2017 Annual Meeting Montana Academy of Sciences

Student Union, Montana Tech, April 7th & 8th, 2017

Abstracts for Oral Presentations

(Arranged by Time of Presentation)

9:00-9:15am

CHARACTERIZATION AND TESTING OF COMPOUNDS PRODUCED BY *ASPERGILLUS TURCOSUS* THAT TARGET CANCER-ASSOCIATED PATHWAYS

Niel Mondava *, Hellgate High School, Missoula; Montana Junior Academy of Sciences

The Berkeley Pit was once an open pit mine, but today it is a highly acidic and toxic lake. The Berkeley Pit is home to many different species of extremophilic fungi. These fungi have developed the ability to produce bioactive compounds that act as a defense against the harsh environment of the Berkeley Pit. Relating to this research is the acidic and oxidative environment of the Berkeley Pit. These factors affect analogous pathways in fungi and mammalian systems, with the mammalian pathways relating to the onset (caspase-1) and progression (MMP-3) of cancer. Because of this it was hypothesized that the Pit fungus Aspergillus turcosus would produce compounds that target pathways associated with cancer. To test this, the PM 16-149 CHCl3 enzyme inhibiting crude extract was run through two silica gel columns and an HPLC in order to isolate the active compounds. This yielded the known compound Pseurotin A. However Pseurotin A had never been tested for caspase-1 and MMP-3 inhibition. The results from the caspase-1 and MMP-3 signal transduction assays show that Pseurotin A is a potent inhibitor of MMP-3, however it shows no caspase-1 inhibition. As a result of these data the NCI-DTP has agreed to test Pseurotin A against their 60 human cancer cell lines

9:15-9:30am

A NOVEL TECHNIQUE FOR SAFE AND INEXPENSIVE ANTIBIOTIC MECHANISM OF ACTION DETERMINATION

Zoe Peach-Riley, Hellgate High School, Missoula; Montana Junior Academy of Sciences

Antibiotics are a diverse group of chemicals that successfully inhibit bacterial growth by interrupting one in a series of biochemical steps necessary for successful cellular proliferation. Novel antibiotic development requires determining what bacterial cellular process is inhibited at the molecular level, labeled as the mechanism of action (MOA). Current strategies to determine a MOA involve radiolabeled amino acids, which not only pose major biological health and safety threats, but are extremely costly. A new method, presented and tested here, using Cytochrome c (a spectroscopic protein intrinsic to prokaryotic

cells) and a UV-visible spectrophotometer (an instrument which can measure protein concentration), is significantly cheaper and safer than radiolabeling amino acids.. This method was shown to be reliable in determining whether an antibiotic targets specific steps in protein synthesis; these results are currently being verified. Methods that incorporate additional techniques are being developed to determine an exact MOA of any given antibiotic

9:30-9:45am

CHARACTERIZATION AND CLASSIFICATION OF A MONTANA MYCOBACTERIOPHAGE (ORAL)

Margeaux Black, Montana Tech of the University of Montana, Butte

Froghopper, a Mycobacteriophage discovered by Nikki Boyd in 2005 and stored in Dr. Marisa Pedulla's collection, was adopted in the fall of 2016. The bacteriophage was plated, or used to infect *Mycobacterium smegmatis* on Petri dishes, in order to determine the morphology of the resultant plaque. Froghopper was purified and amplified, and a high titer stock was made. DNA of the phage was extracted using phenol/chloroform. Restriction digests and agarose gel electrophoresis of Froghopper DNA were performed in order to compare the DNA of Froghopper to DNA of phages in the Actinobacteriophage database. The polymerase chain reaction (PCR) was used for preliminary determination of Froghopper's phage cluster. A phage cluster is a group of bacteriophages with similar DNA sequences. Phage clusters can be predicted by a set of primers used in PCR to determine genetic similarities to sequenced bacteriophages (Smith et al., 2013). Determination of the bacteriophage's structural morphology was determined by imaging the phage under transmission electron microscopy at the University of Montana. DNA of the bacteriophage was sent to the University of Pittsburgh for the DNA sequencing. Once sequenced, the DNA sequence was annotated; putative protein coding genes were identified and described in relation to other known sequences, and the annotated sequence was submitted to GenBank.

