous bluegrass (*Poa bulbosa* L.) is a widespread invasive cool-season perennial grass that reproduces via bulbets. Although it is relatively common, research is limited on bulbous bluegrass and few herbicides are labeled for its management in rangelands. Our objective was to evaluate the efficacy of various herbicides in controlling bulbous bluegrass. We established 2 field sites in northeastern Wyoming in May of 2018 to assess bulbous bluegrass control with 11 different herbicides alone and mixed with Roundup. We applied herbicide treatments to 3 x 9-meter plots as a split-plot randomized complete block design with four replicates at each site. Roundup (520 g ae·ha⁻¹) was applied to 1/3 of each block following other herbicide applications. We collected post-treatment data 30 and 160 days after treatment (DAT) and 1 year after treatment (YAT). We recorded canopy cover by species in ¼ m² quadrats at a density of 6 quadrats per 0.3 are. Additionally, we visually estimated bulbous bluegrass control (%) and damage (%) to perennial grasses and forbs. Data collected 1YAT indicate that Landmark and Matrix effectively controlled bulbous bluegrass alone, combined and mixed with Esplanade at different rates. Plateau and Esplanade tank mixes effectively controlled bulbous bluegrass but were less effective when applied alone. All combination treatments provided greater than 90% control of bulbous bluegrass. Herbicides performed similarly regardless of Roundup application when combined herbicide treatments were applied. Our data shows several effective options for control of bulbous bluegrass. Further research should look to understand the implications of non-target effects in treatment areas.



Poster Session Monday 1: Poster Pod 11, Poster 61

MESQUITE CONTROL IN THE SOUTHWEST

Kert Young*; NMSU, Las Cruces, NM

ABSTRACT

New Mexico contains 67 million acres of rangelands (86% of NM). Invasive shrubs and weeds degrade the condition and productivity of NM rangelands. Mesquite has overtaken hundreds of thousands of acres in NM. We tested the effectiveness of herbicides at reducing mesquite dominance and increasing herbaceous productivity and community composition. Herbicide treatments were applied to four working ranches in 2016 and three ranches in 2017 throughout eastern NM. Initial study results suggest that herbicides effectively control invading mesquite when applied correctly and improve rangeland condition.



Poster Session Monday 1: Poster Pod 11, Poster 62

DURACOR: INTRODUCTION OF A NEW HERBICIDE FOR USE IN RANGELAND, PASTURES, AND NON-CROP SITES

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ABSTRACT: UNDERGRADUATE STUDENT

DuraCor is a new herbicide developed by Corteva Agriscience™, for control of broadleaf weeds, including invasive and noxious weeds, and certain woody plants. DuraCor represents an innovative new tool that is a non-ester, non 2,4-D containing, low odor, low use rate formulation that provides post emergence and reemergence residual control of susceptible broadleaf plants and seedlings and some woody plants. It will provide control of all species known to be controlled by Milestone® herbicide plus many additional species and offers flexibly in application (ground, aerial, broadcast, or spot treatment). A key component of DuraCor is Rinskor™ active, a novel new active ingredient never before used rangeland and pastures and is an EPA Reduced Risk Pesticide just like Milestone. In trials over multiple years across the United States, DuraCor provided excellent control of many noxious and invasive weeds. Based on these efficacy data, it is anticipated that DuraCor will be a useful tool in the management of troublesome weeds in various use sites.



Poster Session Monday 1: Poster Pod 11, Poster 63

INITIAL EFFICACY OF *INDAZAFLAM* ON CHEATGRASS RANGELANDS

Charlie D. Clements*¹, Dan Harmon², Harry Quicke³; ¹USDA, Reno, NV, ²USDA ARS, Reno, NV, ³Bayer, Windsor, CO

