

THE NEW MEXICO HIGHLANDS UNIVERSITY  
FACULTY RESEARCH COMMITTEE PRESENTS

# 11<sup>TH</sup> ANNUAL RESEARCH DAY

FRIDAY, APRIL 5, 2013  
STUDENT CENTER  
BALLROOM

*CELEBRATING THE RESEARCH AND SCHOLARLY  
ACCOMPLISHMENTS OF FACULTY AND STUDENTS*



NEW MEXICO  
HIGHLANDS  
UNIVERSITY<sup>®</sup>

## President's Statement

**Learning and the advancement of knowledge** represent the *raison d'être* for any university. Here at New Mexico Highlands University, this is represented by faculty and students alike through a wide array of research, scholarship, and other creative activities. Research Day is an opportunity to share and disseminate the results of one's work with the broader community and for everyone to learn more through the reactions and interactions that result. I want to applaud and congratulate everyone who is sharing their work on this 10<sup>th</sup> annual Research Day and to thank all those responsible for pulling it together.

Jim Fries  
President



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## Welcome

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### **Welcome to the 11<sup>th</sup> Annual New Mexico Highlands University Research Day.**

Highlands University in 2013 continues our tradition of showcasing the passion for scholarship, research excellence and creativity of our faculty and students. Much of the faculty research presented today represents work that was supported by funds awarded by the Faculty Research Committee. Research and travel grants are awarded each term to faculty members through a rigorous review and selection process. In addition, faculty members may apply for time away from teaching duties to pursue grants and awards from outside NMHU. The Faculty Research Committee congratulates all grant recipients and encourages *all* faculty members to apply for research funds, conference travel support, and grant-writing release time.

Many of the student presentations represent work that was funded through the Student Research Fund of the NMHU chapter of Sigma Xi, the Scientific Research Society. We congratulate them on their accomplishments and applaud all of our student participants from every discipline for their hard work and dedication to research, creativity and academic advancement. The New Mexico Highlands University Sigma Xi chapter's mission is to enhance the health of the research enterprise, foster integrity in science, and promote the public's understanding of science for the purpose of improving the human condition. The society is a diverse, chapter-based organization dedicated to the advancement of science and engineering through outstanding programs and services delivered in a collegial and supportive environment. For more information about the NMHU chapter and its activities, please visit [nnmex.net/sigmaxi](http://nnmex.net/sigmaxi).

For more information about the Faculty Research Committee and programs, please contact Richard Plunkett (2012-13 Faculty Research Committee Chair) at 505-426-2118 or [rplunkett@nmhu.edu](mailto:rplunkett@nmhu.edu). You are also invited to visit the Faculty Research Committee's web page at:

[www.nmhu.edu/FacultyStaff/research/committee.aspx](http://www.nmhu.edu/FacultyStaff/research/committee.aspx).

## Acknowledgements

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The Faculty Research Committee wishes to thank New Mexico Highlands University for its continued recognition and support of the research and scholarly activities of its faculty and students. In particular, we thank President Jim Fries and Vice Presidents Linda LaGrange and Gilbert Rivera for their continued support of faculty research. We recognize Richard Plunkett, Chair of the Faculty Research Committee, for coordinating this event, including the faculty and student oral presentations, and student poster presentations. We thank the NMHU Sigma Xi chapter for judging the student poster competition, and extend our gratitude to the NMHU Graduate Student Senate for sponsoring the poster sessions. We kindly acknowledge Ms. Germaine Alarcon for her enthusiastic assistance and continued support of the Faculty Research Committee and its grant awardees.

Additional financial support for this event is provided by the Faculty Research Committee.

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## 2013 New Mexico Highlands University Research Day Schedule of Events – Student Center Ballroom

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- 8:00 Poster Setup**  
**8:30 Poster Display** (ongoing until 4:00)
- 8:45 Introduction & Opening Remarks**
- 9:00 Richard Plunkett, Ph.D.** (Biology)  
*Searching for Novel Insect & Amphibian Antimicrobial Peptides*
- 9:30 Reyna Montaño** (Biology)  
*The Effects of Biochar Amendments to Arid Soils (aridisols) on Water Retention and Microbial Abundance*
- 9:45 Olivia Ayala** (NMHU Honors)  
*Women-The Road to Becoming the Boss*
- 10:00 Saul Ruiz-Palacios** (Biology)  
*Antimicrobial Activity of Proteins Extracted from the West Indian Leaf Cockroach (Blaberus discoidalis)*
- 10:15 MORNING BREAK**
- 10:45 Michael Petronis, Ph.D.** (Geology)  
 Recent Advances in Neoproterozoic Glacial Systems: What We Know and What We Think We Know Regarding Neoproterozoic Geochemistry, Paleoclimate Models, Paleo-Rock Magnetism, and Sedimentology
- 11:15 William Jaremko-Wright** (Natural Resource Management)  
*The Role of Wintering Frugivores in the Dispersal Ecology of One-seed Juniper in Northeastern New Mexico Rangelands*
- 11:30 Jennifer Lindline, Ph.D.** (Geology)  
*U-Pb Geochronology Of Proterozoic Granitoids In The Southern Sangre De Cristo Mountains, New Mexico*
- 12:00 LUNCH BREAK & POSTER SESSION – Authors will be present from 12:00 – 1:30 for judging**

## 2013 New Mexico Highlands University Research Day Schedule of Events – Student Center Ballroom

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- 1:30**    **Jesús Rivas, Ph.D.** (Biology)  
*The data versus the model: An anaconda's tale about growth rate, survival, and demography*
- 2:00**    **Micah Daboub** (Biology)  
*A license to kill: The biological control of non-endemic invasive species*
- 2:15**    **Adam Brister** (Geology)  
Paleomagnetic, Anisotropy of Magnetic Susceptibility, and structural Data  
Bearing on Magma Emplacement and the growth of the Miocene, Cinder Cone
- 2:30**    **Deisy Hernandez-Lujan**  
Who's Your Daddy? Parentage Analysis of Green Anacondas (*Eunectes murinus*)
- 2:45**    **AFTERNOON BREAK**
- 3:00**    **Carol Linder, Ph.D.** (Biology)  
*Unraveling pathways required for male fertility*
- 3:30**    **José Griego** (Biology)  
*Leopard Frog Population Structure in Various Fragmented Habitats*
- 3:45**    **Poster Awards & Closing Remarks**
- 4:00**    **Poster Pick-up** (until 4:30)

## Abstracts

Listed alphabetically by author (presenter indicated by asterisk)

### Faculty Oral Presentations

#### Unraveling pathways required for male fertility

Carol C. Linder\*, Ph.D., Associate Professor, Biology

It is estimated that genetic factors are responsible for 15%–30% of human cases of male infertility. Mouse models are well suited to identifying genes and unraveling mechanisms required for spermatogenesis and fertility. *Golga3<sup>repro27</sup>* mutant mice have a mutation in Golgin subfamily A member 3 protein, GOLGA3, do not express GOLGA3 protein, and exhibit complete male infertility. GOLGA3 is a Golgi complex-associated protein involved in protein targeting, vesicle trafficking, and apoptotic signaling although its role in spermatogenesis remains undefined. *Golga3<sup>repro27</sup>* mutant mice show multiple defects in spermatogenesis including a disruption in late meiosis leading to germ cell death. Surviving cells exhibit abnormal development, including defects in the formation of the sperm head and tail. Interestingly, the spermatogenic defects caused by the *Golga3<sup>repro27</sup>* mutation are more pronounced in the C57BL/6J (B6) strain compared to C3HeB/FeJ (C3Fe) strain. Next generation high throughput sequencing was used to determine differential gene expression between wildtype and *Golga3<sup>repro27</sup>* mutant mice in two well-established mouse strains: B6 (mt: C57BL/6J- *Golga3<sup>repro27</sup>* (B6-27)) and C3Fe (mt: C3Fe.B6-*Golga3<sup>repro27</sup>* (C3-27)). Using the DeSEQ analysis tool, strain-specific gene expression signatures were identified between mutant and wildtype in the B6 strain (91 genes: 80 genes up regulated in B6-27) and C3Fe strain (127 genes: 125 genes down regulated in C3-27), 45 genes were significantly different in both B6-27 and C3-27 compared to controls. This global gene analysis study is providing new avenues for research and clues into genetic pathways required for male fertility.

