



Poster Session Tuesday 1 Abstracts



Poster Session Tuesday 1: Poster Pod 28, Poster 1

USING TECHNOLOGY TO HELP QUANTIFY CALF LOSS IN RANGELAND CATTLE: AN INTERNATIONAL EFFORT

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ABSTRACT

The use of birthing sensors in controlled dairy environments have been effectively employed to decrease dystocia rates and increase cow and calf survival at birth yet they have not been developed or utilized in large-scale environments such as ranching operations. We evaluated vaginal birthing sensors, specifically adapted for large-scale environments, as an effective calving alert system. The intra-vaginal sensor monitored temperature and sent calving alerts when the sensor was expelled, coinciding with labor and the expulsion of the amniotic sac. A Long Range Wide Area Network (LoRaWAN) communication system LinkLabs© Symphony Link™ gateway was deployed within each study system to capture sensor alerts and inform clients/researchers real time. We deployed a total of 297 birthing sensors from JMB North America (product # JMB-10005) in dams on three Florida ranches. Average sensor deployments were 72.1 days (range 0.5-146 days) and a total of 140 (47.1%) sensors failed. Of the 140, 65% were determined to be drained of battery power and 12% were in locations unable to communicate with the gateway. The time sensors were deployed negatively affected success rate. At best, the probability of success was 81.8% at day zero and was reduced to 63.8% after 50 days deployed in cattle. The vaginal birthing sensor technology used was not as an effective tool to monitor calving as it should be. A second follow-up study in Northern Territory, Australia, has deployed 197 improved sensors from August 2019 to Dec 2019 in combination with every cow having a LoRaWAN SmartPaddock™ GPS accelerometer collar. Using successful alerts, we will model if calving can be predicted from cattle movement, thus alleviating the need of birthing sensors. If successful, the relatively cheap LoRaWAN communication combined with GPS may be a system to allow remote monitoring of calving events for both research on calf loss and for farm practices.



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BIOMASS ESTIMATION USING UNMANNED AERIAL VEHICLES TECHNOLOGY

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ABSTRACT: MS STUDENT

The application of Unmanned Aerial Vehicles (UAVs) in the monitoring and management of rangelands has exponentially increased in recent years due to the miniaturization of sensors, pictures with high spatial resolution, lower altitude platforms, and the ease of flying UAVs in remote environments. Lengthening the radius of usable area and improving the stability, control, and camera quality of the UAV gives the potential for a more precise, but less troublesome field sampling method. The application of UAVs could be used to provide a more exact estimate the vegetation biomass that can be incorporated into management decisions. The methods of field data collection widely used for decades to estimate aboveground biomass do not account for the real-life variability that commonly occur in rangelands. The aim of this research is to estimate vegetation biomass in rangelands using high-resolution imagery derived from the UAV. The specific objectives are (1) to evaluate the feasibility of quantifying biomass in semi-arid rangelands with high-resolution imagery and (2) determine altitude for optimal pixel resolution of UAV imagery. Imagery at very high resolution (<5 cm) resolution will be acquired by flying an UAV at altitudes of 30, 40, and 50 meters above ground level. Study sites are located in Kleberg, Duval, and Jim Hogg County; thus, giving three significantly different topographic sites and land management practices. The imagery will produce 3D models of the study sites to estimate volumes for the vegetation. Biomass data collected in the field is used to calibrate and assess accuracy the 3D biomass production model derived from exceptionally high-resolution imagery at each level of altitude.



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A TEST OF LORA WAN REAL-TIME GPS TRACKING ON BEEF CATTLE IN DESERT PASTURES

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ABSTRACT: Ph. D STUDENT

Monitoring livestock behavior in real time using GPS, movement sensors, and data-mining algorithms has potential to help improve animal wellbeing and livestock production on western ranches. We sought to evaluate GPS fix rate (10-min intervals; expecting 144 fixes*d-1) of LoRa WAN-enabled GPS devices housed in water-tight Pelican™ cases fixed to Weaver™ nylon cattle collars or fixed to the top of a nylon cattle halter. We tested two Abeeway™ industrial tracker devices for 13 d (Trial 1 [T1]: 4/18– 4/30, 2019) in a 2.4 ha planted triticale pasture at the New Mexico State University (NMSU) campus farm and for 13d and 15d, respectively (Trial 2 [T2]: 6/29 – 7/7, 2019; Trial 3 [T3] 8/27 – 9/10) at the NMSU Chihuahuan Desert Rangeland Research Center (largest pasture >1475 ha). We used a Kerlink™ LoRa antenna and gateway (with an expected 10 km reach) to receive and route GPS data from the trackers to the cloud. We were able to configure trackers, visualize GPS data on a map, and download GPS points using an online application developed by Abeeway™ and Actility™. In T1 (planted pasture), the industrial tracker devices recorded 93% ± 1% of the expected fixes whereas in T2 (rangeland pasture) trackers recorded 57% ± 4% of expected fixes. In T3 (rangeland pasture) trackers recorded 77% ± 5% of expected fixes and no GPS fix rate differences were found between the collar vs halter design ($P > 0.40$). Differences in GPS fix rates among trials are possibly related to GPS battery and antenna location which was approximately 100 m away from the farm pasture (T1) and up to 5 -7 km away from the farthest points in our rangeland pastures (T2, T3). Our preliminary results suggest that LoRa-enabled GPS tracking is a promising technology for development of precision grazing tools for western rangelands.



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GPS VS ACCELEROMETERS: THE BATTLE BETWEEN TECHNOLOGY TO MONITOR CATTLE BEHAVIOR AND WELFARE

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ABSTRACT: Ph. D STUDENT

Monitoring livestock in a rangeland setting can be an arduous task and may not be observed on daily basis. The increased ability to monitor livestock behavior remotely gives managers the ability to reduce labor costs while having the ability to improve animal welfare. In an arid or semi-arid rangeland, failure of livestock water delivery systems is a very critical issue. Real and near-real time devices are becoming available, such as HerdDogg (near-time accelerometer-based) and Moovement (real time GPS) that can remotely monitor livestock behavior. The objective of this study was to evaluate efficacy of GPS tracking and accelerometer sensing for detecting a water delivery failure, a major animal welfare concern. During 2018 and 2019, eight and nine, respectively, Corriente cows were fitted with GPS tracking collars and accelerometers during the summer in a 1090 ha pasture at the Deep Well Ranch near Prescott, Arizona. Cattle were tracked at 2-minute intervals and movements were recorded at a frequency of 12 Hz by ear tag accelerometers. Cattle behavior was visually observed and recorded with video. Activity was predicted using random forest procedures. Movement rate was the most important variable for predicting behavior followed by side to side and fore and aft accelerometer movements. Variation of accelerometer metrics and other combinations of metrics may also be effective. Simulated water delivery failure was evaluated on 5 occasions in June 2018 and July 2019. Panels were used to keep cattle away from the water drinker for 4 hours at mid-day. Cattle remained near the water tank and displayed aggressive behavior during the period when water was not available. Preliminary analyses suggest that simulated water failure may be more accurately predicted by remotely collected data from GPS tracking collars rather than by accelerometers.



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CHARACTERIZING CATTLE BEHAVIOR IN THE RUGGED RANGELAND OF SOUTHEASTERN OREGON USING LOW-COST GPS COLLARS

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ABSTRACT: UNDERGRADUATE STUDENT

Our understanding cattle terrain use in the rugged high desert of southeastern Oregon is limited. Characterizing cattle behavior, using low-cost GPS collars, provides an insight into grazing distribution on public rangelands. Across the west, grazing is usually permitted on these lands to promote functionally healthy landscapes and mitigate risk of large-scale wildfires. The high desert exhibits rough terrain and it is important to learn cattle behavior across this landscape so land managers can make more informed rangeland management decisions. The objective of this study was to characterize individual cow behavior on rugged high desert rangelands in southeastern Oregon using the low cost iGotU GT-120 GPS device. Data were collected from 20 GPS collared cows over a 30-day period, 10 cows from spring and 10 cows from winter from separate pastures, using a 10-minute interval. We characterize individual cow behavior related to slope, elevation, distance traveled, and vertical and horizontal distance to water. Individual cow differences demonstrate different cattle terrain use across adjacent pastures. We also captured 360-degree images inside the pastures to provide visual understanding of the terrain use beyond satellite images to understand terrain use more clearly. Characterizing differences and trends between individuals provides a better understanding of variations in cattle movement, which can lead to more informed management decisions on rangelands.



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CORRECTION ALGORITHM TO REDUCE BIAS IN DAILY TRAVEL DISTANCE ESTIMATED FROM GPS COLLARS

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ABSTRACT

Numerous studies have demonstrated the utility of GPS technology to study movement patterns of free-ranging livestock. Among the most common metrics derived from GPS collar data are estimates of daily travel distance (DTD) for collared animals. Sampling error associated with GPS technology is a source of concern for researchers estimating DTD. A significant portion of livestock daily behavior consists of non-movement activities, such as resting or ruminating, which have an additive effect on distance error over time. Additionally, as GPS technology and battery life improve, researchers are able to sample livestock locations at increasing frequency, which may further increase DTD measurement error. Although distance errors as a result of GPS collar data have been acknowledged, no research has been conducted to correct this problem. To address this, a study was conducted in 2016-2018 at the Cottonwood Research Facility in southwestern South Dakota using a non-commercial GPS collar outfitted with an accelerometer to predict livestock behavior. GPS devices were set to record fixes at 1-minute intervals. An algorithm was developed to identify large GPS point clusters associated with specific periods of resting behavior (e.g. overnight sleeping periods). To correct for DTD GPS error, latitude and longitude values of point cluster periods were averaged, and average coordinate values assigned to all points within a cluster, reducing distance between resting points to zero. For each GPS collar, DTD was calculated before and after the correction algorithm was applied to test for differences. Results from the study indicate that, at 1-minute GPS fix intervals, DTD may be overestimated by 2-3 km per day. By utilizing the distance correction algorithm, researchers will be able to reduce sampling bias and get a more precise measurement of livestock DTD, resulting in improved estimates of energy expenditure and travel distances associated with treatment effects.



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THE RANGELANDS PARTNERSHIP: YOUR SOURCE FOR RELIABLE SCIENCE-BASED INFORMATION ON RANGELAND ECOLOGY & MANAGEMENT

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ABSTRACT

The Rangelands Partnership (RP) is a collective effort by rangeland specialists, IT experts, and academic librarians from 19 U.S. land-grant universities working to bring together resources and expertise needed to inform public debate and decision-making regarding today's grand challenges of food security, climate adaptation, public health, environmental impacts, and economic development as they relate to rangelands around the world. Through numerous projects and initiatives, the RP has been developing the *Rangelands Gateway* website, which features a database of rangelands resources and tools and offers 11 collections of rangeland content. These collections include full-text resources from professional societies such as the Society for Range Management, Grassland Society of Southern Africa, The Land Portal, and the Australian Rangelands Society as well as carefully selected best of the best materials. Topics address a wide variety of rangeland issues and content is available in many formats including journal articles, images, videos, podcasts, maps, reports, and educational tools. In addition, the RP is involved with other rangelands groups from around the world to gain support for a United Nations designated International Year of Rangelands and Pastoralists (IYRP), coordinating numerous meetings and events as well as working with IYRP initiative members to gain support from their governments. Members of the Partnership are also actively involved in projects dealing with research, outreach and forging collaborations. The Partnership is committed to facilitating sustainable management of rangelands, informed decision-making, professional enhancement, and education for a wide audience of rangeland stakeholders. Visit *Rangelands Gateway* and learn more!



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OPTIMIZATION OF MULTI-MODEL ENSEMBLE SEASONAL FORECASTS FOR RANGELAND MANAGEMENT APPLICATIONS IN THE WESTERN UNITED STATES

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ABSTRACT

Skillful seasonal climate forecasts could improve the cost-effectiveness of rangeland management practices for both land management agencies and private-land owners across the western US. Previous problems with the adaptation of forecasting tools to rangeland management applications include difficulty in accessing forecast information at the spatial and temporal scale useful for management, and lack of tools to assess the usefulness, dependability and effectiveness of forecast information. Previous studies of forecast utility have also shown relatively low forecasting skill over much of the western US. In this study we evaluated the potential utility of statistically downscaled and spatially-disaggregated estimates of monthly precipitation and temperature for site-specific management applications in the Desert Southwest, California Annual Grassland, Great Plains, and Great Basin. For this, we used 7 component models of the North American Multimodel Ensemble (NMME) forecast, that were disaggregated to provide monthly estimates of total precipitation and average temperature on a 4-km grid, with lead times of 1-7 months, for every month of the period 1982-2016. Unlike previous studies that have evaluated forecasting skill of both individual and full-ensemble models, we are using rank correlation tests to evaluate individual, full-ensemble, and all combinations (127) of multi-model ensemble predictions. Our general objective was to evaluate the potential utility of monthly and seasonal forecasts for specific regional management applications and to provide general guidance for a preliminary forecast-skill assessment. We found that that sub-ensemble multi-model forecasts were generally more skillful than either single-model forecasts or the full multi-model ensemble; general forecasting skill was better in the DS than any of the other ecoregions; optimal seasonal forecasts were application-specific for a given location; and confirmed that forecast skill for individual locations and applications was better for temperature than precipitation. Lead time did not generally affect optimal-forecast skill for either temperature or precipitation.



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SAGEDAT: DATA AND TOOLS TO SUPPORT COLLABORATIVE SAGEBRUSH ECOSYSTEM CONSERVATION AND MANAGEMENT

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ABSTRACT

Collaborative and science-informed management has been at the heart of the large-scale efforts to conserve the sagebrush ecosystem for greater sage-grouse and over 350 other species that rely on the sagebrush ecosystem. The development and use of geospatial data and decision support tools to inform management of rangeland fire, restoration of sagebrush habitats, and conservation of sage-grouse has resulted in exciting new opportunities, but the volume of data and tools has resulted in challenges for providers and users of this information. SageDAT is a web-based system that uses the latest technology to reduce barriers to data sharing and increase access to information through the development of a multi-agency data catalog. For data providers, this effort will increase communication and coordination on data management and provide tools to help protect sensitive/proprietary locations and information, which can alleviate past impediments to participation in previous large-scale planning efforts. For users, SageDAT will provide access to a comprehensive list of datasets and decision support tools via a web interface and improve mechanisms for increased communications and cooperation between federal, state, and local agencies, tribes, non-governmental organizations, universities, and industry across 11 western States to enhance long-term stewardship of the sagebrush ecosystem.



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RESULTS OF STUDYING THE NORMS OF SEEDING SORGO "ORANGE 160" AFTER GROWING RYE (SECALE CEREALE)

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ABSTRACT

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Deserts and foothills regions that occupy half of the country's territory have an important place in the development of the astrakhan sector. The lack of attention to this sector in recent years and the degradation of pastures have a significant impact on the development of the industry. Sustainable use of this area requires the efficient and effective use of available water resources. The only way to solve this problem is to effectively use the available water resources of artesian wells existing in the desert. Taking this into account, the staff of the Research Institute of Karakul sheep breeding and Ecology of Deserts conducted a series of field experiments on the irrigated plots of this area for the first time and studied the peculiarities of the cultivation of sort "Oranjevoe 160" sorghum in the irrigated area of the Konimekh district of the Navoi region after the main crop of rye. Sorghum seeds were sown at a rate of 10, 15, 20 kg. Seeds were sown on June 7 and immediately irrigated. Seeds germinate about 5-6 days. Full shoots were obtained in 13-14 days. The highest yield was obtained at a seeding rate of 20 kg / ha. In this variant, the first yield was $32.3 + 0.55$ t / ha, and the second yield was $30.6 + 0.56$ t / ha, for a total of two mowing, the yield was 62.9 t / ha of green mass. In the variant with a seeding rate of 15 kg / ha, the yield was lower by 14.7 t / ha, and when sown with a seed rate of 10 kg / ha, the yield was 23.3 t / ha of green mass less than the variant with a seeding rate of 20 kg / ha . Summing up, it should be noted that a good result can be obtained from a sowing variant of 20 kg / ha of sort "Oranjevoe 160" sorghum from a sown area that was used during the year.



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INDICATORS OF GROWTH, DEVELOPMENT AND PRODUCTIVITY OF TRITICALE CULTURE BY WATERING IN THE DESERT KYZYLKUM

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ABSTRACT: UNDERGRADUATE STUDENT

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The Kyzyl Kum desert and adjacent areas occupy more than half of the total area of the country and play an important role in animal husbandry, especially in areas where Karakul sheep are raised. However, the annual increase in pasture degradation in these areas due to inefficient use of pasture has a negative effect on livestock production. The only way to solve this problem is to effectively use the available water resources of artesian wells existing in the desert. Taking this into account, for the first time, the staff of the Research Institute of Astrakhan and Desert Ecology conducted a series of field experiments in the irrigated areas of this area for growing intermediate crops. Intermediate cultures are primarily an important source of feed. They make it possible to significantly increase the utilization of arable land in crop rotations of intensive farming. In desert conditions, the best precursors for triticale will be maize and perennial grasses. Phosphorus and potassium are introduced before sowing. Nitrogen - during the growing season. The first dose of nitrogen-containing fertilizers should be no more than 60-70 kg / ha. Carry it out before tillering. The second is carried out in the period of release into the tube. At the same time, it is desirable to introduce foliar fertilizing with micronutrient fertilizers. In the experiment on the cultivation of triticale as an intermediate crop, the indicators of growth, development and productivity of the variety "Prag serebristy" were studied. Triticale seeds were planted on October 22. Plant density was 1640.0 + 30.2 thousand units per hectare and in spring decreased to 147.0 thousand units. The height of the plants before the cutting was 60.77 + 0.99 cm, and the number of shoots was 4.03 + 0.30 pieces. Triticale formed a yield of 29.6 + 0.95 t / ha of green, 6.3 + 0.2 t / ha of dry feed, and 2.1 + 0.1 t / ha of grain. **Conclusion.** In the Kyzylkum desert, you can grow Triticale in the irrigated areas of this region, using self-pouring wells and get high yields of forage and grain.



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EVALUATING MESQUITE DISTRIBUTION USING UAVS AND OTHER GEOSPATIAL METHODOLOGIES

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ABSTRACT: MS STUDENT

Recent advancements in technology such as UAVs have opened new opportunities for Natural Resource personnel to better quantify features within the landscape. Encroachment of invasive plant species on rangelands is of critical concern and Honey Mesquite (*Prosopis glandulosa*) is one of the most invasive species in Texas and the southwest. The first phase, step 1, of a multiyear study included collection of additional imagery and field data for comparisons with the Sentinel and LiDAR data analysis products. Different methodologies were used to evaluate mesquite extent on a ranch in Hood County, TX. The methods used in this project included: on-site data and tree height measurements, LiDAR elevation Data, Sentinel 2 Satellite Imagery, and Unmanned Aerial Vehicle (UAV) imagery. A DJI Phantom IV paired with Pix4D® software was used to collect the UAV images. Drone2Map for ArcGIS® was used to process the images to create 2D and 3D outputs and used Esri ArcPro® 2.3.3 to evaluate and perform analyses for mesquite distribution. Thresholds of spectral values from RGB bands of Satellite Imagery were identified and then reclassified into a preliminary extent of mesquite tree occurrence. This was filtered through the plant height derived from the LiDAR first return data. This procedure was replicated with UAV RGB imagery paired with created LAS data that were used for evaluating mesquite extent within the landscape. Due to the variety of color values in the higher resolution UAV imagery, an attempt was made using zonal statistics to determine the thresholds of RGB values identifying the presence of mesquite trees. This process is still under development. Initial results suggest good agreement between on-site field measurement plant height values and UAV plant height that was interactively measured with the Esri ArcPro® 2.3.3 software vertical measurement tool.



