CONCLAVE 2022

BYU Plant & Wildlife Sciences

The Plant and Wildlife Sciences Department at Brigham Young University invite faculty, staff, students and members of the community to come support graduate student research within our department at our Graduate Research Conclave. Our graduate students will give presentations on their current research projects and compete for prizes.

Thursday, November 17, 2022

Poster Presentation Session

Life Science Building
4th Floor South Hallway
9:00 am -12:00 pm

Oral Presentation Session

Life Science Building
Room 2145
2:00-5:00 pm

BYU Redd Center
Charles Redd Center for Western Studies

POSTER PRESENTERS

Sarah Chan

Kyle Cook

Otto De Groff

Jacob Henrie

Caleb Jensen

Amber Johnson

Ryan Pienaar

Jacob Smith

Devri Tanner

Sidney Wadsworth

BYU Redd Center

Charles Redd Center for Western Studies

Presenter – Sarah Chan

ENVIRONMENTAL SCIENCE & SUSTAINABILITY, MS STUDENT

TITLE: Viability of dust-transported microbial communities in alpine lake water in Utah, USA

AUTHORS: Sarah C. P. Chan, Zachary T. Aanderud, Greg Carling, Janice Brahney

ABSTRACT

In the arid climate of southern Utah, dust is in constant flux. Microbes are transported great distances through the air as passengers on particles of dust and deposited in alpine lake systems. This study aims to measure the viability of the microbial communities that enter alpine lakes via dust. Using an established network of Modified Wilson and Cooke (MWAC) sampler masts, we are collecting dust from sites spanning across Utah and into Nevada. DNA will be extracted from the dust itself, from alpine lake water, and from the lake water again following dust addition. Dust additions will be conducted in-situ at several alpine lakes (Mary, Martha, Catherine, and Dog) during summer months - peak dust transport season, and a time when alpine lakes are completely thawed - to ensure consistent light and temperature conditions. Following DNA sequencing, ANOVA, PCoA, and core microbiome analysis will be performed to investigate what changes, if any, occur following dust addition.

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Presenter – Kyle Cook

WILDLIFE & WILDLANDS CONSERVATION, MS STUDENT

TITLE: Improving direct seeding success of winterfat using fungicide and hydrophobic seed coatings

AUTHORS: Kyle Cook; Chris Miller; Amber Johnson; Bridget Calder; Samuel Leigh; Rebecca Black; April Hulet; Phil Allen; Brad Geary; Kevin Gunnell; Melissa Landeen; Matthew Madsen

ABSTRACT

Winterfat (*Krascheninnikovia lanata*) is a protein-rich subshrub native to western North America that has been displaced from much of its native range. Success in restoring this species to the landscape has been limited due to seed handling difficulties and low seedling establishment. Seed coating technologies may present a solution to both of these problems. Winterfat seeds are enclosed in fruits that are densely covered in hairs which impede flow through equipment like rangeland drills and broadcasters. Consequently, the species is often excluded from restoration seed mixes. Applying coating material to fruits compresses hairs down and creates a flowable product, thus improving seed handling. Additionally, additives can be applied to coatings to mitigate specific environmental stressors that prevent seedling establishment. We examined the use of fungicide coatings to reduce seedling mortality from pathogen attack, and hydrophobic coatings to delay germination and reduce seedling exposure to lethal winter conditions. We compared emergence of fruits coated with calcium-carbonate (blank coating), fungicide, hydrophobic material, and combination coatings to control fruits. Studies were planted in the fall of 2021 at four field sites in the Great Basin Region of the United States and emergence was counted in the spring of 2022. We found that emergence was greatest for fruits with a hydrophobic coating ($p < 0.01$), and all other treatments were statistically similar to the control. This finding suggests that hydrophobic seed coatings may improve direct seeding success of winterfat by delaying germination and reducing exposure to harsh winter conditions.