#### U-Pb Geochronology Of Proterozoic Granitoids In The Southern Sangre De Cristo Mountains, New Mexico

Jennifer Lindline\*, Ph.D., Professor, Geology, Danielle Cedillo, and Andrew Romero

The Hermit's Peak batholith, a Proterozoic metamorphic-plutonic massif in the southern Sangre de Cristo Mountains, is located in the tectonic transition zone between the Yavapai and Mazatzal Precambrian provinces. During Fall 2012, we conducted zircon geochronology at the University of Arizona's LaserChron Center on five previously undated Hermit's Peak batholith intrusions to establish the timing of magmatism relative to Proterozoic deformation events. The Gallinas Canyon felsite is a fine- to medium-grained quartzofeldspathic gneiss that yielded a date of **1.705±0.017 Ga** (billion years). The gneiss displays a strong penetrative steeply dipping northeast striking foliation. It is frequently interlayered with fine- to medium-grained amphibolite and commonly intruded by K-feldspar megacrystic alaskite pegmatites. The Hermit's Peak granite is a coarse equigranular and variably foliated rock. A sample of the Hermit's Peak granite from Porvenir Canyon yielded a date of **1.700±12.1 Ga**. The Evergreen Valley tonalite is a coarse equigranular strongly foliated garnet-bearing hornblende-biotite tonalite that crystallized at **1.736±0.014 Ga**. It was intruded by the Evergreen Valley granite-gabbro complex which yielded ages of **1.448±0.012 Ga** and **1.450±11.8 Ga**, respectively. The granite-gabbro complex is layered on the macroscale but lacks a foliation. Our results illustrate the episodic nature of magmatism in the Hermit's Peak batholith at circa 1.7 and 1.4 Ga as well as the prevalence of pre-1.45 Ga deformation. Our ongoing studies are addressing: *What is the structural relationship between the Hermit's Peak granite and its host rocks?* If field and microstructural studies conclude that the Hermit's Peak granite was emplaced syntectonically, it could constrain the timing of the Yavapai-Mazatzal collision. *Does the Evergreen Valley complex represent a bimodal continental rift-like system?* Such would require resurrecting the anorogenic tectonic setting of 1.4 Ga magmatism throughout the region.



## Recent Advances in Neoproterozoic Glacial Systems: What We Know and What We Think We Know Regarding Neoproterozoic Geochemistry, Paleoclimate Models, Paleo-Rock Magnetism, and Sedimentology

\*Michael S Petronis<sup>1</sup>, Ph. D. (Associate Professor, Geology), #Darren Lemen<sup>1</sup>, Carl Stevenson<sup>2</sup>, #Edward Fleming<sup>2</sup>, Ian Fairchild<sup>2</sup>, Michael Hambrey<sup>3</sup>, Doug Benn<sup>4</sup>

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#student author

The various Snowball/Slushball Earth hypotheses attempt to examine the most extreme climatic shifts in our planet's history. Numerous cross-disciplinary studies provide compelling as well as controversial evidence for low latitude glaciations that suggest the entire globe experienced pan-glaciation events. Copious debate remains as to whether it is possible for a planet to experience a global glaciation (snowball), if the glacial events were truly global (slushball), how did the climate break free from the big freeze, and did these events catalyze a boom in multi-cellular life? The Neoproterozoic (1,000 – 542 Ma) is well known for its ice ages, in particular, the Cryogenian Era (850 – 635 Ma). In Ny Friesland, Svalbard, Norway and on the island of Ella Ø in East Greenland, a Caledonian fold and thrust belt has exposed a thick succession of Neoproterozoic through Ordovician strata including exceptionally well preserved glacial sediments of the Polarbreen Group which includes the globally correlated Wilsonbreen Formation associated with the Marinoan Glaciation. Here we summarize a multidisciplinary study to present the latest advances in Neoproterozoic geochemistry, geochronology, paleoclimate models, paleo-rock magnetism, glacial and carbonate sedimentology, and the paleolatitude of the deposits during the Cryogenian Era from Svalbard, Norway and East Greenland.

## Searching for Novel Insect & Amphibian Antimicrobial Peptides

Richard M. Plunkett\*, Ph.D., Assistant Professor, Biology

As we enter the 21<sup>st</sup> century we leave behind the “Golden Age of Antibiotics”. The attributes that once made antibiotics a primary weapon in the war against infections have contributed to the development of many antibiotic resistant strains of pathogenic bacteria, with associated human and economic costs. Progress has been made against some resistant infections (e.g. methicillin-resistant *Staphylococcus aureus* (MRSA) and rifampin-resistant pathogens), however the emergence of many new antibiotic resistant infections underscores the need for novel treatments that effectively combat infection while minimizing the risk of resistance. Organisms from all domains of life use potent antimicrobial peptides (AMPs) as part of their innate defenses against pathogens. We have developed several hybrid AMPs (hAMPs) by using natural AMPs as models, e.g. cecropin, with two alpha helical domains joined by a flexible hinge. By combining structural motifs of previously characterized AMP from both invertebrates and vertebrates (e.g. insects and amphibians) we have demonstrated that hAMPs can be generated with low minimum inhibitory concentrations against several representative Gram negative and Gram positive organisms. However, predicting the activity spectra of hAMPs from the activities of the parent molecules, especially concerning eukaryotic cells, has been problematic. Our hAMPs with the highest potency against bacteria also displayed hemolytic activities when tested against mammalian red blood cells. In our pursuit of novel source material for hAMPs we are also seeking uncharacterized AMPs from amphibians such as bullfrogs (*Lithobates catesbeianus*) and leopard frogs (*L. pipiens*), and from insects including several species of cockroach (e.g. *Periplaneta americana* and *Blaberus discoidalis*). Because they have been implicated as sources of potent antibacterial compounds, we have collected skin peptides from frogs, and proteins from hemolymph, fat body and brain from cockroaches for isolation and characterization of antimicrobial peptides. In addition, we have initiated transcriptome analysis for one species of cockroach (*Periplaneta americana*). When completed, this will facilitate a bioinformatics approach to novel peptide discovery. Each aspect of this project has provided student research opportunities and building collaborations with other investigators. These studies also hold possibilities for basic science leading to discoveries in immunology and genetics, and may serve as starting points for several new lines of investigation. Future efforts building on this work may potentially lead to the discovery of compounds with great potential for development into effective chemotherapies to fight infection.

## **The data versus the model: An anaconda's tale about growth rate, survival, and demography**

**Jesús Rivas\*, Ph.D, Assistant Professor, Biology**

Our understanding of demography of long living snakes has increased by leaps and bounds thanks to long term studies in a few taxa. However, data from the tropics have not been as abundant, particularly regarding South American species. Here I present data from a 19-year long mark and recapture study on green anacondas from a location in the Venezuelan llanos. I collected data from 917 captures (444 females and 473 males) and re-caught 210 in an area of approximately 2500 h. I modeled the anaconda population using MARK (CJS model). The estimated population size is 394 anacondas with 286 males and 108 females. The apparent contradiction between the data from the field and the results of the model falls into place when considering the length of the study and other aspects of anaconda biology. Females experience lower survival (65%) than males (77%) from year to year. This difference in survival explains the male bias in the estimated population. The higher mortality among females is surprising because females face few predators due to their larger size. However, females tackle larger, more dangerous prey. Risk of injury and even death while attacking a large prey may be associated to their lower survival. This study emphasizes the need for comprehensive long term studies that address all aspects of life history, including input from both field work and theoretical models, as the best approach to gain a complete understanding of the animal's ecology.

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NOTES:

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## Student Oral Presentations

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### Women-The Road to Becoming the Boss

Olivia Ayala \*, Undergraduate Honors Student

The topic of this paper is women's success in the business world as top level managers. To show how they have reached that success the paper includes a history of women in the workforce and their progression to becoming top managers in small businesses and in the corporate world. The history of women's progression toward that goal is shown in this paper from the time of World War II to today's current standings. To help show that progression, books such as *The Feminine Mystique* by Betty Friedan and *A Strange Stirring* by Stephanie Coontz are used to identify the changes that influenced women to join the workforce, as well as the circumstances that prevented them from further achievement. The paper then goes further in discussing how far the progression of women will continue, or if it has reached its peak.

### Paleomagnetic, Anisotropy of Magnetic Susceptibility, and structural Data Bearing on Magma Emplacement and the growth of the Miocene, Cinder Cone

\*Adam Brister<sup>1</sup> (Graduate Student, Geology) Petronis, M.S.<sup>1</sup>, Lindline, J.<sup>1</sup>, van Wyk der vries, B.<sup>2</sup>, Rapprich, V.<sup>3</sup>, Cedillo, D <sup>1</sup>

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The Trosky Volcano is a monogenic cinder-spatter cone associated with the middle Miocene Jičín Volcanic field of northeast Czech Republic. The intent of this research is to map the Trosky Volcano subvolcanic deformation, magma plumbing system geometries, eruptive dynamics, and cinder cone morphology using paleomagnetic, anisotropy of magnetic susceptibility (AMS), and structural data. The results from this study will be used to compare and contrast three other monogenic volcanoes that exhibit exposed magma feeders systems. We hypothesize that cinder cones conceal multiple magma conduits as opposed to a single conduit as envisioned for many volcanic constructs. By comparing the results from three other monogenic volcanic centers 1) Cienega Volcano, NM, 2) several quarried volcanoes in the Raton-Clayton volcanic field, NM, (future study) and 3) Lemptégy Volcano, France to the data from the Trosky Volcano should enhance our understanding of both ancient and active intra-rift volcanic systems. Preliminary results are encouraging with high values of magnetic susceptibility, single component demagnetization response, and pseudosingle domain grain size. The data obtained will enhance our understanding of subsurface magma transport to the eruptive vent and provide insight into subvolcanic deformation processes. These data should further allow us to provide insight into the growth and hazards associated with active volcanic systems worldwide.