ABSTRACT

The accidental introduction and subsequent invasion of cheatgrass (*Bromus tectorum*) throughout millions of hectares of Intermountain West rangelands has resulted in astronomical changes to many plant communities. Cheatgrass is native to the cold deserts of central Asia where humans are first thought to have domesticated animals. These native habitats are very similar to the big sagebrush (*Artemisia tridentata*)/bunchgrass and salt desert ranges of the Intermountain Area of North America. Resource managers need tools to conduct aggressive and effective weed control practices on cheatgrass-infested rangelands to improve restoration/rehabilitation efforts. The use of pre-emergent herbicides has proven to be very effective in decreasing cheatgrass densities and seed banks which are limiting to the establishment of perennial species through competition for limited resources. *Indazafam*, Esplanade, is a pre-emergent herbicide recently available for research on Nevada rangelands. In 2018 we started a research project to measure the efficacy of Indazafam on cheatgrass control in northern Nevada compared to other pre-emergent herbicides that we have experienced good cheatgrass control with, *Imazapic* and *Sulfometuron methyl*. Due to the environments of the cold desert of Nevada rangelands, we applied these pre-emergent herbicides in the fall of the year, fallow the site for 1-year and then seed with desirable perennial species. *Indazafam* plots reduced cheatgrass initial densities by 94.8%, while *Sulfometuron methyl* experienced 99.9% followed by 97.8% for *Imazapic*. When attempting cheatgrass control efforts it is important to understand that control must nearly reach 100% due to the prolific ability of cheatgrass to produce seed and build persistent seed banks. As few as 43 cheatgrass seedlings/m² can outcompete perennial grasses at the seedling stage. The reported residual ability of *Indazafam* for up to 4-years may add longer-term control of cheatgrass that could benefit residual and seeded perennial species.



Poster Session Monday 1: Poster Pod 11, Poster 64

MEDUSAHEAD SILICON, CONSTRAINING FACTORS OF CONTROL, AND RESEARCH NEEDS

Casey Spackman*¹, Thomas A. Monaco², Juan J. Villalba³; ¹Utah State University, 84333, UT, ²Forage & Range Research Laboratory, Logan, UT, ³Utah State University, Logan, UT

ABSTRACT

Medusahead (*Taeniatherum caput-medusae* (L.) Nevski) is currently one of the most detrimental invasive plants impacting rangeland sustainability and livestock operations. Furthermore, it decreases wildlife habitat, plant diversity, and increases the frequency of fires. These impacts are further compounded by the fact that traditional control techniques are often unsuccessful, likely due to high silicon tissue concentrations [Si]. There is a critical need to assess the underlying causes for medusahead invasion and potential obstacles to its control in an ongoing effort to better understand its ecology and develop improved mechanistic and conceptual approaches for effective management. High [Si] are known to increase medusahead invasion through three key aspects: 1) increased plant fitness and production; 2) increased litter accumulations; and 3) decreases in herbivory. For instance, [Si] has been shown to provide delayed litter decomposition which provides better microsite conditions for germination and seedling growth, ultimately increasing plant production and decreased competition of native species. Furthermore, [Si] has been shown to decrease digestibility of the plant through the formation of a varnish on the stems, leaves, and awns, which deters herbivory and increases selection pressure for more palatable plant species. We propose to address each aspect of the medusahead invasion processes by discussing: 1) What do we currently understand about [Si] in medusahead and its role in the invasion process? 2) What is currently being done to control medusahead? 3) Which research approaches are needed to better address the knowledge gaps concerning medusahead invasion? and 4) Which new control strategies may originate from such efforts?