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Presenter – Otto De Groff

WILDLIFE & WILDLANDS CONSERVATION, MS STUDENT

TITLE: Climate Response of Great Basin Bristlecone Pine (Pinus longaeva D. K. Bailey) along an elevational gradient in the Spring Mountains, Nevada

AUTHORS: De Groff, O. W., S. L. Petersen, M. F. Bekker, R. L. Johnson, and L. Allphin

ABSTRACT

Great Basin Bristlecone Pine (*Pinus longaeva* D. K. Bailey, or PILO) is the longest lived non-clonal organism on earth, with individual trees attaining ages of close to 5,000 years. In the Great Basin Desert of western North America, PILO grows on isolated mountain ranges, where it is a member of sky-island montane forests. Near tree line, cold average annual temperatures limit tree growth, and lower down, tree growth is often restricted by insufficient precipitation. The long annually resolved record of growth exhibited in tree rings, combined with tree growth correlation to climate extremes, make PILO an ideal candidate for learning how tree growth responds to climate fluctuations through time. The Spring Mountains (Clark County, NV) are located northwest of Las Vegas and support extensive PILO stands. In the summer of 2022, cores of PILO trees were sampled along an elevational gradient between 10,200 and 11,200 feet (3100 and 3400 meters) southwest of Charleston Peak, in the upper Carpenter Canyon drainage. Chronologies developed from three sites (lower, middle, and upper) show that in response to recent warming trends, trees near tree line show faster rates of growth than those below tree line, as the previously temperature limited tree line PILO are transitioning to a precipitation dominated growth pattern. Additionally, millennium length chronologies developed for this site offer insight as to how the species has and will respond to future fluctuations in climate.

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Presenter – Jacob Henrie

ENVIRONMENTAL SCIENCE & SUSTAINABILITY, MS STUDENT

TITLE: Combating Fungal Pathogens (Pithium ultimum) with Secondary Metabolites of Strepomyces Bacteria

AUTHORS: Jacob Henrie, Bradley Geary, Shawn Christensen

ABSTRACT

The fungal disease Pythium ultimum (Pythium leak) has detrimental effects on potato tuber (Solanum tuberosum) quality and yield. Tubers are the world's fourth largest agricultural food crop and are crucial for feeding a growing population. Bacteria from the genus Streptomyces are known for producing a wide variety of secondary metabolites with antifungal properties. Isolates of Streptomyces have recently shown inhibitory effects towards P. ultimum in Petri dish assays. These data suggest that Streptomyces may work as a biocontrol to protect tubers from P. ultimum. We are working to extract the bioactive secondary metabolites from the Streptomyces bacteria in order to identify their chemical structure and potential as biocontrols. We grew streptomyces in nutrient broth and then concentrated, filtered, and lyophilized the solution to obtain a powder containing the bioactive compounds. We tested the inhibitory ability of the powder against P. ultimatum using Petri dish assays and found it inhibits the fungus similar to the live culture of the Streptomyces strain. Using methanol columns and high-performance liquid chromatography, we plan to isolate the bioactive metabolites for future analysis.

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Presenter – Caleb Jensen

ENVIRONMENTAL SCIENCE & SUSTAINABILITY, MS STUDENT

TITLE: Increased Methanogenesis in Waste Activated Sludge

AUTHORS: Caleb Jensen, Zach Aanderud

ABSTRACT

Waste management is an international responsibility shared by diverse communities, organizations, and societies at large. While it is easy to view waste treatment as a shared problem due to toxicity and methane production, our research focuses on the use of human waste as a means of renewable bio-energy production to reduce dependency on fossil fuels and pursue a more sustainable energy landscape. Methane production and extraction from wastewater have been used to power wastewater plants and other systems for years, however, microbial optimization of these biofuel processes is still far from complete. Our research focuses on the propagation of novel microbial communities within wastewater samples to determine high-yield combinations of methanogenic bacteria and archaea. These microbial cocktails, once identified, can be grown and applied to various treatment plants to produce a multiplicity of renewable energy as compared to wild type methanogenic communities. As our experiments are currently underway, results have not yet been determined for which methanogens are most productive. Once completed, our research will greatly increase renewable bioenergy production from underused wastewater, decrease reliance on fossil fuels, and help establish more efficient ways to be productive stewards over our own waste.