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MORPHOLOGICAL ONTOGENESIS STRUCTURE (LYCIUM BARBARUM L.) IN THE CONDITIONS OF SAMARKAND REGION

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ABSTRACT: Ph. D STUDENT

Introduction. The effective use of plant materials for food, pharmacy and medicine in order to improve the welfare of the population is a very urgent problem. *Lycium barbarum* L. is a perennial deciduous branched shrub 1–2.5 m tall of the family Solanaceae. *Lycium barbarum* berries are widely used in traditional medicine in a number of countries (China, USA, Argentina, etc.) as an immunomodulator. The study of *Lycium barbarum* is of scientific and practical interest for expanding the range of herbal remedies. Therefore, it is important to study the biomorphology and reproduction of this species. Material and research methods. Plants were sown in 2018 from seeds. A study of the growth and development of *L. barbarum* L. was carried out according to the methodology for herbaceous plants. Research results. Studied the individual development of *L. barbarum* L., which can be divided into the following periods:

1. The latent period. This period of *L. barbarum* L. is determined by the formation of egg cells in the seeds and physiological processes in them. Seeds of *L. barbarum* L. in the form of a kidney, 2-2.5 mm long and 1-1.2 mm wide. The outer coating is covered with a dark brown or lowered coating. The average weight of 1000 seeds is 1.1-1.2 g. 2. Plant developmental period This period of *L. barbarum* L. includes the time interval from which the seed develops to the first flower. It was determined that the virgin phase lasts 2-3 years. During this growing season, the following stages of development can be distinguished: lawn, juvenile, immature (young shoots), formed vegetative plants. 3. Stage of seedling. Germination of seeds of *Lycium barbarum* begins with the appearance of the main root, the young stem extends and grows into the interior of the soil. When this root reaches a depth of 0.4-0.6 cm, leaves appear. The aim of the work was to study the individual development of *Lycium barbarum* in a culture. Ontogenesis of this plant in Uzbekistan has not been studied. Thus, the study of the ontogenesis of the plant *L. barbarum* L. is of theoretical and practical importance.



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RESULTS OF STUDYING THE DEVELOPMENT AND EFFICIENCY OF THE SECALE CEREALE IN KIZILKUM DESERT

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ABSTRACT

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Karakul sheep is mainly concentrated in the Kyzyl Kum desert. Due to the drought in the last 4-5 years, the maintenance of animals on pastures was difficult, they had to be additionally fed. There are many artesian wells in this desert region that can be used efficiently and effectively. Taking this into account, the staff of the Research Institute of Karakul sheep breeding and Ecology of Deserts, for the first time conducted a series of field experiments on irrigated plots of the area and studied the features of cultivation, development and productivity of non-traditional rye plants (*Secale cereale*) in the region. Seeds of rye were sown in experiments in October. Due to the lack of moisture in the soil per hectare, irrigation was carried out at a rate of 700 m³ of water per hectare. Seeds germinated on the 5-6 day, full shoots marked on the 13-14 day. The number of plants is 1120.0 + 45.51 thousand units/ha. In order to study the viability of this crop in the KyzylKum desert, it was noted that in January of this year the number of plants decreased by 88.0 thousand units or by 7.86%, and in spring - by 149.0 thousand units or by 13.35%. During the growing season, it was noted that the rye plant loses 217.0 thousand individuals per hectare, or 19.5% of the total. The growth of plants before cutting was 90.18 + 2.77 cm, and the number of shoots was 3.66 + 0.22 thousand per hectare. The yield of this crop was 25.4 + 1.4 t / ha of green or 5.6 + 0.32 t / ha of dry food. When irrigating in an Kyzylkum desert environment, an unconventional plant like rye (*Secale cereale*) can produce high yields of forage and grain.



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A RAPID ASSESSMENT OF DROUGHT INDUCED FORAGE REDUCTIONS TO AID REHABILITATION

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ABSTRACT

In March, 2019 Ag. Department Secretary Sonny Purdue designated four Arizona counties as primary natural disaster areas due to the persistent drought conditions. Subsequently, on 7 May, 2019, the USDA Natural Resources Conservation Service (NRCS) announced the availability of financial and technical assistance for producers in the designated counties to aid recovery from the impacts of drought. Traditional assessment of the most affected lands to determine which producers and what areas might be eligible for assistance is costly, time consuming and covers only a fraction of the affected area. Under normal circumstances quantifying the amount of lost forage and identifying the most affected areas would require weeks to months' worth of assessment including costly ground reconnaissance such as conducting vegetation sampling along transects across numerous Ecological Sites to evaluate production relative to a long-term baseline. However, given the rapid increase in remote sensing tools and datasets (e.g. Rangeland Production Monitoring Service; RPMS) scientists and managers sought to develop a more rapid and precise process to increase the area evaluated and speed up the overall drought assessment and mitigation process. In this vein, the USDA NRCS and Forest Service developed the Northeastern Arizona Drought Responsive Seeding Strategy which aids evaluation of eligibility to provide financial assistance to agricultural producers to aerial seed rangeland areas within the designated boundaries. This is an inaugural effort by the NRCS and USFS to work together to rapidly quantify the impact of drought on vegetation production across large areas to inform a reseeding strategy for affected areas.



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EFFECTS OF FIRE INTENSITY ON RESPROUTING VIGOR OF MESQUITE (*PROSOPIS GLANDULOSA*)

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ABSTRACT

Woody plant encroachment has occurred across millions of hectares of rangelands in the southern Great Plains since the start of the 19th century. While fire suppression has been cited as a major cause, reintroduction of fire has often been ineffective at reversing woody encroachment due to the resprouting capability of many species. Initial resprouting vigor is linked to overall survival of such species, including honey mesquite (*Prosopis glandulosa*). Recent studies have indicated that high-intensity fires are more effective at reducing survival of resprouters. We evaluated effects of fire intensity, soil moisture, root collar exposure and weather factors on the ability of honey mesquite to resprout following fire in central Texas semi-arid savanna. Fire intensity was the only significant predictor of number of resprouts, with low-intensity treatments having more resprouts by a factor of 30.39. Fire intensity also significantly predicted resprouting occurrence. Low-intensity fires treatments were more likely to resprout the next growing season by a factor of 46.65. Our results support previous works that suggest high-intensity fires can reduce survival of resprouting woody plants.



Poster Session Tuesday 1: Poster Pod 31, Poster 20

EVALUATING GRAZING EFFECTS ON PONDEROSA PINE HABITAT TYPES FOLLOWING A LARGE SUMMER WILDFIRE

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ABSTRACT: MS STUDENT

The Lodgepole Complex fire burned 109,346 ha in east-central Montana in July 2017, and re-burned areas burned in 2003 by the Bureau of Land Management for fuels mitigation. Previous research indicated areas need rest before allowing livestock grazing, while others show that grazing the first year following fire has no negative effects on the plant community. Our objectives are to 1) determine plant community response to grazing or rest the first growing season after fire in ponderosa pine grassland communities, 2) determine how timing of defoliation during the first growing season after fire affects the plant community, and 3) learn if prescribed fire before wildfire alters plant community response to wildfire. Exclosures were built, 4 on re-burn (Rx) area and 4 on wildfire (Wild) area. To determine seasonal defoliation effects, 5x10-m plots were mowed in the exclosure to 10 cm in June, July, or August, or not mowed. A non-grazed section in the exclosure was paired with a grazed section outside the exclosure. Biomass samples were clipped at peak production, and species composition and diversity were measured with point-intercept transects in 2019. The only difference between grazed and non-grazed (NG) sites in 2019 was greater shrub production on NG sites than grazed or RX NG sites ($P=0.0469$). On mowed sites, cool-season perennial grass standing crop was greater on control than June and August mowed sites ($P=0.0366$), there were more annual grasses on control than June mowed sites ($P=0.0462$), and more total standing crop on control sites than the three mowing treatments ($P=0.0241$). Most of the difference in standing crop was due to previous years' standing dead. Results show that this community is resilient to post-fire defoliation and that although prescribed fire 16 years before wildfire altered fire behavior, it had little to no impact on the herbaceous community.



Poster Session Tuesday 1: Poster Pod 31, Poster 21

PRESCRIBED FALL FIRES DECREASE ANNUAL BROME AND SAGEBRUSH ABUNDANCE IN THE THUNDER BASIN ECOREGION IN NORTHEASTERN WYOMING

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ABSTRACT: MS STUDENT

In the Thunder Basin Ecoregion of northeast Wyoming, fire is a natural disturbance to which native grasses and forbs are adapted. There is strong evidence that fires promote a positive feedback-loop enhancing annual brome invasion in the Great Basin. One recent study found that historical wildfires did not promote annual brome in the Thunder Basin Ecoregion, but these historical wildfires did eliminate sagebrush from the burned areas for many decades. My research supplements this study by investigating effects of fall prescribed burns on annual brome (*Bromus tectorum* and *B. arvensis*) and Wyoming Big Sagebrush (*Artemisia tridentata*) in the Thunder Basin Ecoregion. Prescribed fires typically have lower wind speeds, higher relative humidity, higher soil moisture, and lower temperatures than wildfires. We hypothesized that if burn severity and intensity were high enough, prescribed fall fires would reduce annual brome abundance without completely eliminating sagebrush from the sites. In October 2018, we burned a 2x4m plot at 16 sites selected to represent a gradient of annual brome cover, which ranged from 0-45% across sites. In the first year following fire, fall burns reduced brome cover by 59% (p -value=0.0008) relative to unburned plots. Fall prescribed burns also dramatically reduced sagebrush densities. Prescribed fall burns may represent a proactive approach to reducing annual brome abundance in northeastern Wyoming, but tradeoffs exist between management goals for brome and sagebrush. Further investigation using spring prescribed fire, which could have lower fire intensities than fall prescribed fire, will provide additional information for managers working to maintain quality forage for livestock and wildlife and habitat for the Greater Sage-Grouse.



Poster Session Tuesday 1: Poster Pod 31, Poster 22

ESTABLISHING FUEL BREAKS TO PROTECT SAGE-GROUSE HABITAT IN NW UTAH

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ABSTRACT: MS STUDENT

Frequent wildfires in the Great Basin have caused significant shifts in species composition. These frequent fires are driven by invasive annual grasses, particularly cheatgrass (*Bromus tectorum*). The annual grass fueled fires can permanently alter critical habitat for sage-grouse. Recently the Bureau of Land Management and Utah's Watershed Restoration Initiative have implemented fuel breaks to help defend critical sage-grouse habitat. In an effort to reduce the impact of wildfire on critical sage-grouse habitat in Box Elder County, UT, fuel breaks were put in two locations. A 19-mile fuel break at Badger Flat in 2010 and 13 miles at Dry Basin in 2016. Both fuel breaks were created using a chain-harrow followed with a treatment of Plateau herbicide, then seeded with a seed mix. Badger Flat received a second application of seed in 2016 as well. We assessed functional group frequency in in the late-summer of 2017, 2018, and 2019. Both sites average 200mm – 250 mm precipitation annually, with the majority coming as snowfall and spring rain. A lower frequency of cheatgrass was observed in the treatment compared to the control in 2017 (46% versus 20% at Badger Flat and 60% versus 25% at Dry Basin). But in subsequent years there has not been a difference between the treatment and control. There has not been a discernable difference in native perennial grass frequency from 2017-2019. Introduced perennial grasses were not seeded at Dry Basin, but at Badger Flat there was no difference between the treatment and control in 2018 and 2019 despite a difference of 17% in 2017 (25% in the treatment and 8% in the control). Despite the initial success of both fuel breaks, it is necessary to consider their ability to resist reinvasion by invasive annual grasses. Otherwise we may see these fuel breaks become to fuel runways.



Poster Session Tuesday 1: Poster Pod 31, Poster 23

SILVER SAGEBRUSH FIRE RESPONSE

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ABSTRACT: UNDERGRADUATE STUDENT

Artemisia cana (Silver Sagebrush) is a low shrub species common in northern mixed grass prairies that provides important wildlife habitat. Sagebrush habitat has historically experienced frequent wildfires, but post-settlement fire control efforts have reduced fire frequencies. The effects of fire on Silver Sagebrush growth and regeneration are not clearly understood; here we examine the effects fire on Sagebrush regeneration using two years of post-fire plant size and distribution data. Sites were in the northern mixed prairie in Saskatchewan, Canada, and included pastures where the plant community was recovering following both prescribed fires and an intense wildfire. *Artemisia cana* responded to fire by rapidly producing new shoots via rhizomes, with some plants also regenerating from the crown. Larger plants and dense stands of Silver Sagebrush appear to regenerate more successfully than lone plants. No seedlings were observed. Our results demonstrate that Sagebrush recovery is primarily vegetative, with clone mortality rare.



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ECOLOGICAL AND ECONOMIC IMPACT OF PATCH-BURN GRAZING IN SUBTROPICAL HUMID GRASSLANDS

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ABSTRACT

Subtropical, humid grasslands (SHG) are an important global land-use, and support ~30% of the US beef herd. Research is lacking on how SHG management can be improved to sustain ecosystem services and economic viability. Patch-burn-grazing (PBG) is an innovative tool with multiple benefits in temperate grasslands. Our objective was to determine how PBG affects provisioning and regulating ecosystem services in SHG, including forage production, plant diversity, and greenhouse gas regulation, as well as assess economic impacts.

A randomized block experiment was established in 2017 with 16 pastures (16 ha each) in two different pasture-types (intensively-managed (IM) vs. semi-natural (SN)) at Archbold's Buck Island Ranch, FL, USA. Eight pastures were completely burned ("full-burn grazing": FBG) and eight pastures were partially burned ("patch burn grazing": PBG) under a fire regime of one-third burned annually (2017, 2018, 2019). Economic analysis was based on average calf production in FL, forage productivity, stocking density, calf production, and recent calf \$ values. In 2017, ANPP was greater in burned areas (in FBG and PBG) than unburned areas ($F=4.64$, $p=0.006$). In 2018, ANPP was greater in the PBG patches (both one year since fire and the recently burned patch) compared to the FBG that was one year since fire and the unburned patch in PBG ($F = 4.78$, $p=0.005$). Forage quality was greater in recently burned areas and declined with time since fire in both years. Cattle grazing intensity was greater and more even in recently burned patches compared to unburned patches in PBG. Preliminary analysis indicates that using PBG compared to FBG in SN pastures benefits cattle production by \$19.40/ha. In contrast the same PBG to FBG comparison in IM pasture suggests a loss of -\$46.94/ha. Outcomes will likely change with increased time since fire in FBG pastures.



Poster Session Tuesday 1: Poster Pod 32, Poster 25

THE VISUAL IMPACT OF FIRE SCARS, EFFECT OF FIRE RECOVERY TREATMENTS, AND NEXT STEPS

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ABSTRACT

In the past 10 years, the Bureau of Land Management Winnemucca District has experienced roughly 219 fires, totaling roughly 922,072 acres. In response to those fires, the district has applied stabilization and protection actions to control non-native invasive plants and assist revegetation. Remote sensing imagery and the visual appearance of a viewshed indicate a sea of cheatgrass or non-natives are present in a large part of burned areas. This visual impact begs the question, what plant community really occupy these areas? In this case study, the author takes a closer look at several treatment areas throughout the district to find out what is behind the visual impact of fire effected areas, the seeding effort, and what further management action may be required to shift the plant community. Site selection is based on a visually dominant landscape with a fire recovery treatment overlap. Three fire recovery treatment types will be considered; natural recovery, aerial seeding, and drill seeding. Assessment, Inventory, and Monitoring data will be used to reveal the plant community composition found on that landscape within the treatment area, using the associated Ecological Site Description to evaluate the potential plant community. The goal of this exploration is to see what is really on the ground in a burned area that appears to have only non-native vegetation, what result came from the seeding effort, and what can land management do to further promote a desirable plant community?



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SEASON OF BURN EFFECTS ON FORAGE PRODUCTION AND COMPOSITION OF GULF CORDGRASS COMMUNITIES

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ABSTRACT: MS STUDENT

Gulf cordgrass (*Spartina spartinae* [Trin.] Merr. ex Hitchc.) is a productive, warm season, perennial bunchgrass that has potential to provide valuable forage for livestock and wildlife. Mature Gulf cordgrass is often found in almost pure monoculture stands, suppressing other species; leaves and stems are coarse, and low in palatability and nutritive value. Fire removes old growth and rejuvenates aged stands, promoting the production of tender, palatable shoots, and improving overall forage quality. We applied prescribed burning in different seasons (Winter and Summer) at the pasture scale in grassland communities of coastal prairies and marshes dominated by either Gulf cordgrass or seacoast bluestem (*Schizachyrium scoparium* var. *littorale* [Nash] Bickn.). The objective was to determine the optimal season of burning to enhance forage for cattle and habitat for wildlife by rejuvenating stands of Gulf cordgrass. Results of this study show strong positive relationships between plant mortality and peak fire temperature ($p < 0.0001$), and plant mortality and duration of heat over 65°C regardless of season ($p < 0.0001$). Forage production of Gulf cordgrass for approximately 90 days following burning did not differ between four burn treatments ($F_{3,4} = 0.905$, $p = 0.51$), or season of burn ($F_{1,6} = 0.034$, $p = 0.86$). NMDS ordination analyses of biomass composition demonstrated greater fluctuation and movement between functional groups than species density did following burning. Although there was no difference in forage production between seasons, composition of FSC returned to pre-burn conditions more quickly after winter burning than summer burning. Prescribed burning in Gulf cordgrass patches allowed other species to increase in relative abundance and productivity, and enhanced the production of tender new growth, nutrition content and utilization of Gulf cordgrass and adjacent vegetation compared to non-burned treatment plots.



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SPARKS AT THE CAMPFIRE: PARTICIPANT ASPIRATIONS AND MOTIVATIONS TOWARDS FORMING THE WYOMING PRESCRIBED FIRE COUNCIL

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ABSTRACT: Ph. D STUDENT

Fire is a natural global phenomenon that can be strategically prescribed to manage landscape features and functions. However, social tolerance of prescribed fire has hindered its application due to perceived and actual risks associated with such projects. Landowners, nonprofit organizations, local, state, and federal agencies, and the public are creating collaborative institutions such as Prescribed Fire Councils (PFCs) designed to address these societal and individual concerns. Wyoming (WY) has recently formed a PFC (WY-PFC; <https://woextension.org/wyprescribedfire/>) making it the 36th council in the United States. In this study, I use semi-structured interviews to understand motivations for why individuals participated in the WY-PFC and what they aspired for the organization to accomplish. Findings demonstrated that interviewee's felt a lack of control over the stories expressed about prescribed fire. The general public's fear of fire was expressed as a major hurdle for the PFC to address if they want to help reestablish prescribed fire to the Wyoming landscape. Participants had a strong passion to enhance outreach efforts about prescribed fire to bolster public understanding and tolerance. Regardless of the hurdles that these participants perceived, they felt that a collaborative effort within the WY-PFC provides an interwoven network of experts and individuals to come together to expand resources and ensure a more concise narrative is told about prescribed fire utility for healthier lands and safer communities in the future.