Poster Session Monday 1: Poster Pod 11, Poster 65

TIMING OF GLYPHOSATE APPLICATION TO INCREASE CATTLE CONSUMPTION OF MEDUSAHEAD

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ABSTRACT

Grazing has been shown to be the preferred method of medusahead (*Taeniatherum caput-medusae* (L.) Nevski) control; an invasive annual grass. However, animals tend to avoid the weed due to its anti-nutritional factors (silicon) and undesirable oral texture. Emerging control techniques of a glyphosate-based herbicide in combination with livestock grazing has been shown to increase utilization of the otherwise unpalatable plant. The objective of this study was to determine at what stage of plant development will the application of glyphosate maximize cattle intake and control medusahead. Treatments of glyphosate at 946 g ae ha⁻¹ were applied to medusahead-infested plots (N=4) at four different stages of plant maturation: early seedling (ES); boot stage (BO); reproductive stage (RE); and control (CT). Vegetation was estimated by hand clipping five squares (0.098 m²) to a 1cm stubble height in each treatment prior to (PrH) and after herbicide application (PoH), and after grazing (PoG) by cattle. Eight beef steers were randomly clustered in pairs and assigned to their respective plots and allowed to graze from 0700 to 1800 for 6 d. Preliminary data shows that there was a large reduction in medusahead biomass between PrH and PoH application for ES (320.3 ± 53.9 and 69.0 ± 24.9 Kg ha⁻¹) and BO treatments (413.7 ± 74.4 and 132.5 ± 25.6 Kg ha⁻¹). Medusahead utilization by cattle PoH to PoG was greatest for RE (442.9 Kg ha⁻¹) with the least occurring in the ES (12.7 Kg ha⁻¹). Cattle preferred the RE treatment, however control of medusahead through the greatest biomass removal occurred in the ES and BO treatments. This suggest a tradeoff between available medusahead as a forage source and control of medusahead. Overall, livestock grazing in combination with a glyphosate containing herbicide can be used to reduce medusahead abundance in the plant community.



Poster Session Monday 1: Poster Pod 11, Poster 66

EFFICACY OF DURACOR AND TERRAVUE HERBICIDES ON NOXIOUS AND INVASIVE SPECIES IN RANGELAND AND NON-CROP

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ABSTRACT

DuraCor and TerraVue are new herbicides developed by Corteva Agriscience™, for control of broadleaf weeds, including invasive and noxious weeds, and certain woody plants. DuraCor and TerraVue represent an innovative new tool that is a non-ester, non 2,4-D containing, low odor, low use rate formulation that provides post emergence and reemergence residual control of susceptible broadleaf plants and seedlings and some woody plants. They will provide control of all species known to be controlled by Milestone® herbicide plus many additional species and offers flexibly in application (ground, aerial, broadcast, or spot treatment). A key component of DuraCor and TerraVue is Rinskor™ active, a novel new active ingredient never used on rangeland and pastures and is an EPA Reduced Risk Pesticide just like Milestone. In trials over multiple years across the United States, DuraCor and TerraVue provided excellent control of weeds such as yellow starthistle (*Centaurea solstitialis*), Canada thistle (*Cirsium arvense*), musk thistle (*Carduus nutans*), wild carrot (*Daucus carota*), spotted knapweed (*Centaurea maculosa*), poison hemlock (*Conium maculatum*), woolly croton (*Croton capitatus*), annual marshelder (*Iva annua*), common caraway (*Carum carvi*), and many more. Based on these efficacy data, it is anticipated that DuraCor and TerraVue will be useful tools in the management of noxious, invasive and other weeds in various sites.



Poster Session Monday 1: Poster Pod 12, Poster 67

INTEGRATED CHEATGRASS (*BROMUS TECTORUM*) MANAGEMENT WITH HERBICIDE AND SHEEP

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ABSTRACT

Cheatgrass (*Bromus tectorum* L.) is one of the most widespread and difficult to manage invasive plants in the western United States rangelands. While herbicide and targeted grazing often fail to provide adequate long-term cheatgrass control or promote desirable species, integrating herbicide and grazing may provide multiple stressors leading to better control than either method alone. We studied the impacts of herbicide, targeted sheep grazing and integrated herbicide plus grazing on cheatgrass and the plant community in southwestern Montana from 2015 – 2017. Herbicide treatments included spring-applied (May 2015 and 2016) glyphosate, fall-applied (October 2015) glyphosate, imazapic and rimsulfuron, and spring-applied glyphosate + fall-applied imazapic. Grazing (May 2015 and 2016) consisted of four sheep for approximately 24 hours in 5 m × 20 m plots. While no treatments were effective in reducing cheatgrass biomass or seed production, grazing integrated with fall-applied imazapic or rimsulfuron decreased cheatgrass cover from approximately 29% to 23% in 2016 and from 24% to 14% in 2017 compared to control plots. By 2017, all treatments except spring-applied glyphosate had increased total plant cover (excluding cheatgrass) by 8-12% compared to the control plots. The increase in cover was generally the result of an increase in forb cover, but ungrazed plots treated with fall-applied glyphosate and imazapic, as well as spring-applied glyphosate + fall-applied imazapic increased native grass cover. Results highlight the difficulties of cheatgrass management and point to a potential management paradox: integrating grazing and fall-applied herbicide decreased cheatgrass cover but did not increase native grass cover, while some herbicides without grazing increased native grass cover, but failed to control cheatgrass. Nonetheless, integrated management of cheatgrass appears to have promise compared to grazing or herbicide alone. Additional research should target strategies that will complement herbicide control of cheatgrass while also stimulating native grass recovery.