### A license to kill: The biological control of non endemic invasive species

Micah Daboub\*, Graduate Student, Biology

Invasive species are a leading conservation problem that threatens to eliminate native species by predation and exploitation of habitats. The American Bullfrog (*Lithobates catesbianus*), native to northeastern United States, is a priority class III invasive species that is widely established in northern New Mexico. . Riparian vegetation on the Mora River has declined from human activities, specifically overgrazing of pastures and the harvest of large riparian trees. Bullfrogs are believed to utilize these anthropomorphically-degraded riparian conditions consisting primarily of seral stages of thick grassy vegetation, uncommon in the native habitat of northern New Mexico floodplains. We utilized temperature recording radio telemetry equipment ( $n = 4$ ) to identify home range and habitat selection of Bullfrogs in Rio Mora National Wildlife Refuge. We found that adult bullfrogs were preferentially selecting habitats containing thick secondary vegetation that resulted from human degradation of riparian forest canopy as well as artificial ponds. Adult bullfrogs seemingly use behavioral thermoregulation to

maintain steady metabolic temperatures in spite of widely fluctuating air and water temperature. Bullfrogs appear to use the invasive Northern crayfish (*Orconectes virilis*) disproportionately to availability? This study provides a foundation to develop initial strategies for the management of invasive American bullfrogs that go beyond the simply eradication activities. There are many reasons why we should restore the original habitat in NM, it seems that preventing invasions of exotic species is another reason to add to the list.

### **Leopard Frog Population Structure in Various Fragmented Habitats**

**Jose I. Griego\*, Graduate Student, Biology**

Riparian areas in Northern New Mexico had suffered great environmental degradation due to over grazing and deforestation. At present most habitats have been severely degraded and fragmented. Leopard frog populations (*L. pipiens* & *L. blairi*) that inhabit New Mexico persist in these habitats that have dynamic conditions, due specifically to drought. Habitat fragmentation may affect the habitat usage strategies of leopard frog populations inducing the congregation of separate populations, which can alter population structure and gene flow. The potential for hybridization between *L. pipiens* and *L. blairi* may be heightened due to strong environmental pressures and limited reproductive windows of opportunity from harsh seasonality and fragmented habitat. This study will investigate leopard frog populations and hybridization using microsatellites, nuclear genes, and mitochondrial genes. The level of structure of the populations will be related to the type of habitat that samples are taken from (fragmented or healthy). Also, species will be screened using the nuclear and mitochondrial genes to determine if differential mating is occurring in the form of hybridization in the different habitat types. Combined, these will provide data regarding genetic and behavior patterns in habitats subject to frequent change due to various levels of drought.

### **Who's Your Daddy? Parentage Analysis of Green Anacondas (*Eunectes murinus*)**

**Deisy Hernandez-Lujan \*, Undergraduate Student, Biology**

Multiple paternity may be a widespread phenomenon that takes place in snakes, but few studies provide direct evidence of this theory. In this study we used genetic parentage analysis to characterize the mating strategy of green anacondas. Microsatellites markers were used in order to test for the existence of multiple paternity in one clutch of anacondas. For this study, I used the mother (Judy), nine potential sires, and 65 offspring. Blood samples from all anacondas were taken from the caudal vein posterior to the cloacae. For this study I assessed the variability of seven microsatellite loci with primers developed by Dr. Corey-Rivas. Of the seven loci, only Eum usat16 amplified well in PCR and had sufficient heterozygosity for the study. Eum usat16 has at least 4 alleles and provides some evidence for multiple paternity. Further testing of additional primers will be required to get more evidence of polyandry and multiple paternity in green anacondas.

### **The Role of Wintering Frugivores in the Dispersal Ecology of One-seed Juniper in Northeastern New Mexico Rangelands**

**William Jaremko-Wright\*, Graduate Student, Natural Resource Management**

The encroachment of junipers into rangelands is dependent upon; the types of animal dispersers present and their post-foraging behavior, micro-site requirements for successful seed germination, and the availability of structurally complex perches. The role of birds in the dispersal ecology of One-seed juniper (*Juniperus monosperma*) in northeastern New Mexico was investigated along a continuum of juniper establishment from young savannas to old-growth woodlands. The wintering bird community was sampled with variable distance point counts (VPC) from January to March 2013. Stand establishment date, juniper regeneration, canopy cover, and other habitat variables were also measured at points. Not surprisingly, frugivorous thrushes (*Turdidae*) were the most commonly encountered group of birds and showed significant habitat partitioning based on tree canopy cover and vegetation complexity. Mountain bluebirds (*Sialia currucoides*) were the most abundant species in the study area, and were found at their highest densities in savannas with the lowest canopy cover. This is significant because these savannas are the youngest in age, and are effectively the ecotone between the juniper woodland and grassland (i.e., where the most active encroachment is occurring). Results showed that a significant proportion of seedlings were found under structurally complex perches; female trees (59%), male trees (29%), and shrubs (5%), highlighting the importance of perches and seedling emergence. Although other species known to consume and disperse juniper seeds were present, the abundance, behavior, and habitat preference of mountain bluebirds suggest they are the primary disperser of juniper into grasslands of northeastern New Mexico.

## **The Effects of Biochar Amendments to Arid Soils (aridisols) on Water Retention and Microbial Abundance**

**Reyna V. Montaña \*, Graduate Student, Biology**

Aridisols are some of the most common soil types found in the world. The semi-arid areas, where they are found also have some of the most rapidly growing human populations. In the southwest, moisture comes in short pulses and soils are dry or covered in snow for a large part of the year. These drought conditions may not allow microbes to thrive and enhance plant growth. While we are currently not facing food shortages in New Mexico, the prospect of rising energy prices and climate change lead us to look at ways to sustainably enhance agricultural production in semi-arid areas. If this challenge is not addressed, in the future people will likely face malnutrition, starvation, and increased disease. There have been many studies conducted in Amazonian tropical soils which show that biochar increases microbial activity, but little is known about the effects of biochar in aridisols. The purpose of this research is to test the ability of biochar added to local aridisol soils to enhance water retention and consequently alter microbial abundance and diversity. Microbial abundance and diversity are critical for both the drought tolerance of crops as well as nutrient cycling in agro ecosystems. We tested the following hypotheses: 1. the addition of relatively small amounts (0, 10% by weight) of biochar increases microbial abundance; and 2. The addition of biochar increases microbial diversity. Biochar was added to soils at 10% by weight with untreated soil (0%) used as a control. Soil with or without biochar was tested at the beginning of the study and every two weeks after that to assess the microbial abundance and diversity. In order to control for drought conditions the five replicates of each soil/biochar samples were watered one time at the beginning of the experiment to saturation and every two weeks after that with 200ml of distilled water. We found that fungi colonies increased in the soil with biochar addition compared to that with no biochar. Bacterial colonies were also higher in soil with biochar after the sixth week of the study. Likewise, there was a correlation between water retention and biochar. The soil with biochar retained more water than the soil with no biochar. Future studies will be conducted to determine the diversity of the microbes along with the interaction between the additions of corn seeds to the already established soils.

## **Antimicrobial Activity of Proteins Extracted from the West Indian Leaf Cockroach (*Blaberus discoidalis*)**

**Saul Ruiz-Palacios \*, Undergraduate Student, Biology**

Continued overuse and abuse of broad spectrum antibiotics has caused a major increase in bacterial resistance as well as an increase in treatment cost for many infections and diseases. This can potentially lead to a pre-antibiotic era where disease and common sickness are no longer treatable through the use of antibiotics. For this purpose the research into antimicrobial peptides (AMPs) as a natural alternative to antibiotics is in demand. Our research focused on the total protein extraction from the brain, fat body, and hemolymph of the West Indian Leaf Cockroach *Blaberus discoidalis*. We injected cockroaches with either heat-killed *Escherichia coli* (G<sup>-</sup>) or heat-killed *Staphylococcus Aureus* (G<sup>+</sup>) as specific challenges to their immune systems. Untreated roaches were used as controls. Total protein was extracted from challenged cockroaches and the control group, and extracts were tested for antimicrobial activity against *E. coli* and *S. Aureus*. Preliminary tests using SDS-PAGE and gel overlay assays. We observed inhibition of both *E.coli* and *S. Aureus* by hemolymph and fat body extractions. Results indicate the possibility of antimicrobial presence and future isolation of specific compounds may be useful for developing possible antibacterial alternatives.

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## Faculty Poster Presentations

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### **The Achieving in Research, Math, And Science (ARMAS) Center at NMHU**

**Edward A. Martinez\*, Elizabeth Ratzlaff, Monique Esquibel, Dorothy Bales**

\*Associate Professor, Natural Resource Management

In 2008, NMHU obtained a two-year cooperative grant from the U.S. Department of Education. The grant allowed for: (1) establishment of a model transfer and articulation agreement for STEM gateway (100 and 200 level) courses with a local community college; and (2) development of a state-of-the-art STEM student and faculty support center (called the ARMAS Center). The ARMAS Center is designed to increase student retention through collaborative-based services such as advising, internships, mentoring and supplemental instruction. For STEM faculty, ARMAS provides professional development workshops on best pedagogical practices in STEM education. Since its opening in 2009 participation at the ARMAS Center has steadily increased, and in the Fall 2012 semester there were over 400 students registered with a total of 4627 visits. Additionally, 36% of students enrolled in the gateway courses are attending supplemental instruction sessions. Consequently, results show that STEM majors who participated at ARMAS between Fall 2009 and Fall 2012 were significantly more likely to have graduated with STEM degrees or still be enrolled in STEM majors in the Fall 2012 semester compared to STEM majors who did not participate at ARMAS. This difference was significant at the  $p < .01$  level. In addition, for every non-participating student who graduated or was retained in a STEM major, there were 3.8 participating students who did graduate or return. NMHU has made great strides in retaining STEM students through the ARMAS Center at NMHU. Based on these successful outcomes NMHU administration is working with ARMAS staff to institutionalize the ARMAS Center and its services.