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EFFECT OF FIRE AND SEASON OF DEFOLIATION ON TOTAL NON-STRUCTURAL CARBOHYDRATES CONCENTRATION AND SURVIVING OF PURPLE THREEAWN (*ARISTIDA PURPUREA*)

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ABSTRACT

Purple threeawn (*Aristida purpurea*) is a native perennial grass classified as undesirable to cattle production because of its low quality. Fire is one of the management tools that has been used to improve grasslands invaded with purple threeawn. The objective of this study was to characterize the total nonstructural carbohydrates (TNC) dynamics of purple threeawn throughout the growing season and their response to clipping and fire treatments during three phenological stages. This research was conducted at the Texas Tech University Native Rangeland in Lubbock, TX. During the 2010 growing season, 90 purple threeawn plants were randomly selected regarding plant size and treated with clipping and burning. Treatments were applied to 30 plants during each phenological stage. Phenological stages were vegetative, reproductive and post-reproductive. Ten plants were clipped at each stage; ten were burned and ten more were used as control plants. Clipping treatments simulated 90% utilization while the burning treatment consisted on prescribed fire applied to plants individually. Samples were collected from basal crowns 30 and 45 days after treatments. TNC concentration measurements were performed on basal crowns using the acid hydrolysis process, then TNC concentrations were measured spectrophotometrically at 612 nm. TNC concentrations of control plants showed a constant increase from the first sampled collection in mid-July to the last collection at the end of November. Sampling time, phenological stage and defoliations type interacted ($P > 0.05$) in their effects on TNC concentrations. TNC concentrations in the basal crowns were higher ($P > 0.05$) in plants treated during the post-reproductive stage among phenological stages, on control plants between defoliation treatments and in plants sampled 45 days after treatment applications. Our results showed that threeawn TNC concentration storage period extends as far as late November. Purple threeawn TNC concentration is dynamic across the growing season and it is easily affected by common defoliation events such as burning and clipping. The results of this study can be used to identify the best season to apply to apply prescribed burning in order to control this species.



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FORB COMMUNITY RESPONSE TO INVASIVE SPECIES, GRAZING, AND PRESCRIBED BURNS IN THE PACIFIC NORTHWEST BUNCHGRASS PRAIRIE

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ABSTRACT: MS STUDENT

There is growing concern about the observed worldwide decline in native pollinator populations, particularly bees. In addition, grasslands globally are experiencing intensified degradation from agricultural development, invasive species pressure and the lack of conservation practices for pollinating species. Forbs account for the majority of plant species diversity within grassland systems and their continued decline is severely impacting pollinator communities. The study took place in Northeastern Oregon at the Zumwalt Prairie Preserve (ZPP) which is the largest remnant of the Pacific Northwest Bunchgrass Prairie. This unique landscape is essential to conserving plant and insect communities for the future. The objectives of this study were to examine how prescribed fire, invasive plant species, and livestock grazing impact forb community for native pollinators. Data was collected at the ZPP in Oregon from 2008-2018. Forb foliar cover was sampled in 2008, 2010, 2016 and 2018 in long-term monitoring plots, with prescribed burns implemented in the fall of 2006 and 2016. Overall forb cover was low across all plots and all years, forb cover decreased over time in both burned and unburned sites from 2008 to 2016. In 2018, forb cover increased slightly in unburned sites but remained the same as previous years in unburned sites. However, plots that experienced prescribed fire had the highest forb species richness. Further results will be presented based on forb foliar cover data over time and the relationship to rangeland stressors, various treatments and potential habitat for native pollinator species.



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ACCURATELY MAPPING RESIDUAL DRY MATTER (RDM) ACROSS 50,000 ACRES OF NEVADA RANGELANDS

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ABSTRACT

In 2018, Open Range Consulting was successful in accurately predicting Residual Dry Matter (RDM) across 50,000 acres of the Horseshoe Ranch located near Elko, Nevada. Knowing the RDM of rangelands is a key metric for integrating livestock management and conservation values. Research has shown relationships between better management of RDM and important ecological functions such as grass regeneration, soil stability, nutrient cycling, water infiltration and grass community health. Traditional methods of measuring RDM by using sample locations to clip and weigh vegetation biomass, are limiting in spatial scale and can provide difficulties when creating pasture wide management plans. Using their Earth Sensed Technology, Open Range Consulting was able to overcome this limitation by using biomass data and Landsat imagery to create a continuous RDM map of the entire Horseshoe Ranch. By withholding 10% of the data the final map produced a R2 of 0.85. Estimating RDM across large areas can provide incredibly useful information to land managers by directing needs such as dormant season grazing of cheatgrass to reduce the risk of large fires. ORC is working towards automating this process so that RDM maps can be produced and put in the hands of resource managers in a timely and effective manner.



Poster Session Tuesday 1: Poster Pod 33, Poster 32

PLANT-BIOCRUST-FIRE INTERACTIONS ACROSS FIVE SOUTHWESTERN DESERTS

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ABSTRACT: MS STUDENT

Biological soil crusts (biocrusts) are a critical component of many dryland ecosystems. Biocrust communities (consisting of lichens, mosses, cyanobacteria, bacteria, and algae) have an important impact on ecosystem processes by influencing plant germination and growth, as well as enhancing surface hydrology, soil aggregation, nutrient cycling, and resistance to erosion. While biocrusts are highly adapted to harsh dryland conditions, they are known to be susceptible to fire impacts. Climate change and non-native invasive species have shortened fire-return-intervals in many dryland systems; however, while these changes carry implications for biocrusts and ecosystem recovery, our overall understanding of these consequences remains poor. This research looks at first order fire effects on biocrusts from across the five North American deserts (Chihuahuan, Colorado Plateau, Great Basin, Mojave, and Sonoran) and examines the impact of soil heating on plant-biocrust interactions. Field collected soil samples were homogenized and half of the samples had representative biocrust communities returned to the soil surface to provide a bare soil and biocrust comparison. Half of all samples, both biocrusted and bare, were heated to simulate fire impacts. To test plant-biocrust interactions, all samples were then seeded with *Elymus elymoides*, a perennial native bunchgrass. Plant germination, leaf production, and root and shoot biomass were measured during a 100-day greenhouse study. Seedling germination rates and mean germination times were affected by the presence of biocrust, regardless of soil heating. Plant growth was also influenced by biocrust and soil heating, and the magnitude of this response varied by desert. This work demonstrates the importance of biocrust in shaping post-fire vegetation responses. It also reveals complex dynamics between biocrust, soil heating, and the abiotic parameters of different desert soils. As fire regimes continue to strengthen in many dryland systems, management will increasingly benefit from understanding these mechanisms and the role they play in ecosystem recovery.



Poster Session Tuesday 1: Poster Pod 33, Poster 33

EFFECT OF EARLY-SEASON BURNING AND GRAZING ON SUB-IRRIGATED MEADOW HAY PRODUCTION

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ABSTRACT: MS STUDENT

Sub-irrigated meadows are a valuable forage resource to ranching operations in the Nebraska Sandhills. Within a given year, these meadows can be used for hay production, grazing, or a combination of both. Buildup of standing dead and litter material from ungrazed or unhayed plant material can potentially reduce forage yield and quality. We hypothesized, that prescribed burning on sub-irrigated meadows early in the growing season, late-April to early-May, would result in the removal of standing dead and litter without decreasing total hay production later in the growing season. Research was conducted from 2017 to 2018 with treatments of a 1) spring prescribed burning, 2) mowing, and 3) a control with no early-season management. All treatments were subjected to a modified strip-strip plot design with either grazing or grazing exclusion following the burn, in May and early June. In mid-August, biomass production was collected within the plots for each year. Grazing utilization was greater on the burn (69%) than the control plots (43%), but treatment did not influence biomass production in mid-August ($P=0.32$). There was an interaction between year and grazing which occurred in May and early-June regardless of the treatment ($P < 0.01$). In 2017, biomass was 1.8 times greater on the ungrazed compared to grazed plots, but in 2018 biomass was only 1.2 times greater on the grazed compared to ungrazed plots. Our research suggests that managers of sub-irrigated meadows can burn meadows early in the season with no later loss in hay production but grazing in May and early June may decrease biomass production later in the growing season.



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EXAMINING THE IMPACT OF PATCH BURNING ON LIVESTOCK GRAZING PATTERNS IN EDWARDS PLATEAU, TEXAS

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ABSTRACT: Ph. D STUDENT

Production of sheep, goat, and cattle are major agricultural enterprises on West Texas rangelands, especially in the Edwards Plateau. In this region, the use of fire as a management tool was suppressed until recently. Although previous studies have been conducted to evaluate cattle use of burned versus unburned patches, there has been a lack of studies where combinations of livestock species grazing together on patch burned areas have been evaluated. The objective of this study is to examine grazing patterns of cattle, sheep and goat, both spatially and temporally, on areas where patch burning has been implemented. The study site is Texas A&M AgriLife Research Ranch, Martin Ranch, located in Mesquite-Oak-Savanna ecosystem in the Menard County of Texas. In February 2019, patch burns were implemented on the ranch and represented about one-seventh of the total ranch area (240 ha). After the burns, animals from the resident herd were randomly selected and GPS collars were placed on 34 goats, 33 sheep, and 8 cows to reflect the proportion of animals in the resident herd. The GPS collars were set to collect movement data every 10 minutes during a five-month period. Gates and fences for the entire ranch were opened and livestock were free to choose areas to graze. Data from the GPS's were evaluated to determine locations where the animals grazed and their preferences for different areas of the landscape. Initial observations indicate that cattle and sheep were more attracted by recent burned patches compared to goats. Livestock forage use patterns and time spent by species in the burned and unburned areas and among different vegetation land cover classes will be presented. Information from this study will assist in providing information to producers on how implementation of patch burning would influence their management of these grazing lands.



Poster Session Tuesday 1: Poster Pod 33, Poster 35

PRIORITIZING VEGETATION MANAGEMENT PRACTICES ON PRIVATE WORKING LANDSCAPES TO REDUCE CATASTROPHIC EVENTS

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ABSTRACT

As California policy makers continue to address the impacts of catastrophic wildfires, input from private landowners, who own the majority of California's working landscapes, is often overlooked. Collaborative management of working landscapes can be key to reducing catastrophic fires while also maintaining viable of these lands continue to provide ecosystem services from forest and rangelands. Our project brought together private landowners to evaluate the implementation of management tools on the rangelands that surround Lake Sonoma. Located in northern California, Lake Sonoma is the primary drinking water source for more than 600,000 residents of Sonoma and northern Marin Counties, California. Lake Sonoma watershed includes approximately 230 parcels and 33,500 hectares. The land is mostly privately owned and has not experienced a significant fire in many years. We engaged landowners through a dialogue-based approach, increasing landowner awareness of landscape attributes, especially those related to fire risks. Individual parcel's biophysical attributes and vegetation were analyzed using a variety of existing fire hazard maps, providing different results of fire behavior based on slope, fuels, wind speed and direction, temperature, and humidity. At educational meetings, landowners were provided reports, showing maps and tables that quantified vegetation types and hazard class, along with which management practice(s) were most appropriate for that type. A checklist assessed management practice costs, for grazing, prescribed fire, and shaded fuel breaks, assisting landowners in prioritizing practice implementation and maximizing returns on rangeland management investments. Better informed landowners have a greater chance of adopting management practices, subsequently improving rangeland resiliency and reducing fire intensity. The project methodology will be scaled from individual property owners to larger landscapes and community-owned rangelands. Scaling efforts will increase awareness on how to manage rangelands and implement appropriate practices to mitigate catastrophic fires.



Poster Session Tuesday 1: Poster Pod 33, Poster 36

LONG TERM RESPONSES OF TANGLEHEAD TO PRESCRIBED PATCH BURNING AND CATTLE GRAZING

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ABSTRACT: MS STUDENT

Tanglehead (*Heteropogon contortus*) is a native perennial bunchgrass that is found throughout south Texas. This native grass is a drought tolerant warm season grass, which has drastically increased its distribution over the past 15 years. As tanglehead matures the stems become coarse, undesirable to cattle and reduces species richness in the pasture. These monotypic stands threaten wildlife habitat and the ranching industry on south Texas rangelands. This experiment evaluates the effects of prescribe patch burning and continuous grazing on (1) the composition of a plant community previously dominated by tanglehead; and (2) pasture utilization by cattle and native wildlife. The study site is a 95.5-hectare tanglehead monoculture pasture on a private ranch in southern Jim Hogg County, Texas. Since August 2016, this pasture has been continuously grazed at a stocking rate of 0.1 AU/ha/yr. A total of six plots (approximately 7 ha) used for the study and three of the plots were burned in the November 2016. Cattle (*Bos taurus*) freely graze in either non-burned areas (control) or patch burn areas. Three exclosures were placed on each plot to measure species richness and forage percent utilization. One grazing exclosure was randomly selected in each plot and vegetation 20 meter transect was conducted off of one randomly selected corner. The sampling period has been on 35-day intervals for the past three years. Average plant species richness and percent utilization was 4.83 and 8.33 plants per 0.25 m² and 1.8% and 51.7% in the control compared to the burned plots, respectively. Plant species richness and cattle preference for tanglehead may be increased following a prescribed burn since palatability is increased. Ranchers can use this information as a management tool to increase species richness, cattle utilization of tanglehead and improve wildlife habitat.



Poster Session Tuesday 1: Poster Pod 34, Poster 37

HYDROLOGIC AND BIOLOGIC RESPONSES OF ANTHROPOGENICALLY ALTERED LENTIC SPRINGS TO RESTORATION IN THE GREAT BASIN

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ABSTRACT

Water is a limited and highly valued resource in the Great Basin. Surface water sources are often small and widely spaced apart, comprising only 1-3% of the surface area of the overall landscape. Despite their small size, these springs and surrounding wet meadows have a substantial effect on the surrounding environment. In recent years, many of these springs have become dewatered due to diversions of groundwater and climatic shifts in precipitation affecting recharge. These hydrologic changes can cause a drop in the local water table that promotes a shift in the plant community from wetland-obligates to more drought-tolerant species which can result in a degraded system. As degradation progresses, springs and wet meadows lose their ability to store water. The purpose of this research was to examine the responses of both the hydrologic and biologic factors to different springbox restoration techniques. Twenty-four spring sites were chosen in the Sheldon National Wildlife Refuge in northwestern Nevada. Each site was randomly assigned one of six different treatment designs. Various biotic and abiotic variables were measured. In our results, we observed soil moisture increase over the majority of our sites. Biomass increased in four of our six treatments. All treatment types exhibited a similar effect on springs with none having a clearly more restorative effect than any others. This research suggests that springs in the Great Basin have unique characteristics and responses to restoration and may need individualized approaches. Yearly variation caused by increased precipitation may be partially responsible for changes in hydrologic and biologic aspects of springs and wet meadows. Further data collection is needed to determine the true extent of treatment and yearly effects on spring restoration. In spite of the need for individualized approaches, restoration is possible. Simple solutions may be sufficient to recover hydrologic processes that maintain ecological resilience.



Poster Session Tuesday 1: Poster Pod 34, Poster 38

USING THE NVC TO DEVELOP FUNCTIONAL-BASED SEED MIXES FOR RESTORATION OF SAGEBRUSH HABITAT

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ABSTRACT

Big sagebrush ecosystems are widespread throughout the western United States and provide essential ecosystem services. Sagebrush habitat has experienced a 45% reduction in range. While restoration practitioners generally attempt to restore ecosystems to historic conditions, this is not always achievable. The use of functional types (FTs), rather than specific species, to restore ecosystem structure and function may be easier to achieve but is not well tested. We examined the variability of vegetation communities along a sagebrush elevation gradient in western Colorado. We classified 1245 plots based on species cover and aligned that classification with USNVC types. We then performed several FT analyses in PCORD with 517 plots to examine differences in functional dominants among classified groups and relationships among FTs and environment. We asked: (1) Do functional dominants differ along this elevation gradient?; and (2) can we use functional types to refine restoration protocols, such as seed mixes? Plots were classified into nine groups based on dominant species; an NMS ordination clearly discriminates groupings. The data further show a relationship with the environmental variables of temperature and variation in temperature, and elevation and moisture; an elevation gradient. When a similar analysis was conducted on a functional type matrix (including growth form, clonal organ, photosynthetic pathway and life history), distinctions among groups were not clear; the convex hulls have a great deal of overlap and the Basin Big Sagebrush community has an extremely wide distribution. However, we did find some significant differences in functional diversity and functional dispersion among groups. Mean cover of different function types suggest minor differences among groups, but worth noting when developing seed mixes. Differences in the dominance of clonal growth organs was clear, and clonal plants made up 50% -100% of the cover for nearly all groups. For sagebrush communities alone, *A. nova* sites are not even shrub-dominated, perennial and annual graminoids are more common in Wyoming Big Sagebrush than Basin Big Sagebrush, and Mountain Big Sagebrush communities seem strongly dominated by that one species.



Poster Session Tuesday 1: Poster Pod 34, Poster 39

UNDERSTORY VEGETATION RESPONSE TO THINNING PINYON-JUNIPER WOODLANDS

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ABSTRACT: Ph. D STUDENT

Portions of the western United States, extending from West Texas up through southern parts of Oregon, are densely populated with piñon–juniper (PJ) woodlands. Managing tree densities could have positive ecological implications for rangeland watersheds and wildlife habitat. The objective of our study was to determine understory vegetation response to tree removal in small watershed areas. This research reports comparative data collected from six watersheds situated within New Mexico State University’s Santa Fe Ranch, Santa Fe County, New Mexico, to assess herbaceous standing crop and cover over 10 years following tree removal. In 2009, six 1.00 to 1.35 ha paired PJ watersheds were selected. Juniper thinning was conducted in three watersheds (treatment watersheds, T) while the remaining three watersheds were left untreated (control watersheds, C). The variation of slopes is such that, the bottom of the valley may range from 2% to 5%, while the slopes on may vary from 20% to 50% with sandy clay loam texture. We measured understory vegetation biomass and cover in 2009 (pre-treatment), 2014, and 2019 (post-treatment) based on our hypothesis that juniper thinning would significantly increase understory biomass at the watershed scale. Total standing crop significantly increased in T compared to C in both post-treatment years (2014 and 2019). Also, in T, grass basal cover significantly increased after 10 years of treatment compared to C. Our results suggest that juniper thinning at our site in northern New Mexico can promote a 2.5-fold increase in understory grass production. Our results provide land managers critical information for actual effects of tree clearing in small watershed areas.



Poster Session Tuesday 1: Poster Pod 34, Poster 40

TOPO-EDAPHIC CONSTRAINTS ON WOODY PLANT COVER CHANGE IN A SEMI-ARID GRASSLAND

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ABSTRACT: Ph. D STUDENT

Many rangelands have experienced a proliferation of woody plants at the expense of grasses. Efforts to stem WPE include a variety of chemical, mechanical, and pyric brush management practices. However, results from these actions are costly and typically short-lived, necessitating re-treatment. While the WPE process and its drivers are varied, consensus is emerging that interactions among multiple factors are key. The strength of these interactions ostensibly varies depending upon local constraints imposed by landforms, soils and topography, but how these constraints influence the rate and extent of the WPE has not been well-quantified. The long-term efficacy of brush management treatments is also subject to these constraints. Thus, long-term spatial/temporal dynamics of shrub encroachment and responses to brush management are challenging to predict. We quantified long-term rates and patterns of shrub (*Prosopis velutina*) cover change across the 18,210 ha Las Cienegas National Conservation Area at ~20-year intervals between 1936 and 2017 taking into account soils, topography, and brush management history. Shrub cover increased from 1.7% in 1936 to 7.7% in 2017 across the area, but elevation, slope aspect, and soil texture substantially influenced fine-scale changes. For example, shrub cover on loamy upland/limy slopes underwent little change (from 0.3% in 1936 to 1.9% in 2017), whereas change on loamy uplands was higher (from 1.3% to 8.2%) and substantially higher on loamy bottoms (from 4.3% to 19%). Recovery of shrub cover on areas receiving brush management also varied by ecosite, with re-establishment on loamy bottoms increasing from <1% in 1975 to 22.1% in 2017 while a loamy upland treatment increased from <1% to 2.3% over the same time span. We will discuss how knowledge of fine-scale patterns of shrub encroachment and responses to brush management can be used by managers to determine when, where and how frequently to implement brush management activities.