Poster Session Monday 1: Poster Pod 12, Poster 68

TARGETED CHEATGRASS GRAZING - PREDICTING ANIMAL SELECTIVITY IN THE WESTERN GREAT PLAINS

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ABSTRACT

Cheatgrass (*Bromus tectorum*) has invaded tens of millions of hectares of North American rangeland, leading to increases in fire frequency and reductions in forage production, plant and animal diversity, and carbon storage. Targeted early-season grazing may provide land managers with a low-input method of controlling cheatgrass. Two characteristics of the western Great Plains make the region ideal for controlling cheatgrass with targeted grazing. First, its native plants evolved with large herds of wild ungulates and are well-adapted to grazing. Second, there is relatively little overlap (weeks to a month) between the primary growth period of cheatgrass and that of native cool-season perennial grasses, which provides an opportunity to schedule grazing to favor native grasses. To maximize the efficacy of targeted grazing in this region, we need to answer two questions: (1) which phenological stages of cheatgrass are preferentially grazed by livestock?, and 2) how do the amount and quality of available forage influence livestock selectivity? We used DNA metabarcoding of fecal samples and GPS collars to quantify temporal patterns of cattle consumption of cheatgrass and native, cool-season perennial grasses. The study was conducted for three years at two mixedgrass rangeland sites in Wyoming and Nebraska. At each site, a 4-ha pasture containing a mixture of cheatgrass and native perennial grasses was grazed by 3-4 yearling heifers between mid-April and early July. Results show that the timing of cheatgrass use varies widely among years but can be predicted from a combination of cheatgrass height and phenological stage. Cheatgrass consumption, as a proportion of the overall diet, was highest during periods when cheatgrass was relatively tall and within 10 days of the onset of flowering, corresponding to periods of maximum protein and energy content. Fence-line comparisons demonstrated that early season grazing can lead to 30%-75% reductions in cheatgrass seed set.



Poster Session Monday 1: Poster Pod 12, Poster 69

EVALUATING NATIVE PLANT COMMUNITY RESPONSE USING PRESCRIBED BURNING AND CHEMICAL CONTROL IN AREAS INVADED BY DOWNY BROME

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ABSTRACT: MS STUDENT

Downy brome (*Bromus tectorum*) is known for its ability to accumulate large quantities of litter on the soil surface as it annually senesces and degrades slowly. Research has shown that about 84% of a soil-active applied herbicide can be intercepted by downy brome litter, preventing it from reaching the soil and downy brome seedlings. Prescribed burning has been used as an option to remove this litter layer to eliminate fine fuel and increase the performance of soil-active herbicides. Field studies have shown the combination of burning and applying annual grass herbicides increases downy brome control because of the litter removal. However, little research has been done to determine whether burning increases the efficacy of a new annual grass herbicide, indaziflam. Field studies were conducted at two different locations, to evaluate whether burning does provide extended control with the addition of indaziflam plus different post-emergent products. At each location, there was a burned and non-burned site. The same herbicide treatments were applied at each to control downy brome. Additionally, we wanted to determine the native forb community response in the burned versus the non-burned treatments. Applications were made in March 2018 and treatments included indaziflam (44, 73, 102 g ai ha⁻¹) alone and in combination with four post-emergent herbicides. Visual downy brome and forb cover evaluations were taken in July 2019. At each location, the burned site had significantly greater downy brome control compared to the non-burned site for all indaziflam treatments. Native forb richness also increased on the burned side versus the non-burned side at both locations. This study shows that burning plus herbicide treatments with indaziflam can be used as a tool for land managers to help restore degraded sites and increase native forb richness, while providing increased downy brome control.