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Presenter – Amber Johnson

WILDLIFE & WILDLANDS CONSERVATION, MS STUDENT

TITLE: Breaking dormancy and increasing restoration success of native forbs with innovative seed coating and planting techniques

AUTHORS: Amber J. Johnson, Alexandra J. S. Larson, April Hulet, Brad Geary, Danny Summers, Matthew D. Madsen

ABSTRACT

Many plant species exhibit strong dormancy. While this attribute benefits the species' long-term survival, it can present a challenge within a restoration scenario where rapid establishment is required. Soaking seeds in gibberellic acid (GA_3) can overcome dormancy and increase germination but this treatment may not be effective outside the laboratory. An easier and potentially more effective method to apply this hormone is to coat seeds with a GA_3-impregnated polymer, which provides a slow release of the active ingredient. Seed dormancy can also be mitigated by creating a favorable microsite when planting that has increased soil moisture. We compared the emergence and survival of penstemon seeds that were coated with GA_3 to uncoated seeds planted in traditional drill rows versus deep, U-shaped furrows. These treatments were evaluated in late fall and early spring plantings in three field sites in the Great Basin Region of the western United States. Overall, the GA_3 coating improved the emergence and survival of Palmer's penstemon (*Penstemon palmerii*; $p < 0.01$) and thickleaf penstemon (*Penstemon pachyphyllus*; $p < 0.001$) but did not affect the emergence or survival of firecracker penstemon (*Penstemon eatonii*; $p = 1$). Between our two planting seasons, fewer seedlings emerged or survived from spring planting than from fall planting ($p < 0.001$). Emergence and survival were higher for all species in deep furrows than in shallow drill rows ($p < 0.001$). These results indicate that GA_3 seed coating and deep, U-shaped furrows may improve the restoration success of some native forbs by breaking dormancy and providing a favorable microsite. These techniques could be used by land managers in post-disturbance restoration efforts.

Presenter – Ryan Pienaar

WILDLIFE & WILDLANDS CONSERVATION, PHD STUDENT

TITLE: Impacts of fire and vegetation on deer and elk abundance

AUTHORS: Ryan Pienaar, Samuel St Clair, Devri Adams, Randy Larsen, Jesse Lewis

ABSTRACT

Changing fire regimes are altering animal habitats across the globe and will continue to change in the future. Impacts of fire on deer and elk can vary depending on fire characteristics (severity, frequency, size, etc) and the area in which the fire occurred. We set out to determine the differing effects of burn scars on deer and elk in different vegetation stands on the Wasatch front in Utah, USA. Using camera traps, we compared number of deer and elk in burned and unburned areas in three different vegetation stands: pinyon-juniper, oak-maple and aspen-conifer. Deer were most common in unburned aspen-conifer stands but weren't found in unburned pinyon-juniper or oak maple but were found relatively evenly across vegetation types in burned stands. Elk were always found more in burned than unburned and most commonly in pinyon-juniper for both burned and unburned. We used zero-inflated regression models to predict what factors most influence deer and elk abundance at the different sites. The most appropriate model for both deer and elk included: fire, vegetation, the interaction between fire and vegetation and abundance of the other group (deer on elk and elk on deer). Deer were also influenced by climatic effects, precipitation, and maximum and minimum temperature.

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Presenter – Jacob Smith

ENVIRONMENTAL SCIENCE & SUSTAINABILITY, MS STUDENT

TITLE: Testing Various Irrigation Rates on Native Pinus edulis Seedlings Upon Outplanting

AUTHORS: Jacob Smith, Ryan Stewart

ABSTRACT

The Intermountain West is a traditionally arid region that is facing increasing temperatures and declining precipitation, as the climate changes. Additionally, as water in the Colorado River Basin decreases, the chance of significant water restrictions being placed seem imminent. Utilization of native, drought-tolerant food crops is a potential solution to the pressing climate issues of today. *Pinus edulis*, or two-needle pinyon, is a tree native to the Colorado River Basin that produces edible, nutritious pine nuts. While these pine nuts have historically harvested from the wild, both by indigenous people as well as others, this specie has not been cultivated for agricultural use. Our interest is in establishing fundamental knowledge that will allow these pines to be grown and cultivated commercially, primarily establishing ideal irrigation rates and methods upon outplanting. We hope to test three different irrigations rates, as well as the use of Waterboxx's in a blocked field trial on recently grafted pinyons in order to determine the minimum possible irrigation rate without compromising survival and vigor.