### **Application of OSL for the non-destructive dating of Native Remains**

**Sammeth, David\*<sup>1</sup>, Lail, Warren<sup>2</sup>, & Mahan, Shannon<sup>3</sup>**

\* Professor, Chemistry

<sup>1</sup>*Dept of Biology & Chemistry*

<sup>2</sup>*Dept of Social & Behavioral Sciences*

<sup>3</sup>*U.S. Geological Survey, MS 974, Denver CO, 80225*

The intact skeletal remains of a Native American were discovered in 1973 when they began to erode from the banks of Cimarroncito Creek located on the UU Bar Ranch, Colfax County, New Mexico. A young archaeologist from the adjoining Philmont Scout Ranch hastily recovered the remains and curated them in the Philmont Museum, where they subsequently became lost amid the collections for almost 36 years. Because no artifacts were recovered with the remains, it was almost impossible to fit the skeleton into a historical regional cultural chronology, which in turn made it difficult to determine the proper tribe to consult regarding repatriation under the Native American Graves Protection and Repatriation Act.

Upon examination of the cranium, it was determined that the skull cavity had become filled with sediments during burial. The source of the sediments was the Sangre de Cristo Formation "red beds" that are composed predominantly of sandstone and shales, so even though the recovered cores were very small, they contained a fair amount of quartz. Using Optically Stimulated Luminescence (OSL) dating methods, we were able to determine the minimum age of the sediment filling the skull by determining the time interval since the quartz had last been exposed to sunlight. The age of the skull was determined to be no older than 855 A.D. and no younger than 1455 A.D. The errors on the measurement are 5 to 6 percent. Determining the age of the skull will prove invaluable in repatriation efforts, as it provides an approximate time of burial.

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## Graduate Poster Presentations

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### **Paleomagnetic, Anisotropy of Magnetic Susceptibility, and structural Data Bearing on Magma Emplacement and the growth of the Miocene, Cinder Cone**

**Brister, A.<sup>1\*</sup>, Petronis, M.S.<sup>1</sup>, Lindline, J.<sup>1</sup>, van Wyk der vries, B.<sup>2</sup>, Rapprich, V.<sup>3</sup>, Cedillo, D.<sup>1</sup>**

\*Graduate Student, Geology

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*3. Czech Geological Survey, Klárov 3, 118 21 Praha 1, Czech Republic*

The Trosky Volcano is a monogenic cinder-spatter cone associated with the middle Miocene Jičín Volcanic field of northeast Czech Republic. The intent of this research is to map the Trosky Volcano subvolcanic deformation, magma plumbing system geometries, eruptive dynamics, and cinder cone morphology using paleomagnetic, anisotropy of magnetic susceptibility (AMS), and structural data. The results from this study will be used to compare and contrast three other monogenic volcanoes that exhibit exposed magma feeders systems. We hypothesize that cinder cones conceal multiple magma conduits as opposed to a single conduit as envisioned for many volcanic constructs. By comparing the results from three other monogenic volcanic centers 1) Cienega Volcano, NM, 2) several quarried volcanoes in the Raton-Clayton volcanic field, NM, (future study) and 3) Lemptégy Volcano, France to the data from the Trosky Volcano should enhance our understanding of both ancient and active intra-rift volcanic systems. Preliminary results are encouraging with high values of magnetic susceptibility, single component demagnetization response, and pseudosingle domain grain size. The data obtained will enhance our understanding of subsurface magma transport to the eruptive vent and provide insight into subvolcanic deformation processes. These data should further allow us to provide insight into the growth and hazards associated with active volcanic systems worldwide.

### **Structure of charge transfer polymorphs of TTF with perfluoro-ortho-phenylene mercury**

**Raúl Castañeda<sup>1</sup>, Sergiu Draguta<sup>1</sup>, Evghenia Leonova<sup>1</sup> and Tatiana Timofeeva<sup>1</sup>**

\*Graduate Student, Chemistry

*<sup>1</sup> Departament of Biology and Chemistry, New Mexico Highlands University, Las Vegas, NM 87701, USA*

In a search for new charge transfer materials two polymorphic co-crystals of tetrathiafulvalene (TTF) with perfluoro-ortho-phenylene mercury (Hg<sub>3</sub>) were obtained and characterized. The crystal growth was done by slow evaporation of a 1:1 mixture of CS<sub>2</sub> and CH<sub>2</sub>Cl<sub>2</sub> solvents. These polymorphs are centrosymmetric one triclinic and the other one monoclinic with the space groups P-1 and P2<sub>1</sub>/c respectively. The triclinic polymorph (**1**) contains the centrosymmetrical adduct of [(Hg<sub>3</sub>)<sub>2</sub>·TTF] reported previously in literature. The monoclinic polymorph (**2**) is new and contains one molecule of Hg<sub>3</sub> per molecule of TTF. The crystals of **1** grown as orange needles; crystals of **2** grown in brown prisms that allows to speculate that they will have different photophysical properties. The sulfur mercury interactions in both co-crystals are similar. In both cases the short interactions between the S and Hg atoms were found. In addition in crystal **1** secondary interactions between the S and Hg atoms were found which were not observed in **2**. The two polymorphs have different packing modes and stacking arrangements, therefore they are expected to have different properties.

## Infertility: Validating Differentially Expressed Proteins in *Golga3<sup>repro27</sup>* Mutant mice

### Rodrigue Dikuba\* and Carol Linder

\*Graduate Student, Biology

Infertility has various causes, however, genetic defects are hypothesized to be a significant contributor to male infertility with an unidentified cause. Averagely, 15% of couples in the world are infertile and 50% of these infertility cases are caused by male infertility.

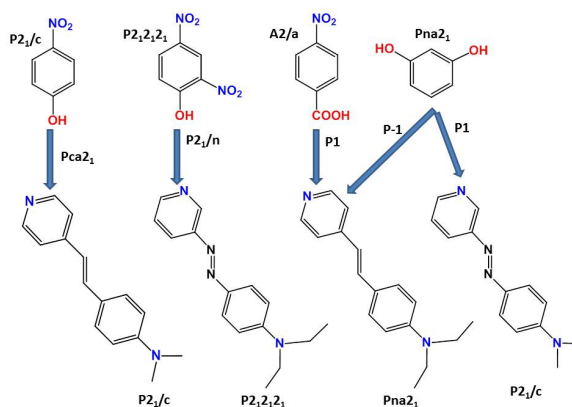
The C3Fe.B6-*Golga3<sup>repro 27</sup>* mutant mice has been found to have a defect in spermatogenesis as a result a defect in a protein, GOLGA3, found in the Golgi complex, which is an organelle important for protein targeting and cell signaling. In the absence of GOLGA3 spermatogenesis initiates normally but at 15-18 days post-partum there is a decrease in germ cell population and subsequent abnormal sperm differentiation, thus making the C3Fe.B6-*Golga3<sup>repro 27</sup>* mutant mice infertile. Proteomic analysis with two-dimensional (2-D) gel electrophoresis identified 17 differentially expressed testicular proteins between C3Fe.B6-*Golga3<sup>repro 27</sup>* mutant and C3HeB/FeJ (C3Fe) wildtype control mice. In this study, western blotting will confirm the expression pattern of three proteins, alpha-fetoprotein, ubiquitin carboxyl-terminal hydrolase, and transferrin. Immunohistochemistry performed on testes sections will determine the localization of these proteins. We expect western blotting to confirm the expression pattern seen in 2-D gel and these proteins will be expressed in the same cell types and cellular location as GOLGA3 in the testis. The confirmation of differentially expressed proteins in *Golga3<sup>repro27</sup>* mutant mice will provide clues to the overall function of GOLGA3 in spermatogenesis and may provide insights into human male infertility.

## X-Ray Structural Study of a New Acentric Cocrystals from Stilbazolium and Diazobenzene Derivatives with Different Acids Coformers for THz Applications

Sergiu Draguta\*, Evghenia Leonova, Tatiana V. Timofeeva

\*Graduate Student, Chemistry

Organic materials with extended conjugated system with donor and acceptor groups are good candidates for non-linear optics (NLO) because of their high molecular hyperpolarizability, fast electronic response and thermal stability. In order to be NLO active a noncentrosymmetric molecular packing of material is required. At present work our efforts have been directed to investigation of formation of acentric materials with extended conjugated system.