Poster Session Monday 1: Poster Pod 12, Poster 70

PRESCRIBED FIRE IS EFFECTIVE FOR REDUCING ANNUAL BROMES IN MIXED-GRASS PRAIRIE AT LOWER INVASION LEVELS

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ABSTRACT

Concern about the impacts of two Eurasian annual brome grasses, *Bromus tectorum* and *B. arvensis*, on the native mixed-grass prairie of the northern Great Plains (NGP) is growing. *Bromus tectorum* is well known west of the NGP, where replacement of fire-intolerant, native sagebrush steppe by fire-prone, exotic annual grasslands is widespread. Consequently, fire is generally not considered as a tool for controlling annual bromes. This should not be the case in the NGP, where mixed-grass prairie is adapted to frequent fires. Fire's efficacy may vary with the degree of invasion, though; suppressing post-fire annual brome populations or enhancing the native plant community may improve post-fire annual brome control in highly invaded areas. To test this, we performed an experiment at two sites to evaluate the relative effectiveness of prescribed fire alone, fire followed by imazapic application, and fire followed by native seeding across a pre-treatment gradient of annual brome:native species cover ranging from 0.05 to 2.35. Autumn prescribed fire alone greatly reduced annual bromes, but by the second year after treatment the effect was significant only at invasion ratios <1.2. Post-fire imazapic application reduced annual bromes even further than fire alone, but only for one year at the less invaded site, and only at invasion ratios >1.2 in year 2 at the other site. Native species cover and total species richness responded positively to all treatments, but the degree of response varied along the invasion gradient, between sites, with time since treatment, and slightly among treatments. Also, at one site, fire yielded a lagged stimulation of short-lived, exotic forbs. Seeding had little or no effect. Fire is an effective tool for reducing annual bromes in the NGP at lower invasion levels, but more tools are needed for long-term effective control at highly invaded sites.



Poster Session Monday 1: Poster Pod 12, Poster 71

ABAM: DEVELOPMENT AND IMPLEMENTATION OF AN ADAPTIVE RESOURCE MANAGEMENT FRAMEWORK FOR NATIONAL PARKS WITHIN THE NORTHERN GREAT PLAINS

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ABSTRACT

National Park Service units in the Northern Great Plains (NGP) have recorded an increase in invasive annual brome grasses within their native mixed-grass prairies, but management targeting their control has so far been minimal. Parks in the NGP preserve and protect historical landscapes and natural ecosystems. Invasion by annual brome grasses into these landscapes reduces historical and ecological integrity, in part by reducing native plant diversity, which is hallmark of high-quality prairie. Managing annual bromes is a complex problem because land managers are uncertain about the effectiveness of specific management treatments in controlling annual bromes. Monitoring data from NGP parks suggest that prescribed fire reduces annual bromes for at least two years, and results from outside the NGP show promisingly strong but expensive 4-year annual brome suppression by the herbicide indaziflam, but this information is insufficient to guide managers on how to best use their limited capacity to implement management treatments. The Annual Brome Adaptive Management project (ABAM) is addressing this problem through a cooperative effort among seven parks; their supporting Inventory & Monitoring networks, Exotic Plant Management Teams, and Fire Management Office; and U.S. Geological Survey scientists. ABAM is developing a structured adaptive management framework comprised of a decision tool and a formal communication structure among the natural resource experts and park decision makers. The decision tool is a state-transition Bayesian network developed using 20 years of NPS monitoring data. The tool considers the state of the vegetation in each management unit, compares the predicted outcome of each potential treatment within the next 5 years, and determines the optimal management action according to managers' relative preferences for different vegetation communities and the cost of treatment. The framework will guide parks and their supporting networks in making more effective and strategic vegetation management decisions.