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Presenter – Devri Tanner

WILDLIFE & WILDLANDS CONSERVATION, PHD STUDENT

TITLE: Forest regeneration and recruitment across multiple forest types following a 61,000 Ha megafire

AUTHORS: Devri D. A. Tanner, Kordan Kildew, Brian Brown, Noelle V. Zenger, Samuel B. St. Clair

ABSTRACT

Background/Questions/Methods

Fires are becoming larger, more intense, and more frequent due to human activity, which necessitates a further understanding of novel fire regimes and their impacts. Novel fires have the capacity to expand past historical fire boundaries leaving patches of varying burn severity that may significantly alter plant regeneration. To study these phenomena, we asked the following question: How do burn conditions from a novel fire affect sapling regeneration and recruitment across multiple forest types? We installed transects across three forest types in central Utah's 2018 Pole Creek Megafire burn scar: aspen-conifer, oak-maple, and pinyon-juniper. We geographically paired each fifty-meter transect between a burned and an unburned site, with six replications per forest type. Sapling density, browse, and height were measured within each 50x2-meter belt transect each July from 2019 to 2021.

Results/Conclusion

Our results suggest that high severity fires differentially affect post-fire sapling regeneration in adjacent forest-types because sapling density varied by burn level and species type. Oak and aspen had higher average sapling densities in burned areas than in unburned areas by 3- and 1.9-fold, respectively. The remaining species all had higher sapling density in unburned areas than in burned areas, with maple showing the strongest difference at a 5-fold decrease in sapling density post-fire. Aside from independent species trends, the most notable density trend was the altered ratio of oak to maple saplings between burned and unburned sites. In the absence of fire, the sapling density of OM forests was maple dominant, with maple saplings having 2 times the density of oak saplings. Post-fire sapling density then flipped to be oak dominant, with oak saplings having a 7.3 times greater density than maple saplings. The switch was likely due to oak trees' ability to rapidly send up sprouts from their existing roots following disturbance. Our results also suggest that recruitment is differentially affected by high severity fires because herbivory damage and sapling height varied by species, burn level, and time since fire. Needle-like species (conifer, pinyon, and juniper) were not included in the recruitment analysis due to a lack of robust data for statistical analysis during the timeframe of the study. Browse pressure on deciduous species was greater in burned areas than in unburned areas, though the magnitude of browse damage varied by species. Maple saplings experienced 3.8 times more browse damage in burned areas than unburned areas, while oak and aspen were browsed 2.3 and 1.4 times more in burned areas, respectively. Deciduous sapling height increased on average 1.6-fold from 2019 to 2021. In unburned areas deciduous sapling height increased by 1.4-fold during 2019-2021 while sapling height in burned areas increased by 1.8-fold during the same period. These height trends imply that both the burned and unburned forests are trending towards successful recruitment with increasing time since fire despite browse pressure. Our study suggests that high severity fires alter sapling regeneration and recruitment differentially by species, and thus forest type, which may have implications for successional pathways taken during regeneration.

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Presenter – Sidney Wadsworth

WILDLIFE & WILDLANDS CONSERVATION, MS STUDENT

TITLE: Monitoring of Rare Plant Populations and Ungulate Use, Particularly of Mountain Goats, In Alpine Plant Communities of the La Sal Mountains, Utah