A series of new stilbazolium like and diazobenzene compounds were synthesized (N,N-dimethyl-4-[(E)-pyridin-3-yl diazenyl]aniline, N,N-diethyl-4-[(E)-pyridin-3-yl diazenyl]aniline) and N,N-diethyl-4-[(E)-2-(pyridin-4-yl)ethenyl]aniline) and single crystal were obtained. Also, these compounds were cocrystallized with different acids (4-nitrophenol, 4-nitrobenzoic acid, 2,4-dinitrophenol and benzene-1,3-diol) in order to find out influence of hydrogen bonding system on formation of noncentrosymmetric structures. The crystals were characterized by X-ray single crystal diffraction, melting point, IR, UV-Vis and fluorescence spectroscopies; also, first order molecular hyperpolarizability was evaluated using DFT calculations.



Crystal structure analysis reveals noncentrosymmetric packing in majority of obtained compounds, also, molecular dipole moments are oriented favorable for large NLO effects. In case of individual compounds, changing dimethylamino with diethylamino group attached to benzene ring seems to generate noncentrosymmetric packing. In case of cocrystallization with benzene-1,3-diol, *meta* position of pyridine nitrogen generate noncentrosymmetric space groups in comparison with *para* position. Calculation of first order molecular hyperpolarizability shows that these compounds are good candidates for NLO applications.

### **The Representation of Plants in Hohokam Pottery Design**

**Victoria Evans, MA, Warren Lail, PhD, John McCray\***

\*Graduate Student, Anthropology

The Hohokam, a pre-Columbian people of the Sonoran Desert turned out a myriad of intricately designed ceramics. They were known to depict many aspects of their natural environment including animals, insects, birds and people. However, aside from vessels shaped like gourds or pumpkins and possibly datura seed pods, only a few clear representations of plants have been identified, most of which are obvious flower designs. Plants held great importance to the Hohokam as evidenced by botanical remains and irrigation canals. It is possible that the geometric design elements on Hohokam pottery also represent plants that were crucial to Hohokam subsistence. The comparison of designs from five site/site areas with actual plants as well as historic uses and traditions revolving around plant use support the hypothesis that Hohokam artisans were strongly influenced by the plants in their environment and depicted these plants on their pottery design.

### **Effects of Climate Change on Arsenic Concentrations in Surface Waters and Stream Sediments in the Jemez Mountain Region, New Mexico**

**Lorraine Garcia\*, Daryl Williams, Edward A. Martinez**

\*Graduate Student, Natural Resource Management

The Jemez Mountains, located in north central New Mexico, are known for containing one of the largest volcanic craters in the world, the Valles Caldera. It is also home to an extensive network of hydrothermal springs and seeps created by the large geothermal reservoir, which lies beneath the crater. These hydrothermal springs and seeps, along with the geology contribute large amounts of heavy metals, most importantly arsenic, to the waters and sediments of the Jemez River and its tributaries. Due to climate change, over the past five decades average annual temperatures have risen 2 °F, while average annual precipitation has decreased three inches in this region. With global climate change predictions of shorter and warmer summers it is plausible to conclude that runoff from snow pack will decrease while the geothermal spring contribution of water to the streams will increase in proportion. We believe understanding the distribution and fate and potential hazards of As contributed during these changing conditions is crucial in determining how the changing climate will impact New Mexico's high mountain streams and their biota. Results from this study indicate that seasonal variations of arsenic concentrations in water and sediments are dictated by a variety of site-specific conditions as well as physiochemical parameters. In general As concentrations tend to be greater south of the caldera when stream discharge and temperatures are relatively high.

### **Diel Fluctuations of Arsenic Concentrations and Physiochemical Parameters along the Jemez River, New Mexico**

**Lorraine Garcia\*, Daryl Williams, Edward A. Martinez**

\*Graduate Student, Natural Resource Management

Spanning roughly 129 km and contributing more than 50,000,000 cubic meters of water to the Rio Grande River annually, the Jemez River is the largest tributary to the Middle Rio Grande Basin. Additionally, it is the primary source of drinking and irrigation water for the towns of Jemez Springs, San Ysidro, Jemez Pueblo, and Zia Pueblo. Over the last several decades, the Jemez River's contribution of water to the Rio Grande has been slightly declining due to decreased precipitation and increased temperature caused by climate change. Further complicating matters, the surrounding geology of the Jemez River is of volcanic origin which produces many hydrothermal springs and seeps in the area, which allow for introduction of heavy metals, especially arsenic into the Jemez River. As the regional climate changes with a continual increase in temperature and decreased precipitation, it is highly probable that arsenic concentrations will rise in the river; possibly high enough to impact downstream users and the water quality of the Rio Grande River. This study shows that the arsenic

concentrations and a variety of physiochemical parameters are closely correlated and fluctuate diurnally, providing insight to long term changes that the river may experience in the future due to climate change impacts.

### Analysis of Phosphate leaching on a biochar amended agricultural Southwestern soil

Erika F. Guaba<sup>1\*</sup>, David M. Sammeth<sup>1</sup>, Craig Conley<sup>2</sup>

Graduate Student, Chemistry

Global warming, food security, oil demands, water pollution and soil degradation continue to be topics of great importance around the world today. Due to the astonishing population increase in the past century, research has become increasingly focused on strategically solving some of these problems in a sustainable fashion. Biochar, more commonly known as pyrolyzed biomass, has been speculated to increase soil fertility by facilitating the exchange of plant nutrients such as phosphorus. In particular, biochar has been shown to increase soil fertility due to its ability to facilitate cation exchange in acidic soils. There has been little research on the efficacy of biochar in relation to nutrient retention in alkaline soils that are found in the-Southwest region of the US. To investigate the ability of biochar to facilitate the exchange of phosphate, a key plant nutrient, 144 12" PVC columns were filled with a sandy clay loam soil and amended with 0%, 1%, 3% and 5% by mass with pinon biochar. These were then flushed with a 0.211M solution of  $P_2O_5$  once a week for a period of 12 weeks. The effluent recovered from the bottom of each column was analyzed using UV-Vis spectrophotometry to measure both total and inorganic phosphate concentrations, hence, the impact of biochar in soil on retention and leaching of phosphate.

### *n*-Type Ferrocene Dopants for Organic Thin-Film Transistors

Evgheni Jucov<sup>1\*</sup>, Siyuan Zhang<sup>2</sup>, Benjamin D. Naab<sup>3</sup>, Zhenan Bao<sup>3</sup>, Stephen Barlow<sup>2</sup>, Seth R. Marder<sup>2</sup>, Tatiana V. Timofeeva<sup>1</sup>

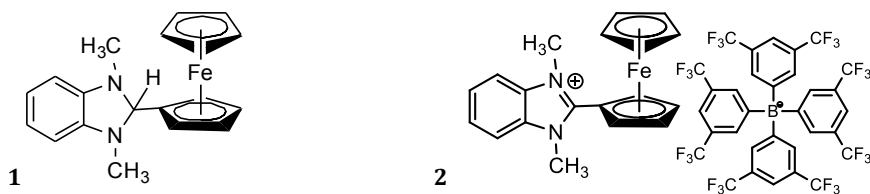
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<sup>3</sup> Department of Chemical Engineering, Stanford University, Stanford, CA

Two ferrocene substituted compounds (1,3-dimethyl-2-ferrocene-2,3-dihydro-1*H*-benzo[d]imidazole (**1**) and 1,3-dimethyl-2-ferrocene-1*H*-benzo[d]imidazole tetrakis-[3,5-bis(trifluoromethyl)phenyl]borate (**2**)) were investigated with X-ray single crystal analysis. These compounds are *n*-type dopants, which can be used to dope a variety of semiconductors for organic thin-film transistors (OTFTs) and other experiments. Based on the kinetics measurements, they react faster than similar air-stable organic dopants reported in the literature to date [1,2]. [6,6]Phenyl C<sub>61</sub> butyric acid methyl ester (PCBM) can be effectively doped with solution-processable *n*-type dopant 4-(1,3-dimethyl-2,3-dihydro-1*H*-benzoimidazol-2-yl)phenyl)dimethylamine (N-DMBI) in such way that the conductivities of doped films are significantly increased [1]. Another air-stable *n*-type dopant, 2-(2-methoxyphenyl)-1,3-dimethyl-1*H*-benzoimidazol-3-ium iodide (*o*-MeO-DMBI-I), for vacuum-processed organic thin films, was synthesized [2].



Both studied compounds have two crystallographically independent molecules in the unit cells. Compound **1** crystallizes in monoclinic P2<sub>1</sub>/c, but **2** in triclinic P-1 space groups. In **1** the angles between two Cp planes of ferrocene are equal to 5.5 and 5.2°. In **2** these angles are equal to 5.3 and 7.1°, respectively. The angles between planes formed by benzoic fragment of benzo[d]imidazole and Cp rings of ferrocene lie in the range of 89-108° for **1**, and 30-41° for **2**, that can be explained by the conjugation between benzo[d]imidazole and ferrocene moieties.

#### References:

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2. Peng Wei, Torben Menke, Benjamin D. Naab, Karl Leo, Moritz Riede, and Zhenan Bao, *Journal of the American Chemical Society*, **2012**, 134(9), 3999-4002.