Poster Session Monday 1: Poster Pod 12, Poster 72

USING 30-M, CLOUD-FREE REMOTELY SENSED DATA TO DEVELOP EARLY ESTIMATES OF ANNUAL INVASIVE HERBACEOUS COVER IN SAGEBRUSH ECOSYSTEMS

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ABSTRACT

Since 2015, we have developed and publicly released one-of-a-kind early estimates of cloud-free, 250-m spatial resolution annual herbaceous or cheatgrass cover maps during the spring and/or summer of the current year. These maps provide early predictions of potential fine fuel beds across broad geographic areas, fuel beds that can effectively spread fire into neighboring intact sagebrush ecosystems and induce the return of fire through positive feedback mechanisms. A similar product with a finer spatial resolution could prove helpful to a broader range of users and still serve current users. The current study tests the development of early estimates of cloud-free, 30-m spatial resolution invasive annual herbaceous cover maps for release in 2020. The technique processes NASA's Harmonized Landsat-8 Operational Land Imager (OLI) and Sentinel-2 Multispectral Instrument (MSI) (HLS) data into weekly normalized difference vegetation index (NDVI) composites. We remove residual cloud, shadow, or snow contamination in the HLS data using regression-tree algorithms. To produce the early estimates of invasive annual herbaceous cover, weekly NDVI data within each year is integrated with relevant environmental, vegetation, remotely sensed, and geophysical drivers into regression-tree models with BLM Assessment Inventory and Monitoring (AIM) data as the dependent variable. For a preliminary test area, we show a test R^2 of 0.70 and a mean average error (MAE) of 12.89 for the 2017 invasive annual herbaceous cover mapping model. We anticipate that the finer spatial resolution invasive annual herbaceous maps could, for example, be used to analyze effects from fuel breaks in sagebrush ecosystems and evaluate the efficacy of targeted aerial spraying or cluster seeding with drones.



Poster Session Monday 1: Poster Pod 13, Poster 73

IMPACTS ON HERPETOFAUNA IN THE PRESENCE OF OLD WORLD BLUESTEMS (*BOTHRIOCHLOA* SPP.)

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ABSTRACT: MS STUDENT

Global environmental change is having negative impacts on rangelands and the multiple native species communities that occupy them. These negative impacts include the introduction of nonnative plant species. These nonnative species once established, many times begin to spread and out compete native species for resources and transform once diverse rangelands into monocultures. Mono-specific stands of nonnative species have been found to alter soil microbial communities as well as cause changes in plant and animal communities. An example of these detrimental invasions includes Old World bluestem species such as *Bothriochloa ischaemum* and *Bothriochloa bladhii*. Monocultures of these species cause changes to many different rangeland communities. Studies show that monocultures of Old World bluestem have effects on avian and small mammal communities by changing the availability of food items such as arthropods. Research has shown that herpetofauna are good indicators of change both globally and locally. However, data on changes of herpetofauna in result to specific invasive species is very minimal and to our knowledge non-existent in relation to OWB. The objective of this study is to determine if the invasion of OWB has impacts on the native herpetofauna in rangeland systems. We will collect data on herpetofauna abundances and richness comparing sites of predominately native vegetation to those of monocultures of Old World bluestem. Results of this study will show potential negative impacts that Old World bluestem has on native herpetofauna and add to the body of knowledge on these problematic species and aid in development of policy to control/eradicate them.



Poster Session Monday 1: Poster Pod 13, Poster 74

IMPACTS OF SIMULATED TRAMPLING ON TOTAL NONSTRUCTURAL CARBOHYDRATES IN YELLOW-FLAG IRIS (IRIS PSEUDACORUS L.)

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ABSTRACT: MS STUDENT

It has been well documented that the presence of invasive species negatively impacts biodiversity, system interactions, and the local economics of the areas they invade. It is also well understood that one of the most complex challenges associated with invasive species is how best to manage them once they are established. Yellow-Flag Iris (YFI) is a non-native, invasive wetland species that, due to its physiology, has the capacity to exclude native vegetation in riparian areas and form extensive monocultures. While chemical management techniques are often utilized for larger stands, cattle trampling has been shown to be effective as well. Previous work suggests that after multiple years of trampling YFI density and height decrease significantly. It has also been shown that saturated soil conditions amplify these results. While cattle trampling of YFI could be an effective management tool, the question of what is mechanistically driving these responses remains. One such mechanism could be a reduction in total nonstructural carbohydrates (TNC). To investigate this question, a simulated trampling study was performed. Six treatment groups consisting of both trampled and un-trampled samples, as well as saturated and unsaturated samples, were analyzed. Saturation levels were held constant, and trampling was simulated by applying concentrated pressure to the plant crown. Prior to implementing treatments, as well as again at the conclusion of the study, rhizome samples were collected from each replicate and a molecular assay was performed to determine TNC concentrations. It is our hypothesis that YFI exposed to both trampling and saturated conditions will show the greatest reduction TNCs. Results are pending, but initial observation supports this theory.