Poster Session Tuesday 1: Poster Pod 34, Poster 41

SAGEBRUSH FIELD OF DREAMS AND DASH; EARLY STRUCTURAL ADVANTAGE OF TRANSPLANTS FOR BUILDING GREATER SAGE-GROUSE HABITAT

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ABSTRACT

In the Great Basin USA, increasingly larger areas of big sagebrush (*Artemisia tridentata*) are being killed by wildfires driven by nonnative grasses and these losses have far outpaced rates of sagebrush recovery. Consequently, wildlife populations of sagebrush-obligate species and their habitats (e.g., Greater Sage-grouse, *Centrocercus urophasianus*) are often in decline. In addition to the establishment advantage that transplanting container-grown sagebrush provide for restoration, they also afford an initial height and canopy area advantage over seeded plants, but do they maintain this advantage over time? We examined height and canopy area of sagebrush individuals by substituting space for time at 28 seeded and 20 transplanted locations across the Great Basin using a Bayesian hierarchical regression. We tested if the initial height and canopy area advantage of planted sagebrush might translate into reaching habitat goals for Greater Sage-grouse sooner than seeded plants. Preliminary results indicate that initial height and canopy area advantages for transplanted over seeded individuals lasted for the first three years after planting, but a greater growth rate for seeded individuals allowed them to equal or surpass transplanted individuals in these measures in subsequent years. The transplant advantage disappeared by the fourth year for both canopy area and height. By the sixth year seeded plants were taller than transplanted individuals because of their greater height growth rate. Container-grown plants achieved heights suggested to meet Greater Sage-grouse management guidelines around year three, about a year before seeded plants. Densities of about 2 plants/m² and 4 to 5 years of growth were necessary to meet cover requirements for Greater Sage-grouse. Since big sagebrush often establishes poorly from seeds, planting nursery-grown sagebrush that are 1-2 years old may be the best hope for quickly achieving wildlife habitat goals after fires at least for site-level applications.



Poster Session Tuesday 1: Poster Pod 34, Poster 42

LONGTERM IMPACTS OF PINYON-JUNIPER REMOVAL ON VEGETATION AND HYDROLOGIC PROPERTIES

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ABSTRACT: UNDERGRADUATE STUDENT

Throughout the western U.S., extensive pinyon-juniper (*Pinus* spp., *Juniperus* spp.) encroachment into sagebrush (*Artemisia* spp.) shrublands has reduced sagebrush habitat and modified hydrologic function. Land managers are combating this challenge with tree removal treatments to return current woodlands to historical sagebrush shrublands. This study examines the effects of fire and mechanical tree-removal treatments on vegetation as well as the spatial patterns and persistence of litter accumulation and soil hydrologic properties along hillslopes. Experimental plots were located at three sites in the Great Basin region. Vegetation sampling was completed pre-treatment (2006) and 1, 9, and 13 years after mechanical and prescribed-fire treatments at two sites. Sampling was also conducted in a naturally burned and unburned third site two consecutive years after a wildfire (2008, 2009). In 2019, hydrologic, soil, and vegetation characteristics were measured in canopy and intercanopy microsites within all treatments at each site. All treatments were effective in reducing tree cover. Over a period of 13 years, sagebrush and perennial grass cover increased in mechanical treatments and perennial and annual grass cover increased in prescribed fire treatments. Wildfire initially reduced perennial grass cover 4-fold and removed 100% of the limited pre-fire shrub cover. Perennial grasses increased 3-fold over the 2nd year after wildfire, but shrub cover remained near 0%. In 2019, soil water repellency was observed on former and existing tree microsites in all treatment areas, but repellency adjacent to standing dead trees and stumps within burned treatment areas was weaker than in tree microsites within untreated and mechanically treated areas. With few exceptions, ground cover was generally greater in treated intercanopy areas than in untreated areas. While treatment effects vary by treatment type, the preliminary results indicated that pinyon-juniper removal treatments can increase vegetation and ground cover, reduce soil water repellency, and improve surface conditions on sagebrush rangelands.



Poster Session Tuesday 1: Poster Pod 35, Poster 43

NOT ALL FUEL REDUCTION TREATMENTS DEGRADE BIOCRUSTS: HERBICIDES SHOW POSITIVE EFFECTS ON COVER OF BIOCRUSTS

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ABSTRACT

In response to increasing fire, fuel reduction treatments are being used to minimize fire risk. Although biocrusts are associated with reduced cover of fire-promoting, invasive grasses, the impacts of common fuel reduction treatments on possible degradation of biocrusts are poorly understood. We use data from a long-term experiment testing fuel reduction treatment on lichen and moss components of biocrusts in sagebrush steppe. Fuel reduction treatments include mowing, prescribed fire, and the use of two herbicides: one commonly used to reduce shrub cover, tebuthiron and one commonly used to combat cheatgrass, imazapic. Given the long-term nature of the dataset, we also compare estimates of biocrust cover surveyed on rainy days versus the dataset as a whole because many, but not all, researchers that study biocrusts wet the soil surface before surveying to ease in the detection of these sometimes-cryptic organisms. This dataset provides an opportunity to compare both approaches. Preliminary results demonstrate neutral to positive effects of herbicides: tebuthiron and imazapic, on both the moss and lichen components of biocrusts. Mowing and prescribed fire led to losses in cover of mosses, with the later leading to comparatively greater declines in cover (declines of 23% - 31% versus 42% - 67%). Reductions in moss cover mirrored gains in cover of bare soil, which are associated with increased risk of invasion by grasses responsible for increasing fire risk. Preliminary results also demonstrate greater differences in cover of biocrusts compared to controls when data was collected on rainy days. This approach highlights that higher cover of biocrusts is likely to be detected when the soil surface is wet. We demonstrate positive effects of the use of herbicides for reducing fuels while simultaneously maintaining or promoting biocrusts and reducing the threat of invasion by annual grasses that are responsible for increasing fire risk.



Poster Session Tuesday 1: Poster Pod 35, Poster 44

EFFECTS OF BIOCRUST DEVELOPMENT ON ESTABLISHMENT OF NATIVE PLANTS IN A SALT DESERT SYSTEM

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ABSTRACT

In salt desert shrublands of the Great Basin, exotic annual plants are displacing native species. Low productivity and recruitment in these systems limits their resilience, and active revegetation with native species is especially challenging. Two underexplored questions for re-establishing native species include: 1) the effectiveness of broadcast seeding vs transplanting of greenhouse-grown seedlings and 2) how different levels of biological soil crust development affect restoration success. In a degraded salt desert shrubland in southeastern Idaho, we experimentally tested broadcast seeding vs. spring or fall planting in areas of high vs. low crust development for three native grasses and one forb. Survival, size and reproductive success were measured over several time periods during the year following planting. Broadcast seeding largely failed across all levels of crust development and species. Survival, biomass and reproductive success of transplanted seedlings differed across species, and biological soil crust development had a significant effect on the ability of some species to survive the first summer after planting. This study demonstrates the success of transplanting as a method of native species establishment, and the benefits of targeting areas of high soil crust development for restoration plantings in a salt desert shrubland.



Poster Session Tuesday 1: Poster Pod 35, Poster 45

BIOTIC CAUSES OF SEEDLING MORTALITY FOR *ELYMUS ELYMOIDES* (RAF.) SWEZEY IN A DRILL-SEEDED RANGELAND ENVIRONMENT

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ABSTRACT: MS STUDENT

Human activities in the Great Basin have impacted rangelands and facilitated the colonization of invasive annual grass and forb species. Generally, areas dominated by invasive annual species fail to provide high quality habitat for wildlife and increase the frequency of wildfires compared to areas dominated by native plants. Subsequently, efforts to restore degraded areas often fail. Understanding processes involved in plant establishment can improve the ability to predict the outcome of revegetation practices and create effective solutions for rangeland revegetation. The purpose of this study was to identify timing and biotic causes of plant mortality for species seeded during rangeland revegetation on the Utah Test and Training Range (UTTR) in western Utah. We placed Reconyx motion sensing trail cameras in 28 plots arranged in a randomized split-plot design with fenced and unfenced plots and seeded with two rows of *Elymus elymoides* (bottlebrush squirreltail) (Raf.) Swezey. We tracked individual seedlings and recorded their status (alive, dead, or damaged), comparing initial seedling establishment and seedling survival between fenced and unfenced plots. Seed predators reduced initial seedling establishment in unfenced plots by 4 times ($p=0.0002$). Seedlings were 7 times more likely to survive in fenced vs. unfenced plots. Of total seedling mortality, 73.6 % of seedling death was caused by herbivory (pocket gophers, invertebrate herbivores, jackrabbits). The effects of small herbivores decreased the success of rangeland revegetation efforts, reducing native plant establishment and leaving sites vulnerable to plant invasion. Continued research should be conducted to determine the effect of herbivores on revegetation efforts at a large scale and what strategies could mitigate those effects.



Poster Session Tuesday 1: Poster Pod 35, Poster 46

COMPARING ESTABLISHMENT METHODS AMONG DIFFICULT-TO-PRODUCE NATIVE PLANT MATERIALS

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ABSTRACT: MS STUDENT

Some native species are highly desirable in reclamation and restoration settings, but seed availability is limited because the species is challenging to effectively establish, grow, harvest, clean, and condition. Additionally, propagation methods may directly impact native plant restoration efforts where original seed sources are limited. We evaluated seed increase methods of native plants sulfur-flower buckwheat (*Eriogonum umbellatum* Torr.) and desert biscuitroot (*Lomatium foeniculaceum* J.M. Coult. & Rose). Sulfur-flower buckwheat is a native, low growing, woody mat-forming perennial that is important for quail, sage-grouse, and ungulate forage and for pollinator habitat. Desert biscuitroot is a broad-leaved, herbaceous perennial of the Apiaceae. It is used for medicinal purposes and is an important forage for sage grouse. We compared establishment and survival between direct-seeding and transplanting containerized seedlings for seed production fields in northeast Wyoming. One year after planting, sulfur-flower buckwheat establishment was 71.7% +/- 21% (95% CI) with transplanting and 0.16% +/- 0.7% (95% CI) with direct seeding. Two years after planting, survival was 18.1% +/- 19.4% (95% CI) with transplanting and 10.2% +/- 1.5 (95% CI) with direct seeding. One year after planting, desert biscuitroot establishment was 18.1% +/- 19.3% (95% CI) with transplanting and a 10.2% +/- 1.5% (95% CI) with direct seeding. Two years after planting, survival was 10.1% +/- 21.2% (95% CI) with transplanting and 6.5% +/- 0.9% (95% CI) with direct seeding. Extended survival, seed production, and cost comparison analyses will be evaluated.



Poster Session Tuesday 1: Poster Pod 35, Poster 47

STRIP-SEEDING, TARGETED GRAZING, AND PRESCRIBED FIRE FOR RESTORATION AND INVASIVE SPECIES MANAGEMENT IN CALIFORNIA GRASSLANDS

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ABSTRACT: Ph. D STUDENT

California valley grasslands are dominated by non-native annual grasses from the Mediterranean regions of Europe. The more recent spread of highly invasive annual grasses such as medusahead (*Elymus caput-medusae*) have led to reduced forage quality and plant species diversity. Restoration and vegetation management are important tools to increase productivity and biodiversity. However, efforts to re-establish native vegetation are often hindered by the high cost of plant material and persistence of invasive species. To address this challenge, we tested the efficacy of combining strip seeding with targeted grazing and prescribed burning. Strip seeding is the seeding of desired species in horizontal patches across a landscape and relies on natural dispersal from these patches to colonize unseeded areas. Proposed benefits of this method include reduced cost and increased invasion resistance over large areas. However, we found that after five years, a legacy of initial seeding configuration remained with lower native and higher non-native abundance in unseeded strips. To reduce invasive cover and encourage dispersal of native species from seeded to unseeded strips, we implemented targeted grazing and prescribed burning treatments in a full factorial design five and six years after initial seeding. We measured post-treatment community composition and reproductive output of medusahead to determine if combining strip seeding, grazing, and burning is an effective strategy to establish native grasses and reduce invasive cover. We found that all burning and grazing treatments reduced native cover, but only treatments that included burning (with or without grazing) reduced the cover of medusahead. The combination of burning with grazing was most effective at reducing medusahead cover but included the tradeoff of reducing established perennial grasses. Further research is needed to determine if altering the timing and frequency of grazing and burning can reduce medusahead while minimizing negative impacts on native perennial grass communities.



Poster Session Tuesday 1: Poster Pod 35, Poster 48

SUCCESS OF INSTALLING NATIVE PLANT PLUGS IN CHEATGRASS (*BROMUS TECTORUM*) DOMINATED LANDSCAPES

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ABSTRACT

An experiment was conducted to determine if it is possible to establish native plants, installed as 10 cubic inch plugs, in cheatgrass (*Bromus tectorum*) dominated locations. There was no effort to control cheatgrass. These plants were compared with plants installed in nearby bare soil (sand) locations. This work was done at the Saddle Mountain National Wildlife Refuge in southcentral Washington State. This shrub-steppe study area is very dry with annual precipitation of about 170 mm. Sixteen shrub-steppe species were compared. In the second growing season and after a fire in the summer of the first growing season Western yarrow (*Achillea millefolium*) had the highest survival of $57 \pm 5.1\%$ in cheatgrass compared with $74 \pm 5.7\%$ in bare soil. Other successful species in cheatgrass were Sandberg's bluegrass (*Poa secunda*, $52 \pm 5.7\%$), sand dropseed (*Sporobolus cryptandrus*, $27 \pm 5.2\%$), Bottlebrush squirreltail (*Elymus elymoides*, $18 \pm 6.2\%$), and orange globemallow (*Sphaeralcea munroana*, 6.3 ± 2.3). The other 11 species were not successful. We conclude that it is possible to establish some shrub-steppe species as plugs, under the conditions of the test, without using herbicides or other methods to control cheatgrass.



Poster Session Tuesday 1: Poster Pod 36, Poster 49

CONTROLLING YELLOW STARHISTLE TO ENHANCE WATER RESOURCES: RESPONSE OF MULTIPLE ECOSYSTEM SERVICES AT THE WATERSHED SCALE

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ABSTRACT

California is facing growing demand for water and 85% of California's surface water supply is generated, passes through, or stored in rangeland watersheds. In addition to conservation, other strategies are needed to meet urban, agricultural, and environmental water demands. A potential method to increase water yields from rangeland watersheds is the removal of dense stands of weeds, specifically Yellow starthistle (*Centaurea solstitialis*) (YST), that use more water than native or desirable annual forage species. Simultaneously, managers are increasingly expected by a diversity of stakeholders to incorporate multiple ecosystem service goals. We aim to measure the response of multiple ecosystem service outcomes to the application of herbicide at the watershed scale. Our sites consisted of four grazed annual-grassland watersheds (2 north/2 south) ranging in area from 6 to 9 acres. All watersheds were equipped with flumes, meteorological stations, and soil moisture sensors and piezometers at three landscape positions. We conducted plant community surveys using 27 (1m²) quadrats nested across 9 (10ft) transects. At multiple time steps, we sampled forage biomass and YST biomass along two transects representing all possible landscape positions. Using a UAS, we recorded thermal and multispectral imagery at each sampling event to create evapotranspiration maps using surface energy balance model. After installation of instruments in 2017 and baseline monitoring in 2018, in the winter of 2019 we applied milestone herbicide to one watershed from each block via helicopter. We found YST in the treatment watersheds, dropped from a baseline of ~40% cover across all watersheds to 0% cover in the treated. Preliminary results suggest greater soil moisture conditions and less total evapotranspiration in the treated watersheds compared to the untreated. We did not find a significant difference in annual grass cover between watersheds, however, species richness and legume cover were lower in the treated watersheds compared to untreated.



Poster Session Tuesday 1: Poster Pod 36, Poster 50

CATTLE REMOVAL IN SAGUARO NATIONAL PARK AND THE COMPOSITIONAL CHANGES FORM ASSOCIATED SUCCESSION

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ABSTRACT: MS STUDENT

In the area that is now Saguaro National Park East, grazing began in the 1880's. Because of the impact to the Saguaro cactus, ecological impacts in the park were determined to be so great that anti-grazing conservationists won a court case eliminating grazing in 1978. Surveys of ten plots began in 1978 and were replicated in 2007 and 2018 by agency personnel. The layout of plots was paired- grazing removed 1956 (control) and in 1978 (treatment). Our hypotheses were: (1) Cover and diversity would increase, (2) Shrubs would increase compared to graminoids, (3) Unpalatable species would decline, (4) Paired plots would show little compositional difference and (5) Plots burned from the 1980's would show significant difference. Canopy cover & diversity increased significantly by 2007 and expanded by 2018. Unpalatable species such as *Ericameria laricifolia* declined dramatically as well due to competition of palatable species. As was found in 2007, the 2018 analysis showed no difference quantifiably speaking between paired plots. Three out five hypotheses were confirmed, indicating differences in composition and cover were not different in burned versus unburned plots. One would surmise from the data that intensity was low and may have only hit portions of the plots-possibly concentrating on the plethora of *Prosopis velutina* that existed on these plots in 1978 but were reduced dramatically by 2007 and steady by 2018. Hypothesis (2) was proven incorrect. Shrub cover increased in 2007 and doubled by 2018, while graminoid cover increased by 2007 and dramatically by 2018. This is likely due to increasing autumn rain from tropical activity from the Pacific Ocean. Trends in this direction slightly increase in the years prior to 2007 (1996, 1998, 2000, 2003 & 2006) and dramatically increase in the years prior to 2018 (2014-2018) leading to the perennial bunchgrass explosion seen in our research.



Poster Session Tuesday 1: Poster Pod 36, Poster 51

NATIVE AND INTRODUCED SEED MIX PERFORMANCE ON CHEATGRASS RANGELANDS

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ABSTRACT

Invasion of alien plant species influences many phases of wildland research in the Great Basin. The accidental introduction and subsequent invasion of cheatgrass (*Bromus tectorum* L.) onto millions of hectares of Great Basin rangelands has led to the conversion of former big sagebrush (*Artemisia tridentata* Nutt.)/bunchgrass communities to cheatgrass dominance. Cheatgrass has revolutionized secondary succession in more arid big sagebrush plant communities throughout the Great Basin by increasing the chance, rate, spread and season of wildfires. The best known method to suppress cheatgrass densities and associated fuels is through the establishment of perennial grasses. We investigated the performance of native, introduced and native/introduced perennial grass seed mixes following for two consecutive years in northern Nevada. Following weed control efforts using the pre-emergent herbicide, *Sulfometuron methyl*, we seeded native and introduced perennial grasses in seed mixes to record establishment and the ability of these seed mixes to suppress cheatgrass. Following 2-years of recording seedling emergence and establishment, we recorded 35.5 perennial grasses/m² in the introduced and native mix plots and 25.8/m² in the native/introduced plots for year-1. Year-2 resulted in 27.9 perennial grasses/m² in the introduced and native/introduced plots, while the native plot decreased to 14.0/m². Year-1 received 335.3mm of annual precipitation compared to 201.9mm in year-2. Cheatgrass densities were recorded from a low of 10.8/m² in the year-1 introduced plots to a high of 144.2/m² in the year-2 native plots. Introduced perennial grass seed mix performed the best at suppressing cheatgrass fuels from 1,352 kg/ha in control plots down to 103 kg/ha, while the native/introduced and native plots recorded 151 kg/ha and 381 kg/ha, respectfully. In arid environments introduced perennial grasses and introduced/native perennial grass seed mixes consistently performed better at suppressing cheatgrass than native perennial grass seed mixes which can be attributed to more arid years than mesic years.