9:45-10:00am

FABRICATION AND CHARACTERIZATION OF ALIGNED FIBERS ON NONCONDUCTIVE SUBSTRATES FROM A NOVEL ELECTROSPINNING SYSTEM (ORAL)

Zachary Burckhard, Mechanical Engineering and Montana Tech Nanotechnology Laboratory, Montana Tech of the University of Montana, Butte
Jack L. Skinner, Mechanical Engineering and Montana Tech Nanotechnology Laboratory, Montana Tech of the University of Montana, Butte

Electrospinning has become a valuable technique for producing micro-to-nanoscale polymeric fibers with length scales from ~1 nm to 100 μm. Alignment of electrospun fibers further expands upon functionality by increasing reproducibility and improving predictive behavior of fibers in various environmental conditions. The utility of electrospun fibers can be subsequently increased with the ability to deposit directly onto a non-conductive/non-energized surface. Possible uses include displays and sensors for commercial or defense applications or in biomedical application for depositing on tissue. In order to accurately deposit electrospun fibers onto a nonconductive surface, we developed a new electrospinning apparatus. The set up for the device includes two grounded electrodes separated with a small gap that sheets of air were be forced through in order to prevent the fibers from contacting the electrodes. Fibers were deposited directly onto a nonconductive surface placed below the grounded electrodes. Details of the apparatus along with images and analysis of resultant fibers will be presented.

10:00-10:15am

RABBIT CREEK: GEOCHEMISTRY OF AN ALKALINE DEEPLY SOURCED HOT SPRING WITH ABUNDANT MICROBIAL MATS (ORAL)

Jordan Foster, LEGEND Lab, Department of Chemistry & Geochemistry, Montana Tech of the University of Montana

Shanna Law, LEGEND Lab, Department of Chemistry & Geochemistry, Montana Tech of the University of Montana

Mallory Nelson, LEGEND Lab, Department of Chemistry & Geochemistry, Montana Tech of the University of Montana

Georgia Dahlquist, LEGEND Lab, Department of Chemistry & Geochemistry, Montana Tech of the University of Montana

Alysia Cox, Department of Chemistry & Geochemistry, Montana Tech of the University of Montana

The Rabbit Creek hot springs in Yellowstone National Park are located along the edge of the Mallard Lake Dome in the Midway Geyser Basin. The principal source, Rabbit Creek hot spring, contains high concentrations of arsenic and antimony relative to hot springs throughout the area. This study investigates the water chemistry of the Rabbit Creek hot spring outflow, geologic explanations for the distinct differences in hot spring compositions of the area, and the implications for the abundant thermophilic microbial mats present in the outflow. The distribution of the microbial mats may be related to the concentrations of arsenic and antimony throughout the outflow. In addition, changes in the microbial mats related to temperature and sulfide concentrations are discussed. This study aids in our understanding of the hot springs in the Rabbit Creek area and of the potential effects of the Mallard Lake Dome on the Midway Geyser Basin.

10:15-10:30am

SEPARATION FEATURES OF FINE PARTICLE PROCESSING IN A CROSSFLOW SEPARATOR (ORAL)

John Hansen-Carlson, Department of Metallurgical and Materials Engineering, Montana Tech of the University of Montana, Butte

Avimanyu Das, Department of Metallurgical and Materials Engineering, Montana Tech of the University of Montana, Butte

A Cross Flow Separator works on the principle of hindered settling and liquid fluidization to accomplish gravity concentration of fine particulate mass. Heavier particles penetrate the fluidized suspension to settle at the bottom to be discharged as the underflow while the lighter particles remain at the top and are carried away by the upward flowing water to the overflow outlet. Influence of bed depth, feed rate and teeter water flow rate on the separation features along with the response of feed particle size was investigated with reference to a difficult fine coal (1.4 x 0.1 mm) having 33% ash. Characterization of the feed was followed by a detailed experimental program using response surface methodology. Products of each experiment were characterized to understand the separation mechanism and how various particles respond to the process conditions. The process responses were estimated in terms of mass yield, ash levels of both products and combustible recovery. The experimental data were analyzed to arrive at statistically significant correlations for the response variables. The process was optimized and under optimum conditions, clean coal with 24% ash at 63% mass yield and over 70% combustible recovery was obtained. Overall Ep was 0.34 with an effective separation density of 1.81 g/cc. It was concluded that a ratio of 10:1 between the top and the bottom sizes of the particles may be acceptable in the feed material. The importance of the flow behavior was discussed. The process features were also described phenomenologically vis-à-vis the experimental observations.