Poster Session Monday 1: Poster Pod 13, Poster 75

WILDLIFE BROWSE SPECIES RESPOND TO CHEATGRASS CONTROL WITH INDAZIFLAM

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ABSTRACT

Boulder County Open Space (BCOS) manages properties in the lowland, foothills and mountains of Colorado that provides critical overwintering habitat for mule deer, elk, and other wildlife. One concern of BCOS ecologists and wildlife biologists is the loss of native forbs, shrub, and brush species in these critical wildlife habitat areas due to increased spread of invasive annual grasses like cheatgrass (*Bromus tectorum*). In winter 2017 and 2018 six sites were sprayed with indaziflam (Esplanade 200 SC, Bayer CropScience) plus glyphosate, while desirable shrub species were in dormancy and no leaves were present. These sites were 2 to 5 acres in size with dense stands of mountain mahogany, four-lobed sumac, antelope bitterbrush, winterfat, rubber rabbitbrush, four-winged saltbush, and fringed sage. Permanent random transects (3 X 200') were created inside treated and immediately adjacent non-treated plots to monitor native shrub growth. Visual percent canopy cover was collected for cheatgrass and all desirable perennial grasses, forbs, and shrubs, in addition to cheatgrass litter biomass to determine fine-fuel weights in treated v. non-treated plots. Fine-fuel biomass provided an indication of how quickly litter degrades. All shrub species' longest leader growth nearly doubled in length for all species in treated v. non-treated plots. Three key browse species on BCOS properties (mountain mahogany, bitterbrush, and rabbitbrush) had 6 to 12" vs 15 to 28" long leaders in non-treated v. indaziflam treated sites, respectively. There was 0% cheatgrass canopy cover in treated v. 85 to 100% cheatgrass cover in non-treated areas. Reduction in cheatgrass with indaziflam treatments resulted in 2-3X increase in perennial grass cover. Cheatgrass fine-fuels decomposed extremely fast at all these sites, averaging 899 lb/A in non-treated plots and 120 lb/A in treated plots, approximately 6 months after treatment (MAT). Cheatgrass fine fuels were eliminated (0 lb/A) at all 6 sites 24 MAT. There was no visible shrub or brush species injury from indaziflam plus glyphosate treatments sprayed during dormancy at these or any other BCOS sites. This research suggests that indaziflam could be a useful tool in wildlife habitat improvement projects on invasive winter annual grass dominated sites.



Poster Session Monday 1: Poster Pod 13, Poster 76

POLLINATOR COMMUNITY AND FLORAL RESOURCE RESPONSE TO CHEATGRASS CONTROL WITH ESPLANADE

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ABSTRACT

Colorado is home to over 900 native bee genera, many of which are found on rangeland, open spaces, and natural areas across the state. Because pollinators have adapted over countless generations to identify the flowers that will provide them the highest pollen and nectar nutrition, a diverse native plant community is crucial to support the bee populations. Through the Urban Bee Project, researchers have found that native bees are four times more likely to visit native flowers than non-native flowers and native plant genera support three times as many butterfly and moth species. Plant diversity leads to pollinator diversity; however, invasive annual grasses like cheatgrass (*Bromus tectorum*) pose a major threat to pollinator habitat. An experiment was initiated in 2019 to evaluate pollinator species habitat enhancement on 12 Boulder County Open Space properties. The focus of this research is to monitor the response of native flowering plants on invasive annual grass invaded sites that were treated with indaziflam (Esplanade 200 SC, Bayer CropScience), compared to directly adjacent non-treated control plots. Field studies at Colorado State University demonstrate that indaziflam provides long-term cheatgrass control (3+ years) with no documented injury to native perennial species. In this study, we documented flowering plant diversity, cover, abundance, flower numbers, and available floral resources. Comparing treated and non-treated plots, plots treated with indaziflam resulted in 2-4X increases across all the flowering plant metrics collected. This provides evidence that long-term invasive winter annual grass control with indaziflam results in additional resource availability to flowering plants, facilitating successful pollinator conservation. This is the first study evaluating the response of pollinator habitat following an indaziflam treatment on an operational scale, and these results suggest that it could be a useful tool for pollinator habitat restoration across rangeland ecosystems in the western US.