AUTHORS: Sidney Wadsworth and Loreen Allphin

ABSTRACT

From 2013-2014 the UDWR introduced 35 mountain goats (*Oreamnos americanus*) to the La Sal Mountains in southeastern Utah. This action sparked lawsuits and controversy regarding concerns over the potential repercussions on the alpine plant community. Mountain goat populations have increased in this area to approximately 85-125 individuals. During the summer of 2022, we initiated research to help provide insight into this controversy through the meticulous monitoring of alpine plant communities and mountain goats in the La Sal Mountains. This study seeks to monitor the plant demographics and survivability of three rare, endemic plants (*Erigeron mancus*, *Potentilla paucijuga* and *Senecio fremontii* var. *inexpectatus*), to characterize the alpine plant communities associated with these rare plant species, to calculate diet composition of mountain goats and other ungulates using these communities through fecal DNA sampling and feeding site analysis, to document ungulate utilization and disturbance at alpine feeding sites and to document the disturbance impacts of wallowing by mountain goats to these alpine communities. The results of this research will aid in the conservation of these narrow endemic plant species, while providing the necessary statistics to elucidate mountain goat impacts on alpine communities in the La Sal Mountains. The results from this research will help to quantify and separate the relative effects of year-to-year differences, recreational use, and various ungulate use on alpine plant communities and the rare endemics. This research will also characterize diet composition and plant utilization by mountain goats and will quantify the total impacts of goat use on disturbance and plant composition at wallow sites in the La Sal Mountains.

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ORAL PRESENTERS

Miria Barnes	2:05-2:15pm
Kaylee Draughon	2:20-2:30pm
Keegan Hammond	2:35-2:45pm
Maliea Holden	2:50-3:00pm
Madison Huie	3:05-3:15pm
Sterling Kerr	3:20-3:30pm
Samantha Shumate	3:35-3:45pm
Sam Stapley	3:50-4:00pm
Noelle Zenger	4:05-4:15pm

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Presenter – Miria Barnes

ENVIRONMENTAL SCIENCE & SUSTAINABILITY, MS STUDENT

TITLE: Soil health in American sports fields and golf courses

AUTHORS: Miria Barnes, Bryan Hopkins

ABSTRACT

Healthy soils are essential for sustaining the world's ecosystems and maintaining human lifestyles. The adoption of biological, chemical, and physical analyses to assess soil health is a relatively new concept with a paucity of scientific work assessing how well these tests can predict and influence soil health. Golf and sports turf are arguably the most intensively managed soil systems in the world, including fertilizer and pesticide use. Excess fertilizer and pesticide application can cause extreme environmental degradation, with concerns regarding soil health. Soil samples (105) were collected between September 2021 and April 2022 from various golf courses and sports fields, as well as farm fields, non-sport urban, and undisturbed native soils (forests, deserts, beaches, and golf sand traps). The samples were then analyzed for chemical, biological, and physical properties, including pH, micronutrients, electroconductivity, aggregate stability, potentially mineralizable nitrogen, and texture. General linear statistical models were then used to evaluate these differences in soil properties based on field type. The data collected, and comparisons made, will add to scientific and community understanding of soil health as a function of land management.

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Presenter – Kaylee Draughon

WILDLIFE & WILDLANDS CONSERVATION, MS STUDENT

TITLE: Evaluating cheatgrass as an ecological trap for Western Burrowing Owls

AUTHORS: Kaylee Draughon, Randy Larsen, Brock McMillan, Steve Petersen, Russ Lawrence, Nicholas Brown, Keeli Marvel

ABSTRACT

Western burrowing owls (*Athene cunicularia hypugaea*) are a species of conservation concern throughout the United States. Increased understanding of their preferred habitats, diet, and distribution is necessary to create conservation plans and inform management decisions. Landscape changes occurring in western North America including conversion of shrublands to grasslands facilitated by invasion by exotic grasses has created an urgent need for information associated with this species. Because population growth is largely influenced by reproductive success in this species, it is important to understand how nesting success and recruitment varies as a result of changes currently occurring on western rangelands. The purpose of our research is to evaluate how an invasive grass, cheatgrass (*Bromus tectorum*), influences the distribution of burrowing owls, and how it subsequently impacts nesting success of western burrowing owls within our study area. From 2021 through 2022 we located 76 active burrows within the Utah Military Operating Area. This encompassed the Utah Test and Training Range, the Tooele Army Depot, Dugway Proving Grounds, and surrounding BLM land. Active burrows were located through audio visual surveys, and each burrow was categorized as a successful or failed nesting attempt. By determining the average percent cover of cheatgrass at each burrow and foraging range, we are able to determine if cheatgrass significantly influences overall burrow success and number of chicks fledged.