10:45-11:00am

MACROINVERTEBRATES AS INDICATORS OF WATER QUALITY IN BLACKTAIL CREEK (ORAL)

Ryan Koch, Department of Biological Sciences, Montana Tech of the University of Montana, Butte
Stella Capoccia, Department of Biological Sciences, Montana Tech of the University of Montana, Butte
Mark Mariano, Department of Biological Sciences, Montana Tech of the University of Montana, Butte

Blacktail Creek, located in Butte, Montana, has a long history of human-caused contamination. Mine waste has polluted parts of its streambed since the late 1800's, causing extensive loss of vegetative diversity along the creek, as well as a loss of aquatic life. The Blacktail Berm is an area currently estimated to contain 35,000 cubic yards of toxic mine tailings. The future removal of remaining mine tailings in Butte is not a certainty at this point, but planning removal and restoration of these contaminated areas has been discussed extensively in recent years. In order to help provide baseline data prior to future restoration efforts, this study was conducted to survey the aquatic macroinvertebrate populations in Blacktail Creek. Macroinvertebrates are often used as part of an assessment of stream health, particularly in relation to restoration work. The presence and abundance of specific aquatic macroinvertebrates can be used to get an idea of the water quality of the stream. Macroinvertebrate samples were collected at five locations along Blacktail Creek from September 13, 2016 through September 17, 2016. Along with stream conductivity, temperature, and dissolved oxygen, an Ephemeroptera, Plecoptera, and Trichoptera (EPT) index assessment was completed. The EPT index used for this assessment provided good, fair, or poor water quality ratings for Blacktail Creek based on the ratio of EPT macroinvertebrates to total macroinvertebrates in a single sample. The results will provide data useful in long-term monitoring of these macroinvertebrate populations before, during, and after the cleanup of Blacktail Creek.

11:00-11:15am

RHETORIC, VISUAL RHETORIC, AND THE 1950'S BETTY CROCKER COOKBOOKS (ORAL)

Barbara Cass, Professional and Technical Communication, Montana Tech of the University of Montana, Butte

This study explores the importance of Betty Crocker to her cookbooks in the 1950's. The Betty Crocker Cookbook was an instruction manual that fits within a particular genre of technical communication. These technical manuals included instruction for women on how to prepare and cook aesthetically pleasing and wholesome meals. The Betty Crocker Cookbook went beyond established norms of cookbook instruction by adding helpful hints on how to be a perfect housewife. Rhetorical and visual analysis of the 1950's Betty Crocker Cookbooks shows the importance of these particular cookbooks was Betty Crocker herself. Because she was an authority on all things pertaining to the kitchen, women accepted this authority, in part because of the ethos of Betty Crocker, a trusted figure and someone they felt a relationship with. She was with them through the Great Depression and World War II, and she was the voice on the radio that brought a sense of normalcy in a turbulent time, the fact that Betty Crocker was a fictional construct did not matter.

11:15-11:30am

FINITE-DIFFERENCE MODELING OF 2-D COMPRESSIONAL WAVEFIELD (ORAL)

Chau Duc Minh Ha, Mathematical Sciences Department, Montana Tech of the University of Montana, Butte

This project discusses the derivation of the 2-D compressional wavefield (P-wave) and its finite-difference approximation. In developing this wavefield, we have two approximations. First, the subsurface density is assumed to be a constant. Second, the angle of wave propagation is less than 15^0 with respect to the surface (horizontal direction). The algorithms are used to demonstrate the propagation of P-wave through a simple subsurface model. Although not discussed in this project, the same algorithms are also able to model the propagation of P-wave in another complex model and the success of depth-imaging algorithms in recovering the subsurface structures indicates the accuracy of the approximations for most modeling purposes. Future studies include modeling P-wave in 3-D, modeling elastic wavefield in 2/3-D, and extending the angle of propagation to more accurately model incoming waves at the edge of the computational grid.