Poster Session Tuesday 1: Poster Pod 36, Poster 52

DOCUMENTING THE PLANT EVALUATION PROCESS FOR COMMERCIAL RELEASE PURPOSES IN WEST TEXAS

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ABSTRACT: UNDERGRADUATE STUDENT

The need for locally adapted seed sources in West Texas is increasing as highway and pipeline right-of-ways and oil and natural gas fields continue to expand, but the region's access to commercially available, locally adapted native seed sources is limited. West Texas Native Seeds, a collaboration between the Caesar Kleberg Wildlife Research Institute and the Borderlands Research Institute, is addressing this limitation by developing regional ecotypic seed sources. The program is actively working to expand the commercial availability of West Texas-specific seed sources to consumers, thus aiding in numerous restorative projects across the region. This project serves to document the preliminary plant evaluations of the grass species, hairy grama (*Bouteloua hirsuta*) and the forb species, narrowleaf globemallow (*Sphaeralcea angustifolia*). Previously collected populations of both species were planted in a greenhouse in March of 2019. Fifty-nine accessions of hairy grama were grown, 19 of which did not have enough plants germinate and were eliminated from the evaluation. Eleven accessions of narrowleaf globemallow were grown, all of which were evaluated. The greenhouse plants were translocated to an evaluation plot south of Alpine, Texas in May of 2019. Preliminary evaluations conducted throughout the growing season were started in July and are ongoing. The evaluations are performed monthly throughout the growing season for the first year and bi-monthly during the growing season the following year. Three populations of hairy grama and two populations of narrowleaf globemallow stand out after two rounds of data collection. Data collection and seed germination testing will continue through 2020.



Poster Session Tuesday 1: Poster Pod 36, Poster 53

ECOLOGICAL RESTORATION OF NATIVE PLANT COMMUNITIES IN FORESTS AND WOODLANDS ON THE NAVAJO NATION

Bryan Neztosie*; Diné College Land Grant Office, Tsaile, AZ

ABSTRACT

The long-term goal of the proposed research project is to determine evidence of ecological restoration of native vegetation after implementing ecological restoration thinning prescriptions in dense pinyon, juniper, and ponderosa pine forest on the Navajo Nation. The objectives are 1) Increase the capacity of staff, faculty and students to participate in applied research. 2) Strengthen collaborations with research institution to improve technical support systems to implement research. 3) Research results will be shared with Navajo Nation Forestry Department, Navajo communities, Grazing Officials, Bureau of Indian Affairs Natural Resources, and land users (grazing permittees).



Poster Session Tuesday 1: Poster Pod 36, Poster 54

STRATEGIC PLACEMENT OF SALT SUPPLEMENTS TO RESTORE SHRUB-ENCROACHED PASTURES. A CASE STUDY FROM ITALIAN ALPS

Ginevra Nota*, Marco Pittarello, Michele Lonati, Simone Ravetto Enri, Davide Barberis, Giampiero Lombardi; University of Turin, Turin, Italy

ABSTRACT: Ph. D STUDENT

Socio-economic transformations occurred in Europe over the last decades led to a broad abandonment of mountain areas. Consequently, the processes of natural succession favored shrub and tree encroachment, resulting in a dramatic degradation of semi-natural grasslands. Grazing by hardy breed cattle can be a sustainable tool to counteract these processes and restore semi-natural grasslands. In this context, the AGER iGRAL project planned to assess the effectiveness of cattle management of hardy breeds for the restoration of abandoned pastures in Alpine and Mediterranean environments. The present contribution shows the preliminary results of the strategic placement of attractive salt supplements to increase the frequentation of shrub-encroached areas by livestock. The impacts of trampling and grazing on vegetation structure were evaluated in a 24-hectare pasture (Vogna Valley, North-western Italian Alps), grazed by 72 Livestock Units of Highland cattle from 18 to 26 July 2019. Three salt blocks were placed within shrub-encroached sites and offered *ad libitum* throughout the grazing period. Each salt site was paired with a control one with similar topographic and vegetation characteristics. To detect the impact on vegetation structure, shrub and herbage heights were measured within a 15-m radius around each site, before and after grazing. The average reductions of shrub and herbage heights around salt sites were 5.9 ± 0.88 and 7.8 ± 1.02 cm (mean \pm standard error), respectively, and they were significantly greater than in control sites ($p < 0.001$). These promising results support the use of salt blocks for an effective grazing management of Highland cattle in shrub-encroached pastures. In addition, they represent a kick-off outcome to address future actions within iGRAL project for the restoration of abandoned pastures.



Poster Session Tuesday 1: Poster Pod 37, Poster 55

COLLABORATIVE RECLAMATION EXPERIMENTS ON OIL AND GAS WELL PADS IN THE UINTAH BASIN: APPROACH AND EARLY RESULTS

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ABSTRACT

Energy exploration and development occurs throughout western rangelands. Although many operators expend significant resources reclaiming disturbed areas, knowledge gaps exist regarding how to successfully and efficiently achieve reclamation success, complicated by the challenging characteristics of arid environments: unstable soils, exotic species, and low and variable precipitation. In addition, reclamation tactics and tools employed vary widely among operators and their efficacy across plant community and soil gradients has not been publicly demonstrated. The U.S. Geological Survey, Vernal Field Office of the Bureau of Land Management, and the U.S. Fish and Wildlife Service have initiated a series of replicated experiments across environmental gradients in the Uinta Basin, to generate information pertaining to what reclamation practices are effective and where. In 2018, the first study was installed in a mixed salt-desert plant community. We compared drill seeding to broadcast seeding over hummocked soil, crossed with an organic soil tackifier and an herbicide treatment. An additional smaller experiment at the same site compared a warm and dry climate-adapted seed mix to a cool & wet climate-adapted seed mix, crossed with several surface amendments: connectivity modifiers, mulch, pitting, and biochar. Data following the first growing season suggested that desirable plant establishment was favored in hummocked and broadcast seeded plots, and at the small scale by adding mulch or soil pits. The warm-dry seed mix performed better when no surface amendments were added. Three additional study sites will be installed in fall 2019, which will evaluate similar restoration tactics across additional plant community types (Wyoming big sagebrush, black sagebrush, and greasewood). This expanding network of studies will not only inform reclamation efforts in the Uinta Basin; it will provide valuable data for a wide range of restoration projects across arid rangelands in the western US.



Poster Session Tuesday 1: Poster Pod 37, Poster 56

A REVIEW OF OIL AND GAS RECLAMATION PRACTICES, MONITORING, AND STANDARDS; IMPROVING RECLAMATION SUCCESS ON WESTERN PUBLIC LANDS

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ABSTRACT

Reclamation of disturbed lands following oil and gas development in the western US is complicated by dry conditions, challenging soils, and heterogeneous landscapes. The objectives of the work described here are to improve success of oil and gas reclamation on these landscapes through: (1) an analysis of existing reclamation practices, monitoring protocols, and standards; (2) an assessment of scientific information on reclamation methods and their effectiveness; and (3) development of a technical reference to inform management or policy decisions. This work is being conducted in close collaboration with Department of Interior partners and other stakeholders to ensure project deliverables meet the needs of managers, policy makers, and the public. We report here preliminary results from our detailed review of scientific literature and agency documents on the topics of reclamation practices, monitoring techniques, and standards for determining bond release for Bureau of Land Management (BLM) permitted oil and gas activities. Our review of approximately 3000 peer reviewed articles and other reports, programmatic and planning documents, and interviews with agency staff revealed several important new insights, information gaps, and science needs. We report our initial, preliminary assessment here. First, among the many relevant studies reviewed, we often found it difficult to determine under what conditions specific study results would be applicable. Second, we found that planning documents and practitioner decisions tended to rely on local knowledge networks (peers, local experts, etc.) more than external information sources, such as the scientific literature. Third, results suggest there is variability in reclamation requirements among BLM management units (state and local offices) and energy projects--particularly how reclaimed condition monitoring is done and the standards by which bond release is determined. Next steps for this work include analysis of existing data structures, convening workshops, and development of a web-based annotated bibliography and decision support tools.



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MICROTOPOGRAPHY SELECTION FOR RESEEDING TECHNIQUES USING UAVS IN THE CHIHUAHUAN DESERT, BREWSTER COUNTY, TEXAS

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ABSTRACT: MS STUDENT

Understanding the fate of rainwater is critical in semi-arid and desertic systems, as water is most often the limiting factor in plant growth and distribution. Therefore, it is important to assess water availability (wetness index) in soils in a degraded state. Microtopography in the landscape can enhance germination and survival by providing soil moisture for longer periods. The goal of this project is to develop a model to select and determine microtopography using high-resolution imagery from an unmanned aerial vehicle (UAV) to then be used as potential seeding microsite, and; implement different reseeding techniques in microsites to establish native grasses in an area treated with Tebuthiuron. A high-resolution topographic map of the study area was created using a combination of low-level aerial photography (DJI Matrice 600) equipped with a multispectral camera (MicaSense RedEdge-M Camera). Flights were designed using Drone Deploy at 60.96 m with a 75% overlap. Images were processed using Agisoft Software to then obtain a digital elevation model (DEM) and an Orthoimage of the study area. To determine wetness index values and select microtopography locations, the DEM was analyzed using TauDEM (Terrain Analysis Using Digital Elevation Model) toolbox in ArcGIS. Microsite points were then ground-truthed to calibrate the model and determine its success. The results of this study will not only depict a detailed analysis of soil surface characteristics, but also a better understanding of the flow of water and deposition of sediments. This will help model which microsites are best suited for reseeding and will improve the probability of seed germination.



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RESTORATION OF NATIVE GRASSES ON ABANDONED CENTER PIVOTS IN SANDY SAGE PRAIRIE OF SOUTHWEST KANSAS

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ABSTRACT: MS STUDENT

Thousands of acres of native sand sage prairie in Southwest Kansas have been converted to croplands. Due to low precipitation and arid conditions, much of these croplands are irrigated by center pivots irrigation systems fed by underground aquifers. Many of these aquifers have reached levels too low for irrigation and the fields are abandoned. These lands eventually become eroded and form large moving sand dunes. Programs like the Conservation Reserve Enhancement Program (CREP) have struggled in restoring native grasslands in abandoned croplands of this area using current protocols. Determining causes for these struggles may help in restoring grasslands in the region. Possible reasons for this lack of success may have to do with water use, soil temperature and larvae insect infestation. Providing moist soil may create more suitable conditions for seed germination. Soil temperature above 65°F may also increase germination, supporting the notion that sowing is currently being done too early. Spraying insecticides a day before planting may protect new seedlings from predation. Our objective is to compare current procedures employed by CREP to new methods currently showing promise at small scales to determine if these new methods are more effective in restoration of this important ecosystem and the wildlife that use it.



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MEZAVUE™ HERBICIDE: THE NEW STANDARD IN PRICKLYPEAR CONTROL AND SO MUCH MORE

D CHAD Cummings*¹, Charles Hart², James R. Jackson³, Morgan L. Russell-Treadwell⁴, Byron Sleugh⁵; ¹Corteva Agriscience, Bonham, TX, ²Corteva Agrisciences, Abilene, TX, ³Texas A & M AgriLife Extension Service, Stephenville, TX, ⁴Texas A&M AgriLife Extension Service, San Angelo, TX, ⁵Corteva Agriscience, Indianapolis, IN

ABSTRACT

MezaVue™ herbicide is a new tool for rangeland managers in the southern US. MezaVue combines three active ingredients to bring unprecedented performance on pricklypear (*Opuntia* spp.). Its superior formulation provides faster pricklypear activity, increased uptake and faster kill than picloram alone, amazing individual plant treatment results and more consistent results in IPT, ground broadcast, and aerial broadcast applications. MezaVue has improved oak tolerance, lower use rate, lower odor, and better value than current industry standards for pricklypear control. In addition to pricklypear control in the southwestern US, MezaVue also controls a wide range of invasive and encroaching woody brush, including old man's beard (*Clematis* spp.), Queen's delight (*Stillingia texana*), broom snakeweed (*Gutierrezia sarothrae*), multiflora rose (*Rosa* spp.), and blackberry (*Rubus* spp.). Foliar individual plant treatment applications (MezaVue 1.0% v/v + MSO 1.0% v/v) control a many additional brush species, including but not limited to callery pear (*Pyrus calleryana*), ailanthus (*Ailanthus* spp.), scotch broom (*Cytisus scoparius*) and retama (*Parkinsonia aculeta*). MezaVue herbicide is the new standard in pricklypear control, but also provides excellent control of additional brush species across the southern US, giving land managers a new tool in the battle against encroaching brush.



Poster Session Tuesday 1: Poster Pod 38, Poster 62

HOTSPOTS FOR POST-FIRE SAGEBRUSH RECOVERY: BURNED AND SURVIVING INDIVIDUALS PLAY A ROLE

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ABSTRACT

Improving the success of post-wildfire sagebrush restoration treatments is important for habitat conservation. Past work suggests that one-year post-wildfire, sagebrush seedling establishment may be enhanced in microsites where mature sagebrush canopies burned and subsequently left behind a “fertile island”- an area of unique soil characteristics that may facilitate sagebrush establishment and inhibit invasive annuals. Further research suggests that post-treatment sagebrush populations, composed of predominantly young individuals with low survival and fecundity, are vulnerable to extirpation through a process called transient population dynamics. Conceivably, the presence of larger, fire-surviving, remnant individuals may lessen the likelihood of transient dynamic-based declines or extirpations. We sought to determine the importance of fertile island microsites and remnant individuals to sagebrush populations 1-2 years post-fire. Preliminary results from 469 plots in sites across the Great Basin suggest several important trends. First, sagebrush seedlings were uncommon, with none detected in 58% of plots. Seeded individuals were even less common. Second, remnant individuals may be important, as they were detected in 21% of plots and 49% of plots with seedlings had at least one remnant individual. Third, fertile islands were the most important microsite for sagebrush establishment, with 65% of seeded individuals being detected in these locations, a value 3.4 times greater than the next greatest microsite type (plant interspaces) despite fertile islands representing far less area than other microsite types. Finally, sagebrush was more likely to establish in locations with both remnant individuals and fertile island microsites present. Thus, the extirpation of sagebrush from an area could have important, long-term implications for seeding success following future fires if there are no mature individuals to leave behind fertile islands or serve as remnant individuals. These preliminary findings could help guide where, and how, big sagebrush is seeded in the future.



Poster Session Tuesday 1: Poster Pod 38, Poster 63

BURNING, SEEDING, AND HERBICIDE PRODUCTIVENESS IN RELATION TO RANGELAND RESTORATION IN SOUTHEASTERN NORTH DAKOTA

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ABSTRACT: MS STUDENT

Rangelands in southeastern North Dakota often face invasion from Kentucky bluegrass (*Poa pratensis* L) and smooth brome (*Bromus inermis* Leyss). As a result of the competitive advantages of these two invasive species, native species may find increased difficulty reestablishing in rangelands. Few studies have been done that analyze the effectiveness of strategies focused on reducing competition from Kentucky bluegrass and/or smooth broom before seeding native species in southeastern North Dakota. In this study, the impacts of five restoration strategies: 1) control (no treatment used), 2) native seeds drilled into the existing conditions, 3) spring burn prior to drill seeding native species, 4) glyphosate treatment before drill seeding native species, and 5) spring burn with the addition of glyphosate both prior to drill seeding native species were used on a degraded rangeland landscape. The study site consisted of a divided pasture with one side exposed to grazing and the other side was left ungrazed. The five treatments were installed into 15 40 x 100 m plots per side of the pasture for a total of 30 plots in 2010. In 2019, vegetation sampling within each plant was conducted to find if the restoration strategies increased total and/or native C4 grass biomass, reduced Kentucky bluegrass and/or smooth brome biomass, or increased grass species richness.



Poster Session Tuesday 1: Poster Pod 38, Poster 64

ESTABLISHMENT OF NATIVE PLANTS IN SALT-IMPACTED SOIL

Abigail P. Blanchard*, Lora B. Perkins; South Dakota State University, Brookings, SD

ABSTRACT: MS STUDENT

Worldwide, approximately 900 million hectares of land are estimated to be salt-impacted, with 10.6 million hectares in the northern Great Plains (NGP). Naturally occurring salinization results when rainfall moves salts in underlying marine sediments upward through the soil profile. After evaporation, salts remain in the root zone affecting plant germination and growth. Traditional methods to remediate salt-impacted soils, including tile drains and gypsum application, are effective in the irrigated soils of the Southwestern US but detrimental in the non-irrigated soils of the NGP. To combat this issue, new remediation methods are needed. This study investigates the revegetation of eight native plant species using transplanting and seeding, with two objectives assessed: 1) determine which native species are suitable for revegetation and 2) compare whether transplanting or seeding results in better field establishment. Species (four forb and four grass) were chosen based on germination ability in salty conditions. Prior to planting, vegetation was cleared and landscape fabric was placed on the 10 x 120 m plot. Further, mechanical scarification was assessed as a treatment to improve seed performance. Transplants, scarified seeds, and control seeds (n = 2016) were randomly planted throughout the plot. For transplants, mid-season and end of season performance were assessed from plant height, number of flowering heads, and survival. Mid-season survival was almost 50% across all species. *Sporobolus airoides* had the highest survival (81.1%) followed by *Elymus trachycaulus* (75.8%) and *Pascopyrum smithii* (75.4%). Of the forbs, only *Asclepias speciosa* and *Gaillardia aristata* had survival above 30%. *S. airoides* survival increased as salinity increased, making it unique among the species. Results from this study will provide information essential for the remediation of salt-impacted soils in the NGP.