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Presenter – Keegan Hammond

ENVIRONMENTAL SCIENCE & SUSTAINABILITY, MS STUDENT

TITLE: Spatiotemporal variation of alfalfa crop water productivity in irrigated alfalfa

AUTHORS: Keegan Hammond, Ryan R. Jensen, April Hulet, Bryan G. Hopkins, Ruth Kerry, Neil C. Hansen

ABSTRACT

Alfalfa (*Medicago sativa*) is a high-water use crop grown throughout the world. Technology, such as variable rate irrigation (VRI) systems, allows growers to water individual parts of their fields to specific needs, thus increasing crop water productivity (CWP). Understanding the spatial and temporal variation of CWP in alfalfa can help better manage specific water needs and increase the potential value of VRI. The objectives of the study are: (1) measure spatiotemporal variation of evapotranspiration (ET) in alfalfa under uniform irrigation, (2) quantify spatial variation of alfalfa yield under uniform irrigation, and (3) describe the spatial variation of CWP and identify factors that control the variation. The study was conducted in a 22.7 ha alfalfa field located near Rexburg, ID, USA. The field was uniformly irrigated throughout the 2021 and 2022 growing seasons. A nested grid sampling design was used with a 60 m spacing and an offset grid of 75 m making 66 sampling points. Soil samples were collected at each point to estimate soil moisture at the beginning of season and immediately following each of four harvests. The ET was measured by adding irrigation and precipitation and subtracting the change in soil water content. Yields were measured by clipping plants within 0.25 m^2 (quadrat frame) at each point and measuring dry biomass. The CWP was measured as yield (Mg ha^{-1}) divided by ET (cm). The CWP varied from 0.30 to 0.38 Mg ha^{-1} cm^{-1}. The CWP was compared to: ET, yield, soil moisture at the beginning and end of season, crown density, elevation, five vegetation indices, and combinations of each using Akaike information criterion modeling. The best multivariate regression model was CWP = -0.02(ET) +0.05(Yield) + 0.3 with an R^2 value of 0.96. These results show that yield and ET are the best predictor variables for CWP.

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Presenter – Maliea Holden

ENVIRONMENTAL SCIENCE & SUSTAINABILITY, MS STUDENT

TITLE: Anaerobic digestion community dynamics of wastewater sludge

AUTHORS: Maliea Holden, Zach Aanderud, Jaron Hansen, John Chaston

ABSTRACT

Biological pretreatments used in the wastewater reclamation process decrease solid waste in anaerobic digestion (AD) effluent by converting the carbon bound in lignocellulosic material to methane.

Caldicellulosiruptor bescii is a model bacterium for biological pretreatment before anaerobic digestion due to its ability to hydrolyze the cellulose and microcrystalline found in waste activated sludge (WAS) to smaller volatile fatty acids. The purpose of this study was to identify the changes in the anaerobic digester microbial community in response to an increase in volatile fatty acids from the pretreatment process. We identified the changes in microbial communities in the AD from three altered substrates of waste activated

sludge: 1. preWAS (WAS with primary effluent around 0.2% solids) 2. postWAS (WAS with effluent from the AD) and 3. WAS (WAS at a two-fold dilution). Gas production increased in the WAS, preWAS, and postWAS substrates with the introduction of C. bescii pretreatment; however, the microbial communities of the anaerobic digester for each WAS type had no change. Additionally, the free floating and particle associated microbial communities in the anaerobic digester were characterized. We found Methanothermobacter tenebrarum had a higher association with particles in the media and the genus Methanosaeta had a higher association with free floating material across each WAS substrate. Our results indicate the bacterial communities of healthy anaerobic digesters do not change significantly with a biological pretreatment but rather the microbial populations change due to the type of anaerobic digester.

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Presenter – Madison Huie

WILDLIFE & WILDLANDS CONSERVATION, PHD STUDENT

TITLE: Monitoring of Castilleja parvula v. parvula herbivory from native and non- native herbivores in the Tushar Mountains, Fishlake National Forest, Utah.