11:30-11:45am

HIGH SATURATED FAT-ENRICHED DIET EVOKES ENDOPLASMIC RETICULUM STRESS AND CONSEQUENTLY INCREASES β- SITE APP CLEAVING ENZYME 1 ACTIVITY IN AMYLOID-BETA ENGENDERMENT IN THE BRAIN (ORAL)

Gurdweep Marwarha, School of Medicine & Health Sciences, University of North Dakota, Grand Forks
Othman Ghribi, Department of Biomedical Sciences, School of Medicine & Health Sciences, University of North Dakota, Grand Forks

Alzheimer's disease (AD) is the most common form of dementia in the elderly that is histo-pathologically characterized by extracellular accumulation of aggregated Amyloid-β (Aβ) peptide as neuritic senile plaques and the intracellular accumulation of aggregated hyperphosphorylated protein tau (τ) as neurofibrillary tangles. The aspartyl protease BACE1 is indispensable for the engenderment of Aβ and catalyzes the rate-limiting step in Aβ genesis from AβPP. The expression of BACE1 protein as well as its enzymatic activity is significantly augmented in the AD brain. The etiology of AD is multifactorial and egregiously comprehended, but epidemiological studies have implicated a diet rich in saturated free fatty acids (sFFA) as a significant risk factor for developing AD. Palmitic acid (palmitate) is the most abundant long-chain free saturated fatty acid in the brain and the diet and higher palmitate levels in the plasma, as observed in obesity and diabetes, inversely correlate with cognitive function. Recent cogent evidence has implicated endoplasmic reticulum (ER) stress as one of the culpable factors in initiating and fostering the deleterious neurodegenerative changes in AD. A multitude of studies have cogently demonstrated that sFFA such as palmitic acid evoke ER stress. In this study we demonstrate that palmitate evokes ER stress leading to the induction of CHOP expression which indispensably mediates the up-regulation in BACE1 expression and Aβ engenderment via the NF-κB signaling pathway. Our study unveils a novel ER stress/CHOP/NF-κB signaling pathway and delineates the molecular mechanism thereof that mediate the palmitate-induced up-regulation of BACE1 expression.

11:45am-12:00pm

RELATIONSHIP OF ATHLETIC INJURIES TO ATHLETIC SEASON (ORAL)

Jessica Ream, University of Great Falls, Great Falls

In the world of sport, to be an excellent athlete, one must have the necessary physical attributes, appropriate environment, and personality variables to succeed. However, a critical variable that affects every aspect of athletic ability is athletic injury. Injuries have negative consequences for the athlete's health, training, and competitive performance. Maintaining an absence of injuries is pivotal for the athletic individual and the team as a whole.

This research characterizes the relationship between type and duration of athletic injuries in different sports and months of occurrence during the period 2012-2015. Archival data was collected from the University of Great Falls, Montana State University, and Westminster College. Due to the higher injury rates, the sports of focus were women's volleyball, women's softball, women's basketball, men's wrestling, and co-ed cheer. This presentation will summarize findings and implications for athletic trainers, coaches, and players.

1:00-1:15pm

DESIGN AND SYNTHESIS OF PROLIGAND PYRIDINE-2,6-DITHIOCARBOXYLIC ACID AND STRUCTURAL DERIVATIVES FOR USE IN ENVIRONMENTAL REMEDIATION OF CARBON TETRACHLORIDE (ORAL)

Ky Mickelson, Department of Chemistry and Biochemistry, Montana State University, Bozeman
Thomas Livinghouse, Department of Chemistry and Biochemistry, Montana State University, Bozeman
Matt Queen, Department of Biological and Physical Sciences, Montana State University – Billings, Billings
Thomas Lewis, Department of Biological and Physical Sciences, Montana State University – Billings, Billings