Poster Session Tuesday 1: Poster Pod 38, Poster 65

BRUSH MANAGEMENT OF A WHITETHORN ACACIA-ENCROACHED GRASSLAND ENHANCES RESOURCE-CONSERVING 'SHRUB ISLANDS'

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ABSTRACT: MS STUDENT

We conducted an integrated suite of measurements to quantify the ecohydrologic impacts of chemical brush management (tebuthiuron) at a shrub-encroached grassland in southeastern Arizona. We addressed two questions: Did tebuthiuron application 1) affect hillslope runoff following high-intensity rainfall?, and 2) alter bare ground connectivity and the magnitude of runoff and sediment transport? Vegetation and soil measurements were conducted in 2018 on rainfall-simulated, small- (0.5 m², n=41) and overland flow-simulated, large- (13 m², n=13) plots in a whitethorn acacia (*Vachellia constricta*) community treated with tebuthiuron (0.84 kg/ha a.i.) in 2013 and on an adjacent untreated area. The treatment successfully decreased live-shrub cover by > 99% from the untreated control to the treatment, and, consequently, increased grass cover by 383%. Importantly, vegetation and hydrologic treatment effects differed by microsites. Grass cover on skeletal-shrub microsites (75%) far exceeded that on live-shrub microsites (12%); interspace grass cover responded less markedly to herbicide treatment (25%) vs. 0% on control. Cumulative runoff from skeletal-shrub microsites during 100 and 120 mm/hr simulated rainfall were 79% and 70% lower, respectively, on the treated site, whereas cumulative runoff from the zones between shrubs were statistically comparable between treatments. Although the basal gap size distribution shifted to shorter gap lengths, rill widths, depths, and velocity during overland flow simulations were statistically comparable. We did, however, measure significantly lower runoff/sediment yields on the treated site at the highest overland flow rate (40 L/min). Our findings suggest mortality induced by tebuthiuron enhanced herbaceous cover on 'shrub islands' that in turn increased their infiltration capacity. The asymmetric runoff/sediment yield response of shrub patches vs. interspaces on treated vs. control sites leads us to hypothesize spatial heterogeneity of hydrologic properties persisted even after recruitment of grass cover. These results indicate resource-conserving patches may be more resilient to certain ecological transitions than previously suspected.



Poster Session Tuesday 1: Poster Pod 38, Poster 66

RESPONSE OF ONE INTRODUCED AND THREE NATIVE SAGEBRUSH STEPPE PLANTS TO ARBUSCULAR MYCORRHIZAL FUNGI INOCULUM

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ABSTRACT: Ph. D STUDENT

Inoculation with arbuscular mycorrhizal fungi (AMF) has been recommended for rangeland restoration projects without complete understanding of the effects on individual species. To further characterize plant-mycorrhizal interactions, we evaluated the effect of a commercial AMF inoculum on a variety of plant morphological traits of *Artemisia arbuscula*, *A. nova*, *A. tridentata* ssp. *wyomingensis* and *Taeniatherum caput-medusae* during the first week's post-germination. Seedlings were harvested at 6 and 15 weeks after growing under greenhouse conditions using the following treatments: field soil (from a disturbed sagebrush grassland), inoculated field soil, inoculated autoclaved field soil, and autoclaved field soil as control. We hypothesized that mycorrhizal colonization and plant biomass will increase with the application of the commercial inoculum for plants grown in the disturbed field soil. The effects of different treatments were analyzed using a factorial ANOVA and a Tukey's Test post-hoc analysis. Application of the commercial inoculum did not significantly increase the percentage of mycorrhizal colonization after 6 weeks, as colonization was higher in plants grown in uninoculated field soil than under all other treatments. Total plant biomass of *A. nova* (harvested at six weeks) and *T. caput-medusae* (harvested at fifteen weeks) was greater when grown in inoculated autoclaved soil compared with all other treatments. Total biomass of *A. arbuscula* and *A. tridentata* ssp. *wyomingensis* was greater for plants grown in autoclaved soil without inoculation at six and fifteen weeks compared with all other treatments. Root biomass was greater for all species in autoclaved soil without inoculation compared with all other treatments. Our results suggest that the commercial mycorrhizal inoculum is not effective at the 6-week period for the species tested under greenhouse conditions in the soils used. The commercial inoculum may require additional time and/or more mature plants to be effective.



Poster Session Tuesday 1: Poster Pod 39, Poster 67

PERCEPTIONS OF WILD HORSE AND BURRO MANAGEMENT ON PUBLIC LANDS OF WESTERN US

Marissa N. Humphreys*; Oregon State University, Milwaukee, WI

ABSTRACT: MS STUDENT

For thousands of years horses have roamed the planet and while they evolved in North America, around 10-14,000 years ago they went extinct, and it wasn't until about 500 years that they returned to North America. In 1971 The Wild Free-Roaming Horse and Burro Act was signed and since then the management of free-roaming horses and burros has been a controversial topic and their management has been an uphill battle for the federal agencies that are tasked managing the almost 82,000 animals that are currently on the range and the 40,000 plus animals that are in off-range holding facilities. The federal agencies only have so many resources and tools that they can use to manage the wild horse and burros. However, often times their management practices are slowed or even stopped by advocacy groups and other stakeholders. Why though? Why are these groups pushing back against the federal agencies who are trying to manage and protect the wild free-roaming horses and burros? This project begins to explore the answer to this question by surveying advocacy groups, rescue organizations and stakeholders, and in turn hopes to provide insights and recommendations to management agencies in regards to outreach about the wild horse and burro program and the issues at hand.



Poster Session Tuesday 1: Poster Pod 39, Poster 68

EXAMINING THE EFFECTS OF MAMMALIAN HERBIVORES ON RECRUITMENT AND STAND STRUCTURE OF QUAKING ASPEN

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ABSTRACT: MS STUDENT

Quaking aspen (*Populus tremuloides*) stands support exceptionally diverse and productive understory plant communities and provide habitat for an array of wildlife species. Unfortunately, this ecologically and economically significant tree species is thought to have declined in many parts of its range in recent decades, due to both adult mortality and reductions in recruitment. Numerous site-specific studies have implicated browsing of young shoots by wild and domestic ungulates as important drivers of the reductions in aspen recruitment. However, few studies have examined the effect of mammalian herbivores on aspen recruitment across large spatial scales, where the abundance, distribution, and species of mammalian herbivores can vary strongly due to contrasting environmental conditions and management practices. We are examining the extent and severity of mammalian herbivory on aspen recruitment using a large and spatially expansive network of aspen monitoring plots in California, Nevada, Idaho, Wyoming, and Utah. Using data from the plot network we are evaluating (1) what topoclimatic, biotic, or management factors predict the severity of mammalian herbivory on aspen recruitment, (2) whether the effect of browsing by mammalian herbivores varies among juvenile trees of different size classes, and (3) whether browsing by wild and domestic ungulates is a major driver of the overall health and structure of aspen stands. This work will allow land managers to more effectively identify the conditions under which aspen may be particularly sensitive to mammalian herbivory and may require wild ungulate and/or livestock exclusion to successfully recruit the next generation of trees. Furthermore, because evidence that ungulates may drive reductions in recruitment is not a unique situation to aspen, this research will have broader implications for informing management decisions and future research in a variety of woody species that are critically important to wildlife.



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MESIC MEADOW HABITAT RESPONSES TO VARIATION IN GRAZING MANAGEMENT: BALANCING SAGE-GROUSE HABITAT WITH LIVESTOCK PRODUCTION

Kenneth J. Randall*¹, Melinda J. Ellison², Tracey N. Johnson¹; ¹University of Idaho, Moscow, ID, ²University of Idaho, Carmen, ID

ABSTRACT: MS STUDENT

Mesic meadows found in sagebrush-steppe provide a unique set of resources for wildlife habitat and livestock production. Greater sage-grouse (*Centrocercus urophasianus*, hereafter, sage-grouse), an Idaho Species of Greatest Conservation Need, rely upon these habitats during brood-rearing because they support diverse communities of forbs, an essential part of juvenile sage-grouse diets. Livestock grazing activities on mesic meadow plant communities and soils may elicit direct or indirect effects on sage-grouse populations reliant upon these communities. Understanding how livestock grazing influences key habitat features of sage-grouse brood-rearing habitat will help inform management decisions on rangelands that provide wildlife habitat and livestock production within mesic meadows. We evaluated effects of variation in intensity and timing of livestock grazing in mesic meadows on sage-grouse brood-rearing habitat. We established 15 pastures at Rinker Rock Creek Ranch in south-central Idaho and stocked them with yearling heifers to evaluate effects of short-duration grazing. We evaluated moderate (30-40%) and high (70-80%) grazing utilization in six pastures in June (16 days) and six pastures in August (16 days) (n = 3 pastures per treatment; n = 12 total). Three pastures provided controls without grazing. We measured heifer performance and plant communities before grazing (< 6 days), after (< 6 days) grazing, and at the end of September to assess vegetation regrowth. We measured heifer body weight to evaluate changes in gain across grazing treatments. We measured vegetation composition, foliar cover, the average height of vegetation by species, biomass, and soil moisture and will compare among our experimental treatments and against other sites where livestock grazing was unrestricted during the growing season. Analyses of these data will provide greater insight into the relationship between livestock grazing and food resources for sage-grouse brood-rearing. Results may be used to guide future best management practices for livestock producers utilizing mesic meadows shared with sage-grouse.



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RESPONSE OF SAGEBRUSH HABITAT CHARACTERISTICS TO FERAL HORSE GRAZING

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ABSTRACT: Ph. D STUDENT

Following the extinction of native equid species in North America during the Pleistocene, shrubland communities existed in absence of large mammalian grazers for roughly 10 millennia. Shrublands evolved with less grazing pressure compared to grassland and savannah systems and therefore may be more susceptible to damage from introduced large grazers such as feral horses (*Equus ferus caballus*) and cattle (*Bos spp.*) Compared to cattle, feral horses are relatively unmanaged in the United States and little is known about how these animals impact fragile sagebrush (*Artemisia spp.*) systems. Sagebrush habitat is crucial to native wildlife species such as pronghorn (*Antilocapra americana*), mule deer (*Odocoileus hemionus*), and greater sage-grouse (*Centrocercus urophasianus*; hereafter ‘sage-grouse’) to fulfill the food and cover requirements of these iconic species in many areas of western North America. High utilization by horses is thought to decrease sagebrush habitat quality through two mechanisms: 1) grazing that may in turn decrease native vegetation cover and height, and 2) trampling that may increase shrub fragmentation and soil penetration resistance. For sage-grouse, these impacts can translate to decreased nesting habitat, escape cover, and forage availability. Empirical examination of how feral horses affect sage-grouse habitat is lacking; however, these evaluations are crucial as the sage-grouse is an imperiled species that has been petitioned for endangered species listing under the U.S. Endangered Species Act of 1971. We set out to address this knowledge gap by measuring a suite of sagebrush habitat characteristics along a gradient of horse utilization within the Adobe Town Herd Management Area in southern Wyoming, USA in summers 2017-2019. We used spatial regression models to examine the effects of horse utilization on canopy cover of plant functional groups, grass height, and visual obstruction. Increased horse utilization was significantly correlated with increased bare ground cover; however, horse use was not significantly correlated other measured metrics. Our results show that horse utilization may have deleterious impacts on soil health, which may impact the vegetation community in the long-term.



Poster Session Tuesday 1: Poster Pod 39, Poster 71

DETERMINATION OF SPECIES AND SEX IN DEER VIA NEAR INFRARED SPECTROSCOPY OF LIVER TISSUE

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ABSTRACT

Near infrared reflectance spectroscopy (NIRS) has been used to determine a variety of chemical characteristics in multiple biological materials but has not been applied to a significant extent in animal tissues. Our objective was to determine the ability of NIRS of liver tissue to discriminate between species and sex in sympatric white-tailed (*Odocoileus virginianus*) and axis (*Axis axis*) deer at the Texas A&M AgriLife Sonora Research Station. During the regular Texas deer hunting season (November) of 2016, 2017, and 2018, liver samples (caudate lobe) were collected at harvest from a total of 87 animals. Samples were stored in whirl-pac bags at -20°C and later thawed to ~24°C for NIRS analysis. Spectra (400-2500 nm) were obtained on liver tissue with an ASD Field Spec using a contact probe directly through the whirl-pac sample bag. Principal component, linear discriminant analysis, and chi-square procedures were accomplished in SAS. Within 62 white-tailed deer samples, 17/22 females (77%) and 32/40 males (80%) were correctly identified. Within 63 male deer samples, 15/23 axis deer (65%) 26/40 white-tailed deer (65%) were correctly identified. When 63 male deer samples were randomly allocated to 2 groups, percent successfully identified was 10/30 for group 1 (33%) and 14/33 for group 2 (42%). There were no differences in the proportion of correct versus incorrect identifications for any of the above comparisons. Prediction of an independent validation set of adult white-tailed deer samples (n = 9 male, 9 female) resulted in 100% correct identification of species but all samples were identified as male. Preliminary results indicate that NIRS of liver tissue was successful in discriminating between species and sex in sympatric white-tailed and axis deer within a given location. Portable NIRS analysis of liver tissue may be useful as a post-mortem diagnostic technique. Further research will explore this capability.



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Poster Session Tuesday 1: Poster Pod 40, Poster 73

DISRUPTION OR DISPLACEMENT: HOW DO LIVESTOCK GUARDIAN DOGS PREVENT DEPREDATION?

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ABSTRACT

Rangeland livestock operations are increasingly turning to livestock guardian dogs (LGD) to protect their herds from predators. At the same time, laws and regulations that protect predators (especially gray wolves, mountain lions, and grizzly bears) limit lethal control options for ranchers. Despite the increasing use of LGD, very little is known about the direct interactions of LGD with predators. Furthermore, little is known about the relationship between LGD and livestock behavior. Some ranchers have expressed concerns that LGD may push predators onto adjacent ranches or grazing allotments. Some wildlife agencies and environmental nonprofit organizations are concerned that LGD may impact non-target wildlife. Previous work suggests that LGD can 1) discern between threatening and nonthreatening wildlife and 2) disrupt predator behavior rather than physically displace predators to adjacent lands. We are using low-cost geographic position system (GPS) technologies, trail cameras, wildlife surveys, and structured interviews with herders and sheep operators, to evaluate LGD behavior and their interactions with predator and non-predator wildlife on a variety of rangeland production systems. In addition, we are examining the effects of breed, sex, age, and reproductive status on LGD behavior. Our preliminary results suggest that predator response to LGD (disruption versus displacement) depends on a variety of factors, including sheep management (fenced versus herded). The next step in this project will use GPS tracking to examine the spatial relationships between LGD and sheep in different landscapes and production systems, including open-range herded sheep on public land grazing allotments in the Sierra Nevada mountains, fenced sheep on annual rangelands and irrigated pastures in the Sierra foothills, and fenced sheep in short grass prairie pastures in central New Mexico.



Poster Session Tuesday 1: Poster Pod 40, Poster 74

RARAMURI CRIOLLO CATTLE AS LIVESTOCK GUARDIAN AGAINST PREDATORS

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ABSTRACT: MS STUDENT

As the human population in Florida expands alongside a recovering endangered panther population, interactions between the two are increasing. Habitat necessary for continued panther recovery is mostly held by either agricultural or livestock producers and negative interactions will largely affect livestock producers in the form of depredations. There is anecdotal evidence in Colombia that San Martinero cattle integration in beef herds decreases calf depredations by jaguars, yet few studies have been conducted on this topic. We have integrated 11 Raramuri Criollo, a closely related cattle breed, with commercial beef cattle in order to assess their ability to deter negative interactions with predators in south Florida during calving in September through January. In order to capture differences in cattle behavior in the presence of a predator, we deployed a total of 20 GPS collars on Raramuri cattle and commercial beef cows that collect location at 10-minute fixes and record activity levels, in a herd of 91 cattle on 358 acres. Predator presence is monitored by a 375m grid game camera array throughout the pasture/rangeland and will also serve to examine predator avoidance of Raramuri Criollo cattle compared to commercial beef cattle. We identify if there is potential for Raramuri Criollo cattle to serve as guardian cattle for beef herds and discuss their impact on future panther conservation.



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MESOCARNIVORE OCCUPANCY IN A SAGEBRUSH-JUNIPER LANDSCAPE AND ASSOCIATED EFFECTS ON GREATER SAGE-GROUSE NEST FAILURE

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ABSTRACT: MS STUDENT

Greater sage-grouse (*Centrocercus urophasianus*, hereafter, sage-grouse) have experienced population declines and habitat loss since European settlement. Expansion of juniper trees into sagebrush steppe habitat is cited as a factor affecting population dynamics. In addition to affecting sage-grouse directly, the presence of juniper and resulting changes in landscape composition and structure may influence activity or abundance of sage-grouse predators, but little if any information exists on how the mesocarnivore (e.g., coyotes [*Canis latrans*], red foxes [*Vulpes vulpes*], and American badgers [*Taxidea taxus*]) community uses juniper-encroached landscapes. Our objectives are to 1) examine whether juniper cover is an important environmental gradient that affects mesocarnivore occupancy and 2) evaluate whether sage-grouse nests in juniper-encroached habitats are at a higher risk of being preyed on by mesocarnivores. From 2016-2019 we monitored sage-grouse nests (n=54) in the Owyhee mountains in southwestern Idaho and placed continuously recording DVR video cameras on a subset of nests (n=27) to determine nesting success and identify nest predators. In 2019 we deployed trail cameras (n= 80) throughout our study site from April–August across a gradient of juniper cover to determine occupancy rates of mesocarnivores. At sage-grouse nests we documented 30 depredation events, six of which we could identify predator species using video footage. Recorded depredation events were attributed to red foxes (n=5) and spotted skunk (*Spilogale gracilis*; n=1). Preliminary analyses of trail camera data indicated the presence of five species of mesocarnivores; coyote, red fox, striped skunk (*Mephitis mephitis*), bobcat (*Lynx rufus*), and American badger. We will present additional preliminary results from the mesocarnivore community. Understanding whether occupancy of mesocarnivores may be influenced by juniper will help inform management efforts aimed at increasing sage-grouse reproductive success and survival areas affected by juniper encroachment. Findings are preliminary and provided for timely best science.



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SMALL MAMMALS AND GRASSLAND RESTORATION: LONG TERM MONITORING OF THE STERNBERG NATURAL AREA

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ABSTRACT: UNDERGRADUATE STUDENT

The Howard Reynolds Natural Area has been under restoration efforts for multiple years. Restoration of grassland areas has been a major component of the efforts, and while this 20-acre project is not much in comparison to other grasslands, it is still an important piece of the conservation puzzle. Seeding of pollinator-plots, prescribed burning, and other projects have been conducted on the site. Restoration projects like this can have effects on many species of both flora and fauna. The objective of this study is to survey the impact that these restoration efforts are having on the small mammal community. Our study design consists of four trap nights per season with three seasons per year (May, September, and November). The study site contains five transects of 20 Sherman traps placed ~10m apart. Data collection started in the summer of 2016, and trends to date show that the diversity in the study area has been altered and populations have seen both increases and declines over time. Cotton rat (*Sigmodon hispidus*) has been a prominent component of the community from the outset but has changed over time. Numbers of harvest mice (*Reithrodontomys spp.*) and deer mice (*Peromyscus spp.*) have been notable in some years and minimal in others. Other species caught on the site include house mouse (*Mus musculus*), Elliot's short-tailed shrew (*Blarina hylophaga*), and prairie vole (*Microtus ochrogaster*). Our results indicate long term monitoring is required to truly assess the impacts of restoration on the small mammal community.