Poster Session Monday 1: Poster Pod 13, Poster 77 – Poster Withdrawn

REMOTE SENSING OF INVASIVE ANNUAL PLANTS AROUND ENERGY DEVELOPMENTS

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ABSTRACT

Invasive annual grasses are of concern in much of the western United States because they tolerate resource variability and have high reproductive capacity, with propagules that are readily dispersed in disturbed areas like those created and maintained for energy development. Early season invasive grasses “green up” earlier than most native plants, producing a distinct pulse of greenness in the early spring that can be exploited to identify their location using multi-date imagery. To determine if invasive annual grasses increased around energy developments after the construction phase, we used Google Earth Engine cloud-computing to calculate a 34-year time series of an invasives index from Landsat imagery and assessed trends for 1,755 wind turbines installed between 1988-2013 in the southern California desert. The index uses the maximum NDVI for early season greenness (January-June), and mean NDVI (July-October) for the later dry season. We estimated the relative cover of invasive annuals (primarily red brome (*Bromus rubens*) and cheatgrass (*Bromus tectorum*)) each year at turbine locations and control sites and tested for changes before and after each turbine was installed. The time series was also mapped across the region and temporal trends were assessed relative to seasonal precipitation. The results showed an increase in early season invasives at turbine sites after installation, but also an increase in many of the surrounding control areas. Maps of the invasive index show a region-wide increase starting around 1998, and much of the increase occurred in areas surrounding wind development sites. These results suggest that invasions around the energy developments occurred within the context of a larger regional invasion, and while the development did not necessarily initiate the invasion, annual grasses were more prevalent around them.



Poster Session Monday 1: Poster Pod 13, Poster 78

CHANGES IN VEGETATIVE COMMUNITY COMPOSITION FOLLOWING TWO-LINED SPITTLE BUG (*PROSAPIA BICINCTA*) INFESTATIONS IN HAWAII RANGELANDS

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ABSTRACT

Two-lined spittlebug (TLSB), *Prosapia bicincta*, (Hemiptera; Cercopidae) was first detected in Kailua-Kona, Hawaii in September of 2016 where it had damaged over 2,000 acres of rangeland. In 2017 four separate locations were selected for long-term, monthly monitoring of TLSB activity and population dynamics, and changes in plant community composition. Two of the monitoring sites were at the center of the initial infestation while the other two sites were located outside of the northern and southern boundaries of the known distribution of the pest to estimate rate of spread. At each location a series of transects were established along elevational gradients between 1850 and 500 m. Along each transect ten sample points were systematically established every 10 m alternating between the left and right side of the transect line. A 0.25 m² ring was used at each sample point to record vegetative cover by species, percent live and dead grass by species, vegetation height by functional group (grass, forb, shrub), and a count of TLSB nymphs and adults. Data were collected across all transects and sites monthly. The monthly surveys revealed that TLSB expanded its range from the initial 2,000-acre infestation to over 130,000 acres of rangelands in approximately six generations. In highly infested areas, TLSB resulted in nearly 100% die back of key range grasses including Kikuyu (*Pennisetum clandestinum*) and pangola (*Digitaria eriantha*) grasses. The loss of these important livestock forages provided entry for the establishment of invasive plants including Pamakani (*Eupatorium adenophorum*), wild blackberry (*Rubus* spp.), fireweed (*Senecio madagascariensis*), Hilo grass (*Paspalum conjugatum*), and several other weeds. The pest was active between March and October with two population peaks before entering diapaus over the winter months. Nymph densities during the peaks reached well over 150 nymphs/m² with this density resulting in complete loss in grass cover.