Carbon Tetrachloride is a carcinogenic pollutant that has contaminated groundwater beneath former grain storage and industrial sites, such as the Department of Energy's Hanford site. Current remediation of these sites involve removal and subsequent treatment, which requires handling of the hazardous material as it is transferred to another location for final destruction. Professor Thomas Lewis has previously described the use of a small molecule (pyridine-2,6-dithiocarboxylic acid [PDTC]), that when complexed with copper has been shown to lead to complete dechlorination of pollutant carbon tetrachloride within atmospheric samples. The process results in conversion to non-toxic end-products (mostly CO_2) and complete removal of the problematic carbon-chlorine bonds. Synthetic chemistry can be employed to develop a series of PDTC derivatives that could increase water solubility and allow for on-site destruction of carbon tetrachloride. The current methods described in literature for the synthesis of proligand PDTC uses or produces large quantities of toxic hydrogen sulfide gas. A modified procedure for large-scale production of PDTC, with minimal hydrogen sulfide production, was successfully developed. However, this method will not be able to be utilized for synthesizing derivatives of PDTC, which defines the need for a novel approach to the development of proligand derivatives. An elegant approach using a dilithiated addition into carbonyl sulfide is currently under investigation to produce PDTC and several derivatives that could be functionalized for use in environmental remediation of carbon tetrachloride.

1:15-1:30pm

USING NUCLEAR MAGNETIC RESONANCE (NMR) METABOLIC PROFILING TO DISTINGUISH HERDS OF BIGHORN (*OVIS CANADENSIS*) SHEEP (ORAL)

Melissa Lambert, Department of Animal and Range Sciences, Montana State University, Bozeman
Jesse White, Department of Animal and Range Sciences, Montana State University, Bozeman
Valerie Copie, Department of Chemistry and Biochemistry, Montana State University, Bozeman
Brian Tripet, Department of Chemistry and Biochemistry, Montana State University, Bozeman
Carson Butler, Ecology Department, Montana State University, Bozeman
Robert Garrott, Ecology Department, Montana State University, Bozeman
James G. Berardinelli, Department of Animal and Range Sciences, Montana State University, Bozeman

The objective of this study was to determine if nuclear magnetic resonance (NMR) metabolic profiling has the potential to serve as a management tool for evaluating herds of bighorn (Ovis canadensis) sheep. Two-hundred and forty bighorn sheep serum samples from 13 herds located in Montana and Wyoming were processed for NMR spectra, profiled for small molecule metabolites using Chenomx®, and then analyzed with MetaboAnalyst (v3.0). Fifty-six small molecule metabolites were identified in ungulate serum. To determine if NMR metabolic profiles can distinguish herds that are geographically distinct with access to different nutritional resources, herds collected in December were compared to herds collected in March. Partial least square discriminant analysis (PLS-DA) indicated a clear, majority separation of metabolic shifts with minor overlaps. Biomarker analysis identified 15 potential biomarkers from the compounds with variables of importance (VIP) scores greater than 1.0. These molecules enabled us to identify 'significantly' important metabolic pathways that discriminate herds sampled in December and herds sampled in March. Key biomarkers resulting from the pathway analysis, included: 2-oxoisocaproate, choline, tyrosine, creatinine, and trimethylamine n-oxide. To determine if metabolic profiling can distinguish individual herds within a month, herds in December, January and March were compared to a domestic, Rambouillet ewes (control) sampled during the sample months. PLS-DA of all herds showed clear metabolic shifts and complete separation between each individual herd and the control ewes for each month. Potential biomarkers for herds within a season that were found to be good discriminants for the December herds included: trimethylamine n-oxide and sarcosine; for January herds included: creatinine and asparagine; and, for March herd included, creatinine. Through identification of small molecule metabolites, it is possible to discriminate herds from each other within and between seasons. These biomarkers represent a potential panel of metabolites that may be used for assessing nutritional status, environmental stress, and herd health through the identification of significantly important metabolic pathways related to energy and protein balance.

1:30-1:45pm

THE WORD PROBLEM FOR HYPERBOLIC GROUPS (ORAL)

Tyler Taylor, Montana Tech at University on Montana, Butte
Atish Mitra, Mathematics Department, Montana Tech at University on Montana, Butte

Max Dehn's word problem asks us the following: Given a finitely generated group in terms of generators and relations, is there an algorithmic procedure to determine if an arbitrary word represents the identity element? In this undergraduate research project, we define the notion of hyperbolicity of a metric space and present a geometric proof that all hyperbolic groups have solvable word problems.