### **Hydrologic Impacts of Burn Severity on Nutrient Concentrations from Surface Water Runoff in the Las Conchas Fire, Jemez Mountains New Mexico**

Anita Lavadie\*, Sara Brown, Joseph Zebrowski, Edward A. Martinez

\*Graduate Student, Natural Resource Management

Climate change is expected to increase wildfire severity in the Southwest. Following large fires, surface water runoff and soils contributes high concentrations of nutrients to water bodies and has the potential to impair surface water quality and terrestrial systems. Although there is a considerable amount of research on the effects of nutrients in surface water runoff and soils following a fire, the need to directly investigate nutrient levels transported from various severity classes is required. The purpose of this study is to investigate the contributions of nitrite-nitrogen ( $\text{NO}_2^-$ ), nitrate-nitrogen ( $\text{NO}_3^-$ ), and orthophosphate (OP) levels from surface water runoff originating from various wildfire severity classes from the Las Conchas fire in the Jemez Mountains, New Mexico. To complete this task  $\text{NO}_2^-$ ,  $\text{NO}_3^-$ , and (OP) concentrations will be determined from surface water runoff and soils originating from predetermined high, moderate, low, mixed, and control (unburned site) fire severity types. Fire severity site qualification was determined in a previous study. We hypothesize that our results from the high severity burn area will have the least contribution of  $\text{NO}_2^-$ ,  $\text{NO}_3^-$ , and (OP) and control will have the highest.

### **Utilizing Geographic Information Systems, Remote Sensing Technology, and Ground-Based Field Measurements to Improve Standardized Burn Severity Classification Systems, Following the Las Conchas Fire Jemez Mountains, New Mexico**

Anita Lavadie<sup>1</sup>\*, Joseph Zebrowski<sup>1</sup>, Sara Brown<sup>1</sup>, Gil Gallegos<sup>2</sup>, Edward A. Martinez<sup>1</sup>

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Climate change is expected to increase wildfire severity in the Southwest and may have adverse effects on ecosystem processes. As a result there is a need to classify burn severity and assess the environmental impacts from these various wildfire severities. Burn Area Emergency Response (BAER) teams have often struggled with the need for consistent methodologies, assessment tools, and terminology that quickly and accurately identifies on the ground post-fire conditions to complete their assessment and initiate remediation strategies within seven days of a fire's containment. The purpose of this study is to compare Landsat Thematic Mapper (TM) imagery, high-resolution Color Infra-Red (CIR) ortho-imagery, and on-the-ground fuel measurements to further improve post fire-severity characterization. To complete this task, numerical values from differenced Normalized Burn Ratios (dNBR) created from Landsat TM imagery, Normalized Difference Vegetation Index (NDVI) generated from CIR imagery, and ground fuel measurements using the Point-Centered Quarter Method were compared using a simple shifted linear regression model. We hypothesize there is a correlation in values through the abovementioned methods however, the strength of these correlations is still uncertain.

### **Mycotoxins, Maize, and Site Abandonment in the American Southwest**

McCray, John W.\*, and Lail, Warren K.

\*Graduate Student, Anthropology

Recent studies have confirmed the presence of certain molds and mycotoxins in maize. *Fusarium verticillioides* produces fumonisin B<sub>1</sub>, which has been linked to esophageal cancer and neural tube defects in humans. Zearalenone produced by *Fusarium graminearum* has been shown to have estrogenic effects on swine and other mammals resulting in lowered fertility rates. Our research analyzes samples from the northern Rio Grande region to identify the types of molds and mycotoxins present in traditionally-grown maize. Comparing climatic data from the 1300s, we hypothesize that climatic and environmental conditions affected not only the quantity and nutritional value of maize, but the toxicity of the maize itself. We explore the potential effects mycotoxins might have had on ancient populations in terms of neural tube defects, cancers, and lowered fertility rates. We conclude that mycotoxins may have played a contributory role in population decline and site abandonment in certain regions of the prehistoric American Southwest.

## **HSP70 Gene Expression and Morphological Abnormalities in Larval Chironomidae as Indicators of Stress Response to Chronic Sediment-Copper Exposure**

**Sebastian Medina<sup>1\*</sup>, Chris Martinez<sup>1#</sup>, Sarah Corey-Rivas<sup>2</sup>, Edward A. Martinez<sup>1</sup>**

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#Undergraduate Student

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The goal of this study is to investigate the toxicological impacts of sediment-copper pollution in the Peterson Reservoir (Las Vegas, NM) using HSP70 gene expression and morphological abnormalities in chironomidae (midge) larvae as indicators of physiological stress response. To accomplish this goal, concentrations of copper in the sediments of Peterson Reservoir will be determined. It will also be determined if sediment-copper concentrations affect HSP70 gene expression and/or morphological abnormalities among midge larvae present within Peterson Reservoir. Finally, it will be determined if copper is bioaccumulating in midge larvae present within Peterson Reservoir. It is anticipated that midge larvae present within Peterson Reservoir will demonstrate elevated levels of HSP70 gene expression relative to control larvae collected from Morphy Lake (Mora County, NM; natural control) and a laboratory culture of *Chironomus riparius*. It is also expected that midge larvae collected from Peterson Reservoir will exhibit higher proportions of morphological abnormalities in comparison to control larvae. Collective screening for HSP70 gene expression and morphological abnormalities among midge larvae provide sensitive and efficient biomonitoring strategies in understanding and detecting toxicological impacts of heavy metal contamination on the health of aquatic ecosystems.

## **The Impact of Invasive Bullfrogs on the Demographics of Northern Leopard Frogs in Northern New Mexico**

**Robert E. Ortega\*, Jesus Rivas**

\*Graduate Student, Biology

Invasive species are able to alter the dynamics of the trophic levels of an ecosystem, having no natural controls they can displace native species in the food web, to prey on species with no adaptive defenses. The Rio Mora National Wildlife Refuge has both invasive Bullfrogs and native Northern Leopard Frogs. The extent to which the bullfrogs have impacted the native Northern Leopard Frogs has not been previously studied. The purpose of this study is to investigate the effects of the presence of the invasive Bullfrog on the demographics of the native Northern Leopard Frog in northern New Mexico. A section of the Mora River in the refuge was divided into two 2000-meter long section a control site containing Bullfrogs and an experimental site where Bullfrogs were eradicated. Relative abundance surveys were utilized to sample demographic parameters. Fifty-one Leopard frogs were captured, pit tagged, and processed for demographic data. Control and experimental regions did not differ in the relative abundance of the leopard frogs. We did not find a significant difference in the mass of frogs from the two regions. However, preliminary data does show lower average mass and greater abundance in the experimental region suggesting an increase in recruitment of metamorphosis frog into the population. A change in demography within a year of bullfrog removal shows how fast a species can react to environmental changes.

## **Individual Identification of Northern New Mexico Urban Black Bears using Molecular Techniques**

**Casey Taylor**

\*Graduate Student, Biology

Black bears are opportunistic foragers, which creates many problems with black bears entering city limits for anthropogenic attractions like garbage cans which alters normal black bear foraging habits. This creates very common instances of human and Black bear conflicts, creating difficulties with management agencies and current management practices. Urban or nuisance bear populations in many areas are experiencing disproportionate increase in numbers and the actual numbers of urban bears are unknown. Relative bear abundance can be determined with non-invasive transect sampling. DNA extracted from bear scat can provide individual identification and census data. Microsatellite markers are an accepted tool used to identify individuals in Black bear populations. Transects will be placed in Raton, NM, particularly around dumpsters where bears frequent. Scat samples will be collected and DNA will be extracted. Polymerase chain reaction (PCR) using six microsatellites chosen based on hypervariability will be scored to create individual genotype profiles. Through these techniques, approximate population size of urban black bears will be determined. Also,

this will contribute to determine whether individual bears are resident bears or migrate between forest and city habitats for the purpose of foraging.

## **X-ray structure analysis of new series of co-crystals for pharmaceutical applications**

**Surendra Thapa**

\*Graduate Student, Chemistry

In pharmaceutical industry, co-crystals are becoming increasingly valuable as it tune a compound's physical properties without altering its chemical identity<sup>1</sup>. In this study, we co-crystallize a series of active pharmaceutical compounds with different acceptable conformers. We co-crystallize different forms of pyridine with dicarboxylic, succinic and (what is the name of that long one?) acids. Co-crystals were obtained by slow evaporation method from ethanol solvent. The proton transfer from base to acid was observed in all compounds. This is related with difference in pKa values of acid and base molecule. Compounds crystallize in triclinic P-1 and monoclinic C2/c and P2(1) space groups. In order to observe some changes in physical properties of obtained co-crystals, melting points were measured for individual compounds and for final adducts.

## **Determination of Cadmium in zinc-rich and zinc-fortified foods**

**Tuo Wang\*, Kaiguo Chang**

\*Graduate Student, Chemistry

### **Background:**

Cadmium is a natural element that widely used in many fields, such as industry, agriculture and pigment. But it is also a very toxic heavy metal that do harm to human kidney, bone and lung. It can be accumulated in the human body for more than 10 years, which result in different kinds of diseases and cancers.

Zinc is an common element that is naturally present in ores and foods. We can obtain Zinc from its ores, which called blende, which may contain various other heavy metals as impurities: such as mercury, lead, cadmium, copper, arsenic. More pure form of zinc metal can be obtained by distillation and electrolysis, but zinc produced by this method is quite costly. The less purification is desired if the impurities satisfy with the requirements for industrial purposes. Anyway, we should know: The commercial metal is never pure.