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LANDCART: LANDSCAPE COVER ANALYSIS AND REPORTING TOOLS

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ABSTRACT

Major challenges to conservation planning on western landscapes include (1) availability of relevant high-quality field data about habitat, (2) data coverage that allows interpolation and contextualization of field data, and (3) information on how habitats change through time. In addition, there is a need for (4) consistent and thorough monitoring and management of critical wildlife corridors. In response to these challenges, the Bureau of Land Management (BLM) initiated the Assessment, Inventory, and Monitoring program (AIM) which collects data on habitat indicators relevant to broad plant and animal conservation goals. The AIM project has, and will continue to produce, an unprecedented amount of data collected with consistent methods and a statistically valid sampling framework across the lands administered by the BLM. However, remote sensing can extend the spatial and temporal context of AIM field data, increasing its usefulness to BLM management decision processes. Here, we share a new web-tool to facilitate extrapolation of AIM measurements in time and space: Landscape Cover Analysis and Reporting Tools (LandCART; www.landcart.org). LandCART generates RandomForest prediction using AIM plot observations as training data, implemented in Google Earth Engine to create 30-m spatial resolution predictions of key AIM indicators along with uncertainty metrics. A web-based tool has been developed to facilitate use by BLM staff to make AIM indicator predictions on-the-fly at any location over various periods of time (14-day, monthly, seasonally, and annually). This tool also reports spatial and temporal uncertainty associated with predictions. Improvements underway for LandCART include a reporting function that will generate the documentation needed to apply LandCART to formal decision processes and analysis tools to evaluate differences between areas of interest and trends through time. The LandCART team of researchers and agency staff have developed the webtool collaboratively, working diligently to ensure the tool meets BLM needs and is scientifically robust.



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SAMPLE SIZE FOR ACCURATE ESTIMATION OF MEAN HERBAGE MASS IN CAMPOS GRASSLANDS

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ABSTRACT: MS STUDENT

Estimation of mean herbage mass in individual paddocks in grazing systems is important for livestock managers and researchers of various disciplines. The question at sampling from paddocks is the sample size (number of samples) required for accurate estimation of mean herbage mass. The answer to this question is influenced by a number of factors relating to population characteristics (e.g., population size [paddock area] and within-population variability), sampling methods (e.g., random or systematic) and accuracy of estimation (e.g. confidence level and allowable error). The aims of this study were to i) assess the sample size needed to accurately estimate the mean herbage mass and ii) evaluate the effect of paddock area and sampling density on sample size. We used a data set consisting of 273 occasions of herbage mass sampling conducted in 26 paddocks in five sites locating from south to north and northeastern Campos grasslands of Uruguay. Herbage mass sampling followed the standard field methodology of “comparative yield method”. The data were classified by heterogeneity and paddock size within heterogeneity to perform bootstrap for each sampling event to choose the lowest sample with highest confidence from $n = 50$ to $n = 400$. Herbage heterogeneity index in the paddocks ranged from a highest level of 2.5 to a lowest level of 0.04, with the majority (61%) in low heterogeneity (≥ 0.58). As herbage heterogeneity increased, sample size required for acceptable estimation accuracy increased, while paddock area appeared not to affect the sample size. Samples with confidence greater than 90% and less than 10% error of the mean ranged from 100, for less heterogeneous sampling events, to 400 for more heterogeneous scenarios. Under high heterogeneous scenarios of herbage mass, which also cover all the situations less heterogeneous, 400 biomass observations are required for paddocks up to 100 ha.



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DETERMINING APPROPRIATE UTILIZATION MEASUREMENTS FOR MULTISCALE SPATIAL ANALYSIS OF GREATER SAGE-GROUSE HABITAT IN SOUTHERN IDAHO

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ABSTRACT: MS STUDENT

Intensity and timing of cattle grazing can have diverse effects on rangeland vegetation structure and composition which can influence wildlife-livestock interactions. Yet, commonly implemented methods for measuring grazing use were not designed to provide data at broad spatial and temporal scales commensurate with landscape wildlife species such as Greater Sage-grouse (*Centrocercus urophasianus*). Understanding the strengths and limitations of these different methods with respect to their precision and scalability is fundamental to effective management of multiple-use landscapes. In 2012 the University of Idaho, U.S. Fish and Wildlife Service, Bureau of Land Management and others initiated a large-scale 10-year research project investigating the effects of spring cattle grazing on the demographic traits and habitat characteristics of Greater Sage-grouse. Wildlife and vegetation data were collected at 5 study sites in central and southern Idaho comprising more than 30,000 acres of rangeland. As part of that study, grazing utilization has been measured using 5 different methods concurrently, which represent commonly accepted and widely used protocols across rangelands in the west: landscape appearance, biomass clipping from utilization cages, vegetation height/weight, percent cover of grazed plants and ocular estimates of percent forage removed. This study looked at the correspondence between these 5 methods and compared their efficacy across different scales relevant to Greater Sage-grouse life cycles. Results indicate correlation between different methods varies across spatial and temporal scales and in some cases across environmental gradients. Main drivers of non-sampling error such as inter-observer bias varied with method selection. Creating hybrid indicators from combinations of methods proved useful in minimizing error and strengthening statistical inference. Spatial analysis of these measurements with cattle telemetry data may further improve our understanding of patterns of grazing intensity across the study area. These conclusions highlight the importance of selecting appropriate monitoring methods which can provide valuable information for sustainable multiple-resource management.



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LANDPKS APP FOR PLANNING AND MONITORING OUTCOME-BASED GRAZING: NEW FEATURES

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ABSTRACT

Outcome-based grazing requires (1) defining management objectives that are realistic, (2) developing and implementing a management system, and (3) monitoring results. The Land-Potential Knowledge System (LandPKS) can be used to easily and cost-effectively address the first and third requirements. The latest version includes a soil- and ecological-site identification function. This function can be used to define realistic management objectives based on both the long-term (ecological site), and current (ecological state) potential. Soil identification is based on location and improved with user inputs of soil texture (using a simple key) and color (using the phone's camera and a post-it note for calibration). A direct link provides full access to the ecological site description in EDIT. The vegetation monitoring tool is rapid (20 minutes/plot), requires only a yardstick and a pin flag, and generates the same indicators as those used by BLM in its AIM program (though at a lower level of precision). It will also include a new feature providing access to habitat information for selected species in some regions. Comparing this information with current data and the ecological site description can help decide whether it's realistic to manage for desired wildlife species. The new LandManagement module supports agronomic recordkeeping (including precipitation, tillage, fertilizer, weed control, etc.) which can also be used for planning and tracking restoration and remediation treatments. Finally, the new version includes a data privacy option. The LandPKS app is available on both iPhone and Android. More information is available at LandPotential.org.



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Poster Session Tuesday 1: Poster Pod 42, Poster 85

USING LIDAR TO ESTIMATE ABOVEGROUND GRASSLAND BIOMASS AND THE EFFECT OF GRAZING ON SPATIAL HETEROGENEITY

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ABSTRACT

There is a strong link between vegetation heterogeneity and biodiversity in grassland ecosystems. However, quantifying spatial patterns of key metrics, such as aboveground biomass, at landscape scales remains a challenge. This stems from difficulties in accurately estimating grassland biomass at fine scales over large areas and determining what spatial scale is most appropriate to monitor how grassland impacts (e.g., livestock grazing) affect spatial patterns of biomass (i.e., spatial heterogeneity). Here, we use lidar metrics (volume, max height, and intensity) in Random Forest models to quantify (pseudo $R^2=0.59$ and RMSD of 139.4 g m^{-2}) fine-resolution (pixel size 1.0668 m (3.5 ft)) aboveground biomass estimates across a bunchgrass prairie grassland system. To determine both the effects of grazing on the spatial heterogeneity of aboveground biomass and which pixel size is most sensitive to the effects of livestock grazing on grassland heterogeneity, we aggregated fine-resolution biomass maps to coarser pixel resolutions (3m , 5m , 8m , 20m , 30m) across 23 pastures with varying levels of grazing intensity. Following aggregation to coarser pixel resolutions, we observed that semivariogram models produced statistically different ($\alpha = 0.05$) measures of biomass heterogeneity. The range statistic was the only pasture-level semivariogram metric sensitive to grazing, and this relationship was only significant when using the finer-resolution datasets ($\sim 1\text{m}$ to 8m pixels). Our results demonstrate 1) the applicability of lidar data for quantifying biomass in short-statured grasslands, 2) that grazing in pacific northwest bunchgrass prairie can decrease spatial heterogeneity of aboveground biomass and 3) that fine-resolution satellite data ($<10 \text{ m}$ pixel sizes) are necessary to effectively monitor the effects of grazing on the spatial heterogeneity of vegetation biomass, an indirect metric of biodiversity at management scales (pasture sizes ranged from 40 to 745 ha) in this grassland ecosystem.



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IMPROVING A BRUSH MANAGEMENT ASSESSMENT TOOL USING DRONE TECHNOLOGY AND ENHANCED LANDSAT IMAGE PROCESSING

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ABSTRACT

Woody species (brush) removal as a conservation practice is used extensively across rangelands in the western United States. The USDA-Natural Resources Conservation Service (NRCS) Conservation Effects Assessment Project on Grazing Lands (CEAP-GL) is tasked with determining how effective the practice has been; however, land managers lack a cost-effective means to conduct these assessments at the necessary spatial and temporal scales. The use of remotely sensed data is key for such assessments. Thus, the Rangeland Brush Estimation Toolbox (RaBET) was developed through a collaborative effort between USDA-NRCS CEAP-GL and the USDA-Agricultural Research Service. RaBET estimates woody canopy cover in 30m resolution temporal maps covering Major Land Resource Area (MLRA) scale landscapes--thousands to millions of hectares--to aid planning and assessment of the conservation practice. These maps are currently produced using high resolution (0.6 - 1m) National Agriculture Imagery Program (NAIP) aerial photography and medium resolution (30m) Landsat satellite imagery. Unfortunately, in the arid and semi-arid southwestern US, the resolution of NAIP imagery is too coarse to capture fine-leaved shrubby species, and low reflectance signal from small leaf area is difficult to detect with Landsat imagery. Therefore, this study investigates the use of ultra-high resolution (< 1cm) small unmanned aerial system (sUAS, drone) photography as a replacement for NAIP and explores methods to improve Landsat detection of sparse vegetation for the creation of improved RaBET woody cover maps to aid land management.



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GAUGING FLORAL RESOURCES FOR POLLINATORS USING HIGH RESOLUTION DRONE IMAGERY

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ABSTRACT: MS STUDENT

Under the multiple-use management regime established in the United States for federally owned lands, government agencies have come under pressure from commercial apiaries to grant permits for the summer pasturing of honeybees on government lands. Federal agencies have struggled to integrate honeybees into their management plans and have little information to make regulations that resolve how many colonies should be allowed in a single location and at what distance sets of hives should be placed. Many conservation groups have voiced their concerns regarding the introduction of honeybees to these natural lands, as they may outcompete and displace native pollinating species. Assessing the quality of an area in regard to its floral resources, pollen and nectar, can be important when attempting to create regulations for the integration of commercial honeybee operations into a native ecosystem. Attempts are made in this study to determine flower cover using high resolution drone imagery to help assess the floral resource availability to pollinators in high elevation, tall forb communities. Roughly 700 images were captured at 23m above ground level using a drone equipped with a Sony QX1 RGB 20-megapixel camera. These images were stitched together using Pix4D resulting in a 60m diameter high-resolution mosaic of a tall forb meadow. Using the program ENVI, a supervised maximum likelihood classification was conducted to calculate the percentage of total flower cover and flower cover by color (blue, white, and yellow). A complete vegetation inventory was taken on site and the major flowers contributing to each color class were noted. An accuracy assessment was performed on the classification yielding an 89% overall accuracy and a Kappa Statistic of 0.855. With this level of accuracy, drones provide an affordable and time efficient method for the assessment of floral cover in large areas.



Poster Session Tuesday 1: Poster Pod 42, Poster 88

SPATIAL PREDICTION OF ECOSYSTEM STATE TRANSITIONS ON THE TAOS PLATEAU

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ABSTRACT: MS STUDENT

Land use, climate, and landscape context jointly determine the occurrence of state transitions in terrestrial ecosystems. State-and-transition models (STM) are used to clarify the roles of drivers, and ecological sites (climodaphic land units) represent the effects of landscape context. On the Taos Plateau in northern New Mexico, uncertainty about the patterns and drivers of vegetation state transitions impedes sustainable land management. The efficacy of restoration treatments is highly variable, likely due to unrecognized variation in climate and soils. Similar challenges are ubiquitous across terrestrial ecosystems and in particular landscapes with high spatial variability in soils. We used data from federal vegetation monitoring programs and spatial, environmental, and land use data to test for the role of climate, geomorphology, soils, and land use history on restoration success on the Taos Plateau. The large dataset comprises a suite of recently-established core monitoring methods that are consistent across agencies and provide scalable estimates of resource distribution and land change trends across the western U.S. We used a suite of multivariate methods to characterize vegetation states and their relationships to environmental variables to test propositions in conceptual STMs. Preliminary analysis verified the ecological site concepts which were hypothesized for the study area. Plant functional group abundance and vegetation structure varied within ecological site based on management history, indicating that multiple vegetation states are present on the landscape and correlated with land use legacies. Differences in state changes across gradients of land use and management history inform the relative resilience of sites a spatial context. A workflow for using multivariate analysis of core methods data to inform ecological site and STM concept development, and the spatial prediction of states, is presented for use in other study areas.



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UBETUBES: A NEW RUNOFF MONITORING METHODOLOGY FOR RANGELANDS

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ABSTRACT: Ph. D STUDENT

Runoff and erosion rates are key indicators of rangeland health, where highly variable vegetation and soil patterns drive complex hillslope hydrologic processes. Currently, rainfall simulations are used to quantify hillslope runoff and erosion models, which help land managers predict runoff and erosion potential. Rainfall simulations allow for the controlled application of precipitation and measurement of the related runoff across variable landscapes but are typically time and resource intensive. Furthermore, although rainfall simulation data are readily available, measurements of hillslope runoff and erosion from actual weather events are quite limited. To address the high cost of rainfall simulations and the lack of measurements from real events, a low-cost, passive runoff monitoring methodology was evaluated for use on rangelands. We assessed this methodology utilizing “Upwelling Bernoulli Tubes” (UBeTubes) in a controlled setting to determine its potential for rangeland use. Specifically, we evaluated whether the technology was robust to high sediment concentrations typical of rangelands. Our testing coupled traditional flow measurements with those provided by the UBeTubes to evaluate efficacy under a variety of conditions expected during runoff events. Testing employed three phases and began with clean water trials, followed by water preloaded with sediment, and concluded with overland flow across a simulated hillslope. We compared measurements from both traditional methods and the UBeTubes to assess accuracy and precision. The preliminary results of the comparisons suggest that this methodology could be effective on rangelands with slight modification of the UBeTube design. We plan to expand the UBeTube testing through a small field deployment followed by an expanded deployment across multiple ecosystems. Overall, the data collected from this passive runoff monitoring methodology could potentially be used to inform continuing modeling efforts and also provide a low-cost alternative to evaluate land management decisions in the context of runoff and erosion processes.



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NUTRITIONAL DIFFERENCES OF PRONGHORN-PREFERRED FORAGE AND A CARRYING CAPACITY ESTIMATION BETWEEN THE MARATHON AND MARFA GRASSLANDS IN TRANS-PECOS, TEXAS

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ABSTRACT: UNDERGRADUATE STUDENT

Forbs play an essential role in the diet of pronghorn (*Antilocapra americana*) due to their higher nutritional value compared to other forages (i.e. grasses and browse). In the Trans-Pecos region of Texas, forbs comprise approximately 80% of pronghorns' forage intake. The objective of this project was to evaluate if a difference exists in the nutritional value of forbs of the same species from two different pronghorn restoration areas, the Marathon Basin and Marfa Northwest. Vegetation plots (1m²) were sampled in Marathon ($n = 50$) and Marfa ($n = 125$) during January 2019, the Cold/Dry season which is believed to be one of the most nutritionally limiting time periods of the year. These plots were located across ~21,000 ha in the Marathon Basin and ~84,000 ha in the Marfa Northwest. For this study, only forb species found in both areas ($n = 19$) were used in the comparison. After collection, the samples were dried and weighed to calculate dry matter then ground and tested for acid detergent fiber, neutral detergent fiber, and protein. The data was analyzed using an independent samples t-test to individualistically compare these three values between the species from the two restoration areas. Knowing if there is a difference in nutritional value of forb species between the two areas will help determine if one region could sustain a higher pronghorn density than the other, which may be used by Texas Parks and Wildlife Department and stakeholders as part of pronghorn restoration efforts in the Trans-Pecos.



Poster Session Tuesday 1: Poster Pod 43, Poster 91

A SYNTHETIC-CONTROL APPROACH FOR ASSESSING LANDSCAPE TREATMENT EFFECTIVENESS: PINYON-JUNIPER THINNING IN WESTERN DRYLANDS

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ABSTRACT

In Western drylands, pinyon-Juniper woodlands are often cleared or thinned to improve a number of ecosystem services including livestock forage (herbaceous cover), sage-grouse habitat (sagebrush cover), and erosion reduction (reduction in bare ground cover). However, the efficacy of these large-scale treatments is seldom quantified at scale, and beneficial effects likely vary widely depending on soil and environmental setting and recent weather. Indeed, some benefits may be only temporary if treatments are on undesirable ecological trajectories. The many instances of pinyon-juniper treatments in the past three decades are thus examples of large-scale natural experiments which cumulatively may yield important ecological and management insights but suffer from insufficient monitoring data and analytical challenges related to lack of replication, randomization, and the availability of a priori controls. Analysis of such large-scale, natural experiments are common in the health and econometrics literature, where relatively sophisticated techniques have been developed to address inherent experimental limitations. Here, we apply a relatively recent technique from this literature, synthetic control, to the assess ecological trajectories of pinyon-juniper woodland thinning, as assessed by remote sensing data. We find that success varies depending on intended outcome (cover of sage, forage or bare ground), climate, and topo-edaphic properties. We also compare outcomes estimated by synthetic control to more simple comparisons and find that the synthetic control method is more robust to sources of confounding noise related to inter-annual variability and satellite imagery.



Poster Session Tuesday 1: Poster Pod 43, Poster 92

A WEB INTERFACE FOR CREATING RANDOM, SPATIALLY BALANCED LANDSCAPE MONITORING DESIGNS

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ABSTRACT

In the monitoring and assessment of landscapes, randomly located sampling plots are often used to minimize sampling bias and enable inference to larger landscape units. In particular, spatially balanced random designs are more robust to spatial autocorrelation and therefore produce data usable for answering multiple management questions. The Generalized Random Tessellation Stratified (GRTS) approach is one technique for creating spatially balanced random designs in natural resources and has been widely adopted by multi-scale terrestrial and aquatic monitoring programs. While the parameters for a GRTS design are relatively simple to specify with stratification polygons and per-stratum sample sizes, generating a design from those inputs has historically required the ability to code using the R package *spsurvey*. As a result, technical skills have been a bottleneck for this statistical approach in resource monitoring programs. To remove this technological barrier, we have developed a web application, the “Balanced Design Tool”, to create GRTS designs through a graphical interface. The tool prompts users to upload polygons describing their study area and stratification then to specify the number of points to draw per stratum before generating a spatially balanced design. Version 1.5, released in October 2019, added significant functionality. The point allocation process now supports three different approaches (manual, proportional by stratum area, and equally by stratum) through a more user-friendly interface. Users can now use an interactive, webmap to evaluate their designs without needing mapping software (*e.g.* ArcGIS). The final downloaded design now includes all the files (including an R script) to recreate the design and design documentation. With this tool, land managers can now create their own reproducible, spatially balanced designs to develop locally appropriate, statistically valid monitoring programs to suit a wide variety of objectives.