1:45-2:00pm

CONTINUOUS NOWHERE DIFFERENTIABLE FUNCTIONS (ORAL)

Tyler Taylor, Montana Tech at University of Montana, Butte
Waleed Al-Rawashdeh, Department of Mathematical Sciences, Montana Tech of the University of Montana, Butte

In this presentation we study functions that are continuous everywhere on their domain but differentiable nowhere. One such function is the function whose graph is called the Kiesswetter curve. First we construct the curve and the piece-wise function that represents that curve. We prove several key properties of the function that gives us insight to why this function is continuous on the unit interval. We then prove the continuity and non-differentiability of the function.

2:00-2:15pm

ESSENTIALLY NORMAL COMPOSITION OPERATORS ON THE HARDY SPACE (ORAL)

Jeff Preston, Montana Tech of the University on Montana, Butte
Waleed Al-Rawashdeh, Department of Mathematical Sciences, Montana Tech of the University on Montana, Butte

In this presentation we will explore composition operators on the Hardy space. We will investigate what it means for such composition operators to be essentially normal. The following question will be answered in this presentation: Are there any composition operators on the Hardy space which are essentially normal but which are not compact?

2:30-2:45pm

GROWTH OF FINITELY GENERATED GROUPS (ORAL)

Jeff Preston, Montana Tech at University of Montana, Butte
Atish Mitra, Department of Mathematical Sciences, Montana Tech of the University of Montana, Butte

Given a finitely generated group, we study various growth functions and growth series. We calculate growth functions for certain groups of polynomial and exponential growth, and study R. Grigorchuk's example of a group with intermediate growth. We examine relations between algebraic properties of a finitely generated group and the equivalence class of its growth functions.

2:45-3:00pm

EXTENSION THEORY IN COARSE GEOMETRY (ORAL**)**

Atish Mitra, Department of Mathematical Sciences, Montana Tech of the University on Montana, Butte

LSAEs (Large Scale Absolute Extensors) were introduced by J. Dydak and the author to study the coarse geometry of metric spaces. In this talk we will discuss how this concept can be used to study extensions of proper large scale Lipschitz functions between metric spaces.

3:00-3:15pm

WOMEN'S EXPERIENCES AND PERSPECTIVES OF CERTIFICATION SCHEMES AND EMPOWERMENT IN THE COSTA RICAN COFFEE INDUSTRY (ORAL)

Laura Stein, W.A. Franke College of Forestry and Conservation, University of Montana, Missoula

Coffee certification schemes, such as Fair Trade, Rainforest Alliance, and Organic, influence the environmental, economic, and social conditions of the global coffee industry by promoting sustainable production practices and equitable trade relations. Over the past three decades, studies show that adhering to environmental standards supports ecological conservation in agricultural communities. However, research examining the economic and social impacts among producers yields mixed results due to context-specific factors such as management strategies, landholding size, and market conditions. Furthermore, although many certification schemes incorporate gender equality and women's empowerment initiatives, little attention has been given to the perspectives of women producers, many of whom confront challenges due to socially constructed gender norms. This research addresses this gap in knowledge through case study analysis of two organizations in southern Costa Rica: CoopeAgri, a mixed-gender producer cooperative, and ASOMOBI, an all-women's coffee association. Data were gathered through in-depth interviews, document analysis, and participant observation within each organization. Preliminary results suggest that while the majority of women believe certifications can provide benefits, there are significant costs (i.e., money, time, energy), and the actual benefits received can be minimal. Although certifications may not provide a comprehensive solution to the challenges facing women in Costa Rica's coffee industry, the majority of women feel empowered through involvement in local organizations and women's groups. This research adds new perspectives to the growing body of literature regarding the efficacy of coffee certification schemes and has implications for certification agencies and local-level organizations in Costa Rica and other coffee producing countries.