AUTHORS: Madison Huie (Brigham Young University, Provo, Ut), Steven Flinders (Beaver Ranger District, Fishlake National Forest, USFS, Beaver, UT), Loreen Allphin (Brigham Young University, Provo, UT)

ABSTRACT

The Tushar Mountains provide critical alpine habitat for a variety of flora and fauna, including 28 endemic plant species. The Tushar Indian paintbrush (*Castilleja parvula*var. *parvula*) is one of five taxa listed as high-priority for conservation and most likely to be impacted by herbivory due to its palatability. Native and nonnative ungulates have been shown to utilize this species, including mule deer (*Odocoileus hemionus*), elk (*Cervus canadensis*), mountain goats (*Oreamnos americanus*), and domestic cattle (*Bos taurus*). Small mammal herbivores have also been observed foraging in these communities, including marmots (*Marmota flaviventris*), pika (*Ochotona princeps*), and white-tailed jackrabbits (*Lepus townsendii*). To determine the extent and effects of herbivory on plant communities with C. *parvula* var. *parvula* in the Tushar Mountains, we established herbivore exclosures near four known populations of the taxon in spring 2020. These herbivory exclosures were established in pairs (one exclosure to exclude ungulates only and the other exclosure to exclude all mammal herbivores, including marmots and pika) to distinguish between the effects of ungulate herbivores and small mammals in these communities. Camera traps were set near the exclosures to identify the herbivore species utilizing these communities. The paired exclosure plots were read at the end of the growing season in 2020, 2021, and 2022. We assessed plant cover by species, plant biomass, overall vegetation height, the number of C. *parvula* individuals in plots, and the reproductive success (in flowers and fruits produced) of C. *parvula* under exclosures and outside the exclosures at each location. Our data showed less herbivory and more C. *parvula* plants under exclosure plots. Moreover, the C. *parvula* plants had higher reproductive success under exclosures. We found significantly higher cover and less utilization under the exclosure plots that excluded all herbivores, illustrating the role of small mammals in these alpine communities.

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Presenter – Sterling Kerr

ENVIRONMENTAL SCIENCE & SUSTAINABILITY, MS STUDENT

TITLE: Outpacing herbivory and conifer domination using forest treatments

AUTHORS: Sterling Kerr, Aaron Rhodes, Jordan Maxwell, Sam St Clair, April Hulet

ABSTRACT

Disturbances are critical in maintaining forest health, namely forest regeneration. Natural fires and other occurrences give room for tree sucker growth, disrupt homogenous species takeover, and clear out dead biomass buildup. Natural fires have been negatively impacted by human activity within ecosystems. With practices like fire suppression, fire is coming much later than necessary. Mixed aspen-conifer forests that have experienced fire suppression and excessive ungulate herbivory pressure are currently experiencing forest regeneration failure. We found untreated aspen-conifer stands were not recruiting aspen for overstory replacement due to high conifer abundance and chronic ungulate herbivory. Practices like prescribed fires and mechanical treatments have been used to mediate the damage of disrupted disturbance regimes. Within conifer-aspen forests, prescribed fire treatments greatly benefit the regeneration of aspen suckers. They do so by stimulating synchronous aspen regeneration. Mechanical treatments also stimulated a strong regeneration but faced the challenges of slower growth and increased ungulate activity. Our results show two significant findings. First, where possible, prescribed fire should be given higher priority to mechanical treatments. Second, treatments should be sufficiently large for the aspen regeneration to saturate ungulate herbivory.

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Presenter – Samantha Shumate

ENVIRONMENTAL SCIENCE & SUSTAINABILITY, MS STUDENT

TITLE: EVAPOTRANSPIRATION IN IRRIGATED CROPPING SYSTEMS WITH STACKED NITROGEN BEST MANAGEMENT PRACTICES IN SEMI-ARID ENVIRONMENTS

AUTHORS: Samantha Shumate, Samuel Stapley, Bryan Hopkins, Neil Hansen, Keegan Hammond, Alton Campbell