Zinc is commonly used in dietary supplements. Since cadmium compounds are often found in association with zinc ores, cadmium oxide is a common by-product of zinc refining. For this reason, we suspect that the cadmium was coexisted in the process of zinc additive food products. Although the food manufacture are not listing them in food label.

### **Sample:**

In this research, we want to select two types of foods, Natural and Manufactured, to see if there is any variations in their cadmium content.

For natural foods, we plan to choose oyster and Peanuts as materials, because these two are common Zinc-rich foods.

For manufactured foods, where zinc is often added as additive or supplement in the products. In this research, we will choose infant formula, sport drinks and Zinc dietary supplement as materials. Because all these products are Zinc-fortified products.

### **Methods:**

- Atomic Absorption Spectrometry (AA): it is very common method used in analytical chemistry. For measuring the concentrations of metal ions in samples with detection limit around ppm with high accuracy.
- Electrochemistry: it is a powerful and sensitive analytical tool used for analysis over a wide range of concentrations.

### **Results:**

The different samples indeed contain cadmium, but more analysis work should be doing in the future.

### **Conclusions:**

With the results, we obtain the results that refer to the suspect. The study demonstrate zinc-rich food contain low concentration of cadmium. Thus, people should consider the possible toxicity of accumulated cadmium in zinc-rich and zinc-fortified food.

## **Invertebrate Bio-Accumulation in a Copper Sulfate Treated Reservoir**

**Daryl Williams\*, Jason Martinez, and Edward A. Martinez**

\*Graduate Student, Natural Resource Management

Copper sulfate has been commonly used as an algaecide to combat cyanobacteria blooms in municipal reservoirs. The United States EPA has classified copper sulfate as a Class I toxic substance with the potency inversely related to the alkalinity and pH of water. Copper can accumulate indefinitely and bind to reservoir sediments until disturbances favor its release into the water column. This study sought to determine the levels of copper in water, sediments, and chironomids as an indicator of reservoir water quality. Samples were collected seasonally at four sites in Peterson Reservoir near Las Vegas, New Mexico. Water was analyzed for temperature, pH, dissolved oxygen, conductivity, turbidity, light intensity, Secchi disk, chlorophyll-a, alkalinity, and total phosphorus. Chironomids, sediment, and water were analyzed for copper using Graphite Furnace Atomic Absorption Spectrometry. Reservoir sediment exhibited relatively high levels of copper (18-34 ppm). Copper concentrations in invertebrates were typically higher than sediments (14-1600 ppm) indicating a bio-accumulation rate of up to 4.5 times that of the surrounding sediment. Due to the high buffering capacity of pH (~9) and alkalinity: (~200), most copper concentrations in the water column were below USEPA MCL standards. However, four sites exceeded USEPA standards (>1.3 ppm) during summer stratification and fall turnover events.

## **The impacts of wildfire on population dynamics of amphibians in northern New Mexico and southern Colorado**

**Molly Wright\*, Jesus Rivas, Sara Brown, and Sara Corey**

\*Graduate Student, Biology

Amphibians are considered an indicator species of ecosystem health because of their sensitivity to habitat degradation. Climate change, coupled with fire suppression, has altered many fire regimes, including southwestern Ponderosa Pine (*Pinus ponderosa*), which now experiences unnaturally catastrophic wildfires. One such fire is The Track Fire, an 11,247 ha wildfire that burned primarily in ponderosa pine during the summer of 2012 along the border of New Mexico and Colorado. The purpose of this proposed study is to understand the impacts of the catastrophic Track Fire on amphibian populations. We ask the following question: How did the Track Fire impact amphibian population dynamics, vegetation, and water quality. Data will be collected this summer (2013) in three locations: 1) The Track Fire which represents our treatment area and includes a river and several ponds; 2) The Pritzlaff Ranch (river site), and 3) Trinidad Lake (pond site) which represent our unburned control sites. We will conduct visual surveys of amphibians using transects, collect water quality samples using a Sonde for water nutrient analysis, and conduct vegetation surveys using a line point-intercept method. The goal of this study is to provide further understanding of how fire may affect areas occupied by amphibians, and thus the role that amphibians play in future fire management decisions.

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## **Undergraduate Poster Presentations**

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### **Effects of Forest Fire on Stream Macroinvertebrate Communities in the Jaramillo Creek, Valles Caldera National Preserve**

**Rae Archuleta<sup>1</sup>\*, Brandon Fernandez<sup>2</sup>\*, Daryl Williams<sup>2</sup>, Edward A. Martinez<sup>2</sup>**

\*Undergraduate Student, Natural Resource Management

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<sup>2</sup>Department of Natural Resource Management, New Mexico Highlands University, Las Vegas, New Mexico.

The Valles Caldera National Preserve (VCNP), located in Northern New Mexico is being affected by climate change. The most pronounced effects on the region are the increasing temperatures and decreasing snowpack. Climate change is expected to increase wildfire severity. Following large wildfires, the potential for soil erosion during precipitation events is also increased, therefore potentially degrading the aquatic systems. The purpose of this study was to determine the impact the Las Conchas wildfire had on diversity and abundance in populations of aquatic macroinvertebrates. Samples were collected from the Jaramillo Creek pre and post fire

and sorted, counted, and identified to family. Pre and post fire diversity and abundance were compared. Results indicate that diversity and abundance changed post fire when compared to pre fire conditions. Future research will be conducted to determine the length of time needed for aquatic macroinvertebrates to recover from the Las Conchas fire disturbance.

### **Incidence of Gastro-intestinal Parasites in *Lithobates castebeiana***

**Jamie Bryant\***

\*Undergraduate Student, Biology

Gastro-intestinal parasites, in any species, pose a risk not only to the host but to the surrounding populations as well. The bullfrog, *Lithobates catesbeianus*, is an invasive species that acts as an intermediate host to many common gastro-intestinal parasites. Parasitized bullfrogs could pose a threat not only to surrounding populations but also in other biological arenas. Ten male and female bullfrogs (*Lithobates catesbeianus*) ranging from 200g to 400g wild-caught from the Mora River in Mora, NM had necropsies performed and the gastro-intestinal tract sectioned out and preserved in 95% Ethanol. The three sections excised for examination are the stomach, small intestines, and the cloaca. Gross exams were done using a dissecting microscope to look for visible parasites. Fecal material collected from the distal colon for a direct smear and flotation in concentrated sugar solution examined for the ova and parasites under light microscopy. The anticipated results are that there will be an incidence of intestinal parasites in the bullfrog overall and that the larger bullfrogs (over 300g) will in fact harbor more intestinal parasites than the smaller bullfrogs. The longer the bullfrog is in the non-native territory the longer it is able to thrive on the resources possibly outcompeting local inhabitants. Older hosts may have time to gather more and more diverse parasites. The older therefore the larger the bullfrog becomes the more interaction with the environment takes place, and it will have more time to gather more diverse parasites to potentially spread into the environment.

### **Testing the Effectiveness of Active Learning Techniques and Lecture-Based Learning Techniques in a Scientific Teaching Module**

**Tara Cusack\* (Biology), Sara Brown (Natural Resource Management)**

\*Undergraduate Student, Biology

Active learning techniques have gained the attention of many teachers and parents, many of them advocating for a more actively engaged approach to teaching in our schools in the United States. Active learning occurs by students being involved in instructional activities, and being actively engaged in their own learning versus passively listening to a lecture presentation. Studies have shown that active learning techniques have been very successful at the high school and college levels however; we understand less about the success of active learning in elementary grade levels. This study provides a more robust understanding of the effectiveness of active learning techniques at the 5<sup>th</sup> grade level. We tested the effectiveness between active learning and lecture-based learning in two separate classes of fifth grade students at Don Cecilio Elementary School in Las Vegas, NM. Initially, we gave the students a pretest assessment before exposing them to content delivered using one of the two teaching methods (active or passive-lecture). Students then took a posttest assessment after the content was presented. The assessments were graded, and an improvement score (difference between pre and post assessments) was determined. An average improvement score was determined for both groups, and an independent sample t-test was conducted using SPSS. Our results suggest that there was no statistical significance (sig. 0.574) between the two teaching techniques. Several distractions occurred in the active learning class, which may have contributed to decreased student attention, and reduced performance on the posttest. These data reflect actual daily learning conditions in elementary schools, and could provide useful data for future educators.

### **A Reliable Method for Isolation and Amplification of Sheep DNA**

**Jessica DeSanto, Richard M. Plunkett**

\*Undergraduate Student, Biology

In the 1800s the Bighorn sheep (*Ovis canadensis*) were close to extinction because of hunters and settlers moving in to the areas of the bighorn. Breeding programs have helped increase the bighorn sheep population, however now the bighorn sheep face another issue of being susceptible to disease. Higher susceptible to disease may be a result of a low variation at the major histocompatibility complex (MHC) genes, which is an important genetic aspect of the vertebrate immune system. This research is interested in developing a reliable method of amplifying the MHC II region from DNA of domestic sheep, and focuses on the identification of primers that will target the MHC region. Molecular procedures including the DNA extraction and PCR are used to determine if the

primers are amplifying the correct region of DNA. This work is critical for future studies of the MHC II region of domestic sheep (*Ovis aries*) as well as bighorn sheep genetic diversity. Anticipated results are that LA31 Forward and LA32 Reverse primers will amplify the MHC region of DNA from domestic sheep. This research will continue with the bighorn sheep DNA using the LA31 and LA32 primers to amplify the MHC region of DNA. With the MHC region amplified comparison between the genetic diversity of bighorn sheep can be examined to determine the genetic variation among the population of bighorn sheep.