3:15-3:30pm

AMPHIBIAN RISK ASSESSMENT IN MONTANA (ORAL)

Alex Kurtz, Department of Biochemistry and Molecular Biology, Carroll College, Helena

The fungus, *Batrachochytrium dendrobatidis*, has been found to negatively impact amphibian populations around the world. This fungus can have multiple effects on frogs and salamander physiology, including changes in osmotic regulation that may lead to death. *B. dendrobatidis* has been shown to be the driving force for many amphibian population crashes and extinctions around the world. The purpose of this project was to build a predictive model of *B. dendrobatidis* infection, one that would be used to assess population susceptibility in order to identify populations of amphibians at risk of infection. This was accomplished by statistical analyses of several components that contribute to infection vulnerability, including amphibian antimicrobial peptide production, cutaneous bacterial colony structure, infection status for each frog and water nutrient composition. This project collected baseline data that will allow us to establish meaningful relationships between susceptibility factors and disease which will permit the identification of populations at risk.

3:30-3:45pm

POTENTIAL FACTORS DRIVING SANDBERG'S BLUEGRASS GROWTH IN RELATION TO SAGEBRUSH COVER (ORAL)

Nate Haygood, Montana State University, Bozeman
Clayton Marlow, Department of Animal and Range Sciences, Montana State University, Bozeman

Sandberg's bluegrass (*Poa secunda*) is a native perennial bunchgrass found throughout most of the Intermountain West. Like many other cool season bunchgrass species, Sandberg's bluegrass is a valuable and readily attainable forage as winter snowpack thaws and recedes. Because a large percent of Western North American rangeland is co-dominated by shrubs, it is paramount that land managers have an adequate and increasingly broad understanding of the biology and relationship between grasses and shrubs. With this in mind, we measured water availability, soil temperature, and basal area of Sandberg's bluegrass plants inside and outside of the sagebrush canopy as well as a simple plant count with the purpose of evaluating potential drivers behind growth and success of this species. Basal areas were significantly greater inside the canopy versus outside ($P = 0.033$) which was consistent with our hypothesis. Soil temperature was significantly lower inside the canopy versus outside ($P = 0.049$) while soil water content was not significantly different. However, there was no significant correlation between basal area and soil water content or soil temperature. We infer from the data collected that Sandberg's bluegrass is indeed more robust and numerous within the canopy of sagebrush compared to outside the canopy; however, the primary driver for this is still unclear. It is our conclusion that future research is needed in order to evaluate and identify the reason for this occurrence.

3:45-4:00pm

YELLOWSTONE UNDER SIEGE: SLOWING THE MARCH OF INVADERS

Shannon Dillard, Department of Land Resources & Environmental Sciences, Montana State University, Bozeman
Anthony Hartshorn, Department of Land Resources & Environmental Sciences, Montana State University, Bozeman

Cathy Zabinski, Department of Land Resources & Environmental Sciences, Montana State University, Bozeman
Jane Mangold, Department of Land Resources & Environmental Sciences, Montana State University, Bozeman

The Greater Yellowstone Ecosystem is one of the most intact temperate ecosystems in the world. But Yellowstone is under threat -- over 15% of current documented flora in Yellowstone National Park (YNP) is non-indigenous, with climate models predicting invasive species on the rise in hotter and drier environments exhibiting reduced ecosystem resiliency. Alyssum desertorum, a non-native forb that has invaded nearly 300 hectares (~750 acres) of YNP, has been targeted by the National Park Service with an ambitious and comprehensive revegetation project. The project has struggled with revegetation success due to variable spring water conditions, which are also changing as weather patterns become hotter and drier. This study looks at microtopography (human-made surface roughness, creating microclimates of small-scale topographic highs and lows) on revegetation sites as a means for improving soil water storage. Microtopography should favor native plants due to increased snow cover, choking out the winter annual Alyssum desertorum and holding soil water later into the growing season. Early spring censuses of invasive plants (presence/absence, percent cover) were compared to precipitation, temperature, and soil moisture data in areas receiving topographic treatment and those without. Other restoration treatment methods, alone and in combination with microtopography, may have the potential to inform management of simple and inexpensive fixes for revegetation success in semi-arid environments.