Poster Session Tuesday 1: Poster Pod 43, Poster 93

NDVI RELATIONSHIP OF DEPTH TO GROUNDWATER AND PRECIPITATION IN A MESIC PASTURE AREA

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ABSTRACT

Depth to groundwater is highly influential on plant community composition and production and can be indicative of vegetative potential for a given land unit. In 2013, 31 ground water wells were installed to monitor depth to groundwater across the recently acquired BLM land historically comprising Winters Ranch, a portion of the Washoe Valley in western Nevada. Hourly depth to water measurements were recorded since installation of the wells. The location and number of the wells across the valley allows for accurate interpolation of groundwater surfaces across the study area utilizing Kriging and other spatial interpolation methods. Ground water surfaces were interpolated across the study area and related to annual climactic trends. Landsat-8 imagery was gathered since time of its launch in 2013 and images captured during June of each year were assessed using several spectral indices. The Normalized Difference Vegetation Index, or NDVI is a common remote sensing method for assessing plant vigor and cover. Averaging June NDVI values across the study area and comparing depth to groundwater as averaged across the water year and across wells provided a strong Pearson's correlation coefficient ($r = 0.88$). Correlation between pixel values at a given well and depth to groundwater averaged across the year also provided a positive relationship an average correlation coefficient ($r = 0.65$), but only while depth to groundwater was deeper than 1 meter. June NDVI also provided a strong relationship with annual precipitation ($r = 0.74$). Given known baseline values, NDVI derived from imagery captured in June can be utilized to quickly and accurately assess depth to groundwater for non-wetland mesic areas. An assessment of scale of inference and NDVI relationships to groundwater are presented here.



Poster Session Tuesday 1: Poster Pod 43, Poster 94

SEMI-AUTOMATED TREE SEGMENTATION AND QUANTITATIVE STRUCTURE MODELS OF TREES FROM TERRESTRIAL LASER SCANNING POINT CLOUDS IN MIOMBO WOODLANDS OF THE NIASSA NATIONAL RESERVE, MOZAMBIQUE

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ABSTRACT: Ph. D STUDENT

Participation in the United Nations Program for Reducing Emissions from Deforestation and Forest Degradation (REDD+) requires nations to monitor, report and verify changes in carbon stocks over time. In this study, we aimed to develop a semi-automated methodology for processing terrestrial laser scanning (TLS) derived point clouds. This non-destructive methodology may be used to improve carbon stock estimates and better capture changes in miombo woodlands in Niassa National Reserve, Mozambique due to disturbances such as fire, elephant grazing, and agricultural land use. Fourteen permanent 30-m diameter forest stands, that were established in 2004, were scanned during field data collection in 2015 using a Faro 3D 330x TLS. After scan registrations and denoising of the point cloud data, stem cylinders were built and diameter-at-breast height computed from the stem cylinders. Individual trees were segmented into individual point clouds using SimpleTree and then tree heights were calculated from the segmented point clouds. Quantitative Structure Models (QSMs) were computed using SimpleTree to estimate tree volume. QSM processing time ranged from two hours to 48 hours depending upon complexity of the model and the processors used. With improvements to this methodology, repeated TLS measures on the same plots should allow researchers to better track changes in carbon stocks over time.



Poster Session Tuesday 1: Poster Pod 43, Poster 95

MONITORING ACCURACY: GETTING THE RIGHT INDICATORS, IN THE RIGHT PLACES, AT THE RIGHT SCALE

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ABSTRACT

Correctly assessing whether rangeland ecosystem services are stable, improving, or degrading is of global importance. In the USA, several plant and soil properties are routinely measured as part of a standardized system for assessing rangeland health. Here we evaluate the effectiveness of several plant and soil properties as indicators of soil water transport in the Northern Great Plains. First, we tested whether appreciable variation in soil water transport (infiltration) was explained by soil (e.g. soil aggregate stability, % soil carbon) and plant properties (i.e. total biomass and composition). Second, we used a meta-analysis to test the generality of the expected positive aggregate-infiltration association. Multiple regression analyses determined that variation in infiltration was best explained by plant community composition variables but not soil properties. Specifically, infiltration was positively correlated with the cover of a tap rooted forb (*Tragopogon dubius*) and negatively correlated with the cover of a fibrous- and shallow-rooted grass (*Bouteloua gracilis*). With a meta-analysis of these and other data from the Northern Great Plains, we found no general aggregate-infiltration association. Our findings counter prevailing scientific and management expectations on the functioning of key range health indicators. Meaningful indicators of soil water transport seemingly fall into two distinct classes. Bare-ground and/or litter cover are likely to explain the largest amount of variation in soil water transport ($r^2 = 0.83-0.99$). Significant albeit lower levels of variation may also be explained by the cover of key plant species ($r^2 = 0.13-0.18$) and plant biomass. We predict that soil infiltration is likely highest at sites with high levels of litter, tap rooted forbs, and plant biomass and low levels of bare ground and cover by shallow- and fibrous-rooted grasses. To maximize predictive accuracy, rangeland health assessment systems should be tailored to individual rangeland types (e.g. ecosites).



Poster Session Tuesday 1: Poster Pod 43, Poster 96

US NATIONAL VEGETATION CLASSIFICATION (NVC) - COMMUNICATION TOOL FOR ECOLOGICAL SITE WORK

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ABSTRACT

E.W. Tisdale, SRM President, estimated there were 928 million acres of rangeland/native grazing lands in the United States in 1957. Presently, only 746 million acres remain (NRI 2015). This disappearing resource is the subject of many ecological, social services, and economic studies that require repeatable and understandable tools of inventory. The U.S. National Vegetation Classification (NVC) is a canopy-based protocol for describing the physiognomy of plant community phases within a confined area of interest. This vegetation description can help communications across boundaries of ownership, interest groups, and agencies. OMB Circular No. A-16 encourages Federal Agency employees to use/crosswalk to the NVC. The NVC Ecological Site Description opportunity makes uncommon plant assemblages easier to describe for then delineated state and transition model (STM) purposes. Generally, there will be many NVC associations that will be grouped within one Ecological Site's STM. This is important for phase-one of Ecological Site concept development within a defined area of interest. Phase-2 would begin collecting production (lbs./ac./yr.) by species and functional groups for the plant associations assigned to the ESD. Photo interpreters may also be interested in a specific photo-signature of aerial photos since canopy is used for remote sensing and map delineation.



Poster Session Tuesday 1: Poster Pod 44, Poster 97

RECONCILING SAGE GROUSE HABITAT MONITORING OUTCOMES

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ABSTRACT

Sage-grouse are being used as an umbrella species to manage for over 350 plant and animal species that also depend on sagebrush communities. Identifying minimum habitat requirements is particularly relevant and establishes thresholds that carry implications to Sage-grouse management. The Utah Greater Sage-Grouse Approved Resource Management Plan Amendment (ARMPA) has set habitat objectives for the Greater Sage-grouse. These objectives are illustrated as thresholds of cover for vegetation functional groups that are 'desired' by Sage-grouse. The thresholds were developed using standard Sage-grouse habitat monitoring methods, Line intercept (LI) used to address shrub cover, and modified Daubenmire for herbaceous cover. Under the Habitat Assessment framework (HAF), the BLM currently uses the Assessment Inventory Monitoring (AIM) protocol which employs Line Point intercept (LPI), to ascertain the cover of the afore mentioned vegetation functional groups. The goal of this project is to determine if the two methods yield the same outcomes. Do standard and current monitoring methods provide the same outputs for the same site?



Poster Session Tuesday 1: Poster Pod 44, Poster 98

SOIL EROSION EFFECTS UNDER CLIMATE CHANGE SCENARIOS IN NORTHERN MEXICO

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ABSTRACT: Ph. D STUDENT

Climate change and land use/land cover change (LULCC) can influence susceptibility to erosion and, consequently, land degradation. Modeling LULCC allows us to understand the dynamics of the processes occurring and the main drivers of these change. The objective of this study was to analyze the effects of LULCC and climate change on soil erosion in the Conchos River Basin (CRB) in northern Mexico, located in the region of the North America's Grasslands. Future climate change in the study area was inferred using the CCSM4 climate change scenario at 2050 and 2070 under two representative concentration pathways (RCPs) 4.5 and 6.0. For the simulation of the dynamics of the future land use/land cover (LULC), a model developed in Dinamica-EGO was used, which uses stochastic models of the Markov chains, cellular automata and weights of evidence. The Revised Universal Soil Loss Equation (RUSLE) was used to estimate soil loss under the climate change and LULCC scenarios. The results show that rainfall erosion (R Factor) will increase in all RCPs scenarios. The maximum amount of R was 399.64 MJ mm ha-1h-1y-1 in 2050 under RPCs 4.5 and 431.49 MJ mm ha-1h-1y-1 under RPCs 6.0. For 2070 the maximum amount of R was 376.472 MJ mm ha-1h-1y-1 under RPCs 4.5 and 443.07 MJ mm ha-1h-1y-1 under RPCs 6.0. The modeled LULC showed that forests and grasslands are becoming agricultural land and scrublands. The change in C and R Factors accounted for most of the increase in soil erosion and sediment production in the study area during the evaluated future period reaching 491.39 t ha-1y-1 in 2070 under RCPs 6.0. Among the drivers of soil erosion, the LULC (C Factor) is where watershed managers could influence to reduce soil loss due to erosion and mitigate the negative effects of climate change.



Poster Session Tuesday 1: Poster Pod 44, Poster 99 – **Poster Withdrawn**

ELECTRONIC AND FIELD VERSIONS OF INTERPRETING INDICATORS OF RANGELAND HEALTH (IIRH) FORMS (VERSION 5)

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ABSTRACT

California NRCS developed an Excel spreadsheet of the forms contained in IIRH version 5. This format allows for minimizing duplicate data entries and inclusion of reference sheets, matrices, and field forms in one electronic file format. The spreadsheet can be protected to prevent inadvertent changes to rangeland health reference information. This spreadsheet could be used as a basis for the development of a rangeland health database.



Poster Session Tuesday 1: Poster Pod 44, Poster 100

ECOLOGICAL SITE GROUP DEVELOPMENT AND PREDICTIVE MAPPING FOR THE UPPER COLORADO RIVER BASIN

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ABSTRACT

Ecological site descriptions (ESD) and associated soil maps have proven to be a useful tool in describing the relationship between abiotic components (soil, climate, topography) and biotic interactions and have become a “common currency” land classification system used by many federal land management agencies. However, ESDs can be difficult to apply to broader-scales due to their often high level of spatial detail, creating a need for a less complicated and data-driven mapping of soil and plant communities. Grouping ESDs that share common ecological dynamics have been proposed as one solution to this problem. In this work, we are creating ecological site groups (ESG) across Major Land Resource Areas 34A, 34B, 35, and 36. Analysis of various digitally-available field collected soil and vegetation data, established state-and-transition models, and structured expert feedback are being employed to develop these new ESGs to provide a framework for a new classification system that is both practical and quantitative. The new groups consolidate roughly 480 ESDs into 21 distinct ESGs. Using a predictive machine learning approach relating observation-based soil survey databases (NASIS/SSURGO, AIM) and available environmental raster data (topography, climate, geology, and satellite imagery) from multiple sources, a field-scale (30-meter) map with pixel-by-pixel uncertainty estimates was produced. These ESGs can provide users with a practical description of the environmental interactions and possible alternate states to facilitate effective future land management decisions.



Poster Session Tuesday 1: Poster Pod 44, Poster 101

RANGELAND MANAGEMENT POLICY EFFECTS ON RIPARIAN VEGETATION

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ABSTRACT: UNDERGRADUATE STUDENT

In a multi-use system, it can be difficult to understand the effect of management policies on a landscape. Disturbances; like livestock grazing, recreational activities and wildlife management all have varying degrees of effect across the landscape. The diffuse nature of these disturbances and their repeated use over decades make it difficult to determine the effectiveness of management policy. Satellite imagery was used to quantify vegetation changes in riparian areas over a 30-year period. Riparian areas were selected, and images with those areas were reclassified to quantify vegetation types. The change was measured over time by vegetation type since management policy was implemented. This technique of measure change across the landscape provides a more accurate account of how the landscape is changing compared to sampling. With this technique we are able to provide land managers a better understand of how management policy is altering the landscape.



Poster Session Tuesday 1: Poster Pod 44, Poster 102

USES AND APPLICATIONS OF VERSION 5 OF THE INTERPRETING INDICATORS OF RANGELAND HEALTH TECHNICAL REFERENCE

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ABSTRACT

Version 5 of the Interagency Interpreting Indicators of Rangeland Health technical reference has been extensively field tested over the past three years and is now available. This version replaces the 2005 Version 4 and is the latest revision of the protocol was initiated in 1994. IIRH is a largely qualitative technique that uses 17 indicators that collectively provide a point in time assessment of three attributes of rangeland health: 1) soil/site stability, 2) hydrologic function, and 3) biotic integrity. IIRH has been used extensively by the Bureau of Land Management to assist in determining if Standards for Rangeland Health are being met on grazing allotments. The National Resources Conservation Service utilizes IIRH as part of its National Resource Inventory on non-federal lands and to assist in the ranch planning process. IIRH has proved to be an excellent communication tool and has been modified to prioritize restoration and invasive species management planning. International applications continue to increase as the value of this qualitative protocol to provide initial information on rangeland health is recognized.



Poster Session Tuesday 1: Poster Pod 45, Poster 103

UNCOVERING TRAITS AND RECOVERING GRASSLANDS: A FUNCTIONAL ASSESSMENT OF OIL AND GAS WELL PAD RECLAMATION

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ABSTRACT

The use of plant functional traits in reclamation assessments may guide the interpretation of variability in both plant community composition and its functional recovery. We compared plant functional traits and soil properties across 18 grassland sites certified reclaimed from former oil and natural gas well pads in southern Alberta (Canada) of two age classes, young (reclaimed/abandoned 8-10 years) and old (17-30 years), to that of proximate reference native grassland sites. We found that reclamation was not yet able to alleviate the legacy effects of industrial disturbance on soil properties (pH, bulk density, organic carbon and electrical conductivity) of old or young well pads and that the effects were more severe on old well pads. Compared with reclaimed well pads, reference sites contained a higher prevalence of short native species that preferred xeric conditions, had semi-abundant seed production and large seed weight. Young well pads included higher prevalence of species preferring hydric conditions, of therophytes, geophytes and of species with low dispersal capacity, whereas old well pads included more introduced species and a higher prevalence of species dispersed by animals, preferring mesic conditions, and high seed production. Old reclaimed well pads had lower trait functional diversity (FDQ) than young well pads and reference sites. Although both old and young reclaimed sites were statistically different from reference sites in terms of FDQ and community weighted means, young well pads, reclaimed under more recent reclamation criteria, shared more traits with reference sites and appear to be converging towards more similar trait composition to reference conditions. Using a trait-based approach as an indicator of recovery, we were able to develop a mechanistic understanding of biological and edaphic filters influencing community assembly on reclaimed sites. These results can inform future best practices for oil and gas reclamation activities.



Poster Session Tuesday 1: Poster Pod 45, Poster 104

BIOASSAYS: THE ROLE OF SEED BANK MONITORING IN RANGE MANAGEMENT

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ABSTRACT

Managing the vast acreage of rangelands in the arid western United States, has become one of the great environmental challenges of the 21st century. The complexity of land stewardship requires a multitude of management actions and the cooperation and collaboration of multiple entities. One very important aspect to a good management plan is monitoring. Monitoring includes outcomes of management actions such as timing and intensity of use as well as range improvement practices. Standardized monitoring protocol such as Assessment, Inventory, and Monitoring (AIM) have become universally used to make rangeland management decisions. While this protocol includes virtually every aspect of vegetation and soil stability characterization, seed bank estimates are not included. Seed banks represent one of the best predictors of future site potential and plant community condition and function. While resources such as Ecological Site Descriptions (ESD) and State and Transition models are often used to predict the best range improvement practices for a site, especially after a fire event, they are often landscape generalizations and may not represent the best assessment at the specific site level. Determining the level of cheatgrass competition seeded species will encounter the initial seedling establishment year is critical to make seed mix and rate decisions. We find that fall bioassay seed bank measurements are the best method to determine the level of competition seeded species will face. We will present various bioassay techniques we use to measure seedbanks in research and management activities. Data from our multiple research projects that use bioassays to measure seedbanks will be presented for reference. Bioassay seed bank results from herbicide treatments, soil nitrogen manipulations as well as perennial grass-cheatgrass suppression zones will be presented. Seed bank bioassays are a very efficient and effective tool to monitor and predict future cheatgrass populations to ensure the best range improvement practices.



Poster Session Tuesday 1: Poster Pod 45, Poster 105

IMPOUNDMENT SALINITY IN NORTHWEST SOUTH DAKOTA

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ABSTRACT: Ph. D STUDENT

Salinity impacts water availability and quality for wildlife and livestock in the western United States. In northwestern South Dakota, impoundments are the primary water source for livestock and may impact water availability and quality in riparian corridors used by wildlife such as the Greater Sage-Grouse (*Centrocercus urophasianus*). Impoundment salinity influences water availability and quality, and in areas with limited surface water resources it can be a concern for resource managers. To characterize spatial patterns in salinity, we measured conductivity in water and soil at 160 impoundments across 14 HUC12's totaling 1,184 square kilometers (292,580 acres) in Butte and Harding Counties in northwest South Dakota during the summer of 2019. We evaluated how the impoundment size, spatial distribution across the HUC 12, type (reservoir or dugout), impoundment drainage area, and soil salinity impacted each impoundment. Sampled impoundment conductivities ranging from 101 $\mu\text{S cm}^{-1}$ to 3,247 $\mu\text{S cm}^{-1}$ across the study area. Initial results suggest that soil salinity and impoundment drainage area impact impoundment salinity across all HUC12's. Characterizing spatial variability in rangeland salinity in northwest South Dakota will help rangeland managers make decisions in the context of broader landscape-scale processes and changes across the region.



Poster Session Tuesday 1: Poster Pod 45, Poster 106

IMPACTS OF COMMERCIAL HONEYBEES ON NATIVE BUTTERFLIES IN HIGH-ELEVATION MEADOWS IN UTAH.

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ABSTRACT: UNDERGRADUATE STUDENT

Under the multiple use management regime in the United States, beekeepers are continually filing for government permits to use natural lands as summer pasture for honeybees. Utilizing natural landscapes in high mountain ranges may help strengthen honeybee colonies, as this natural setting is generally void of chemical pollutants and pesticides that are found in agricultural and urban settings. However, the introduction of a competitive species could impact the native species occupying these landscapes. While honeybees and butterflies have different life histories, behavior, and foraging strategies, they compete for the same nectar resources. Few, if any, studies have focused on the potential population effects of commercial honeybees on native butterfly abundance and diversity. This study attempts to observe this impact using a paired before-after control-impact (BACI) design. In 2017 and 2018, Malaise trap samples were collected weekly through the months of July and August in two similar areas, each containing nine malaise trap sites for replication. In 2017, samples were taken to analyze trends within the pollinating communities. In 2018, honeybees were introduced to only one of the two areas and a change in trends between the two areas was assessed. Contrary to the original hypothesis, the resulting observation was an overall significant increase in the mean butterfly abundance in the impact areas after honeybees were introduced, while control areas remained relatively stable. Several potential theories are 1) Honeybees are deterring a natural predator/competitor of butterflies that previously limited population growth. 2) Honeybees are consuming resources regularly used by butterflies which extends the foraging time and consequent capture rates of butterflies. 3) Environmental factors were inconsistent between control and impact areas, biasing capture rates. This ongoing research will help determine the suitability of high mountain ranges for the summer pasturing of honeybees and the population impacts on native pollinators.



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