ABSTRACT

Precision nutrient management has been widely adopted by producers in recent decades. One strategy for communicating precision nutrient management approaches is known as the nutrient 4Rs: right timing, right source, right rate, and right place. Ideally, the use of the 4Rs would result in economically maximized crop yield while maximizing resource use and reducing environmental harm. The effectiveness of different 4R management practices is commonly assessed by comparing yield or economic response. However, for irrigated cropping systems in water scarce regions, another way is to evaluate crop water productivity. While there has been research into the relationship between irrigation and N, it has not been examined for irrigated winter wheat, potatoes, and silage corn in a semi-arid area. By using a full factorial experimental design with 18 different treatments of the 4Rs on these crops around Idaho, it is possible to isolate the effects of each practice on yield. From there, it is combined with ET values, both daily and season long, that are found with a water balance equation (P+I=ET+D+R+S) to estimate crop water productivity for each treatment. Evaluating how nitrogen 4R management practices affect crop water productivity, recommendations can be made to make the best use of limited irrigation water supply in water-scarce regions.

BYU Redd Center
Charles Redd Center for Western Studies

Presenter – Sam Stapley

ENVIRONMENTAL SCIENCE & SUSTAINABILITY, MS STUDENT

TITLE: Stacking Nutrient 4Rs on Potato and Wheat

AUTHORS: Samuel H. Stapley, Neil C. Hansen, Ryan C. Christensen, Ryan R. Jensen, Matt A. Yost, Bryan G. Hopkins

ABSTRACT

The 4Rs of nutrient management are research-based guidelines with the aim to improve the sustainability of major cropping systems and the environment without compromising crop yield and quality. The objective for this project is to evaluate individual and stacked 4R management practices and how they intersect. A field trial near Grace, Idaho was conducted on potato (*Solanum tuberosum* L.) in 2020 and hard white spring wheat (*Triticum aestivum* L.) in 2021. Nitrogen (N) fertilizer treatments included all combinations of two sources (uncoated vs polymer coated urea (PCU)), two rates (100 or 75%), two timings (emergence or split applied), and two placements (broadcast or band + broadcast) compared to an untreated control. Overall, potato was responsive to N, but the wheat was not (which is common when following potato). Despite large numerical increases for all treatments compared to the unfertilized control (2.2-7.5 Mg ha^{-1}), only the source (PCU) x timing treatment was significantly different (8.22 Mg ha^{-1}). It is also noteworthy that the reduced rate of urea performed identically to the full rate of urea. Although this is a limited amount of data, it reinforces the 4R principles and suggests that stacking some methods may not be necessary. For example, no additional benefit was found by performing a split timing application, even at reduced rates. Future trials are planned to continue this investigation.

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Presenter – Noelle Zenger

WILDLIFE & WILDLANDS CONSERVATION, PHD STUDENT

TITLE: Understory response to disturbance treatments across time

AUTHORS: Noelle Zenger, Sam St. Clair, Mary O'Brien, Jason Kling, Marc Coles-Ritchie, Devri Tanner

ABSTRACT

Fire is an effective and essential disturbance in many forest ecosystems. Fires may change the understory plant community in a forest through increased light availability and altered soil moisture and nutrient availability. Because humans have been suppressing fires for decades, land managers are attempting to restore the natural fire cycles through prescribed burning and mechanical thinning treatments where fires threaten human infrastructure. Fires and mechanical treatments likely have differing effects on understory plant cover because of the different ways they remove biomass and alter the abiotic environment. In addition, the understory plant community can change as time passes after these disturbances. This study aims to determine if the understory community differs after fires and mechanical treatments and how the time since treatment may affect those differences. Monroe mountain in Fishlake National Forest is an ideal location to study the differential effects of prescribed burns and mechanical treatments on mixed aspen-conifer ecosystem diversity because of the large-scale treatments implemented after long-term fire suppression. We measured understory plant cover using methods adapted from the traditional Daubenmire frame method in 42, 50x2m belt transects throughout Monroe mountain in the Fishlake National Forest in July 2022. We expect that plant cover will differ between our control, burns, and mechanical treatments, and we predict that more time after a fire will show increased species richness and cover. The analysis is currently still underway.

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Thank you to all our graduate students for participating, as well as to our wonderful faculty for their willingness to be judges. We would like to extend a very special thank you to The Charles Redd Center and Graduate Studies for their support

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