## **How to Feed 9 Billion People Sustainably**

**Jessica DeSanto, Elyssa Duran, Marcus Garcia, Juan Jauregui, Esther Lovato, Amanda Melendrez, Reyna Montano, Shaun Nalamlieng, Craig Conley**

ARMAS Scholarship Seminar Students Spring 2013

The current world population is at approximately 7 billion people. It is projected to reach 9 billion by the year 2050. Based on the current food system, the reoccurring question that rises is: How would we feed an additional 2 billion people with a food system that provides nutritious food and that in the long term is sustainable? The current system does feed the majority of the population; however, the nutritional value is poor. There are currently one billion people who are malnourished and another one billion who are obese. To feed 9 billion people, a new food system must be considered. Along with the actual production of our food, other challenges must be addressed. We must address: 1) loss of agricultural land to desertification; 2) storage and waste of fresh produce; 3) education of unknowledgeable people on sustainability; and 4) training for them to be able to produce their own food. Our proposed strategy is built around four dimensions of the food security issue: 1) Access; 2) Stability; 3) Utilization; and 4) Availability. We propose using the case of the Loess Plateau Project as a model of where to begin, by restoring unhealthy land back to productive land. Furthermore, we believe that policy changes are essential to reform our current food system so that it may be sustainable and resilient but, we acknowledge that changing policy will be the greatest challenge to overcome.

## **Understanding Nitrogen Dynamics Across Three Burn Severities in the Las Conchas Fire** **Elyssa Duran\*, Sara Brown, Edward Martinez**

\*Undergraduate Student, Natural Resource Management

Climate change models for the southwest forecast intense drought conditions. Drought, coupled with increased fuel loading, lead to spatially extensive "mega fires" that burn at unnaturally high severities. The Las Conchas Fire, our study site, burned much of its area at a high severity. Our research seeks to understand concentrations of two forms of nitrogen (nitrate ( $\text{NO}_3^-$ ) and nitrite ( $\text{NO}_2^-$ )) remaining in the soil post-fire across three different burn severities (low, moderate, and high). Knowing how much  $\text{NO}_3^-$  (readily available for plant uptake), and  $\text{NO}_2^-$  (not available to plants, but can be converted to available forms through microbial activity) is present after fire in various fire severities will help us understand nutrient dynamics that control revegetation processes post fire. We selected three study sites representative of the three burn severities, then collected soil samples at five plots within each site monthly, for six months, (May 2012 through October 2012). Soils were stored in paper bags in a refrigerator until soil analysis began. First, soils were dried in aluminum pans in drying ovens ( $80^\circ - 90^\circ \text{F}$ ), then weighed after 24 hours, and once every two hours thereafter until the weight of the samples stopped decreasing. Soils were then leached by shaking samples of HCL and soil mixtures, filtering out the soil and were stored for later analysis. Analysis of the  $\text{NO}_2^-$  and  $\text{NO}_3^-$  concentrations are to be completed using an FS 3100 OI Analytical Analyzer. We anticipate that moderate severity samples will yield the most nitrogen, high severity will yield a moderate amount, and low severity will yield the least.

## **What is the effect of River Restoration in Mice Abundance in the Mora River? Bison Inhabited vs. Bison Secluded area**

**Carlos Garcia\*, Jesus Rivas**

\* Undergraduate Student, Biology

This report is a study of animal population abundance of two different sides of Rio Mora National Wildlife Refuge (RMNWF). One side accommodates bison which is a non-restoration side, and the other side excludes bison making it a restoration side of RMNWF. The side of restoration excludes bison from the habitat, allowing vegetation to grow. The non-restoration side has many bison which eat vegetation which may not allow animals to diverse as much. Here I report how each side may affect animals in their natural habitat by capturing mice as a tool of measuring population density by using the Lincoln-Peterson method of mark-recapture.



## **Identifying genes responsible for spermatogenesis in repro29 mice**

**Marcus Garcia\*, Alfonso Trujillo, and Carol Linder**

\*Undergraduate Student, Biology

In this study we are interested in identifying the gene responsible for male infertility in Repro29 mice. Repro29 is a genetic mutation that was originally created by ReproGenomic Chemical Mutagenesis Program at The Jackson Laboratory. repro29 mutant male mice have normal amounts of defective sperm that are not mobile. Gene mapping using meiotic recombination techniques has narrowed the known candidate gene region on chromosome 5 to 0.29 Mb; this region includes four known genes Kntc1, Clip1, Rsrc2, and Zcchc8. From genetic complementation tests Clip1 has been ruled out and we are currently working on testing with Kntc1 and Rsrc2 using the Western Blot Protein analysis. Samples were collected using 7 week testes from the congenic strain C3Fe.B6-repro29 and C3HeB/FeJ inbred mice as wildtype controls. Kntc1 is known as Kinetochore associated protein 1 and is located at the centrometric region of DNA and provides an attachment point for spindle microtubules. Kntc1 encodes proteins that contains RZZ complex subunits. Rsrc2 encodes the arginine/serine-rich coiled-coil 2 protein whose function is largely uncharacterized. KNTC1 and RSRC2 protein was present in mutant repro29 samples although it is still possible that the protein is nonfunctional and this result does not completely rule out Kntc1 or Rsrc2 as a candidate gene. RSRC2 protein expression analysis is currently being optimized although DNA sequence analysis of mutant and control cDNA did not identify a mutation in the coding region. Zcchc8 cDNA sequencing and protein expression analysis is planned.

## **Hydrologic Impacts of the Burn Severity on Orthophosphate Concentrations in Soils from the Las Conchas Fire, Jemez Mountains New Mexico**

**Santiago Garcia\*, Anita Lavadie, Sara Brown, Edward Martinez**

\*Undergraduate Student, Natural Resource Management

Climate change is expected to increase wildfire severity in the Southwest. Following large fires, surface water runoff contributes high concentrations of nutrients to water bodies and has the potential to impair surface water quality and terrestrial systems. Although there is a considerable amount of research on the effects of nutrients in runoff following a fire, the need to directly investigate nutrient levels transported from various severity classes is required. The purpose of this study is to investigate the contributions of orthophosphate (OP) concentrations from soils originating in various wildfire severity catchments from the Las Conchas fire in the Jemez Mountains, New Mexico. To complete this task soil was collected from predetermined high, moderate, low and control (unburned site) fire severity sites. Fire severity characterization for each site was qualified from a previous study. We hypothesize that the high severity site will have the highest orthophosphate concentrations in soils. Furthermore, understanding the role fire severity has on soil OP concentrations will help scientists and land managers implement strategies to retain and improve water quality after large wildfire events such as the Las Conchas fire.

## **Ecological Restoration, Gonzales Ranch, New Mexico**

**Benjamin Gonzales\* and Dr. Sara Brown**

\*Undergraduate Student, Natural Resource Management

Gonzales Ranch New Mexico is a small village located West of Highway 3, between I-25 and I-40. Historically, Native American tribes utilized the land for its natural stream, seasonal lakes and abundant wildlife. Due to a large number of ecologically damaging events, such as reduced annual precipitation, high soil erosion and increased insect populations, a request has been made to develop a plan to restore the ecological health of the 120 acre property owned by Benjamin Gonzales. Many high-density, water stressed Ponderosa trees (*Pinus ponderosa*) have started to die as a result of decreased annual precipitation, resource availability and attacks by bark beetles. Pinon needle scale (*Matsucoccus acalyptus*) and Pinon Ips beetles (*Ips confusus*) have also dramatically affected the Pinon trees (*Pinus edulis*) causing over 90% mortality. Also, the high density of juniper trees has decreased grass and herbaceous cover contributing to increased sheet-flow. Despite erosion control attempts, runoff from the property has created large arroyos in excess of 8' deep. This poster describes restoration plans that include: 1) Thinning of Ponderosa to improve growth, decrease likelihood of mortality and reduce fuel loads; 2) The removal of dead and dying Pinyon to reduce pest impact, and fire hazard while increasing grass and herbaceous cover; 3) Using thinned stems and branches, as well as rock, to reduce erosion. Combined goals of effective land management include increasing vigor and range of Ponderosa, isolating healthy Pinyon, reducing fire hazard throughout the property, increasing grazing land, and reducing runoff contributing to soil loss. This process will also increase wildlife accustomed to the area and encourage adjacent landowners to manage their property.

## **Effects of Forest Fire on Stream Macroinvertebrate Communities in the East Fork of the Jemez River, Valles Caldera National Preserve**

**Juan Guaba<sup>1\*</sup>, Benjamin Gonzales<sup>2</sup>, Lorraine Garcia<sup>2</sup>, Daryl Williams<sup>2</sup>, Edward A. Martinez<sup>2</sup>**

**\*Undergraduate Student, Natural Resource Management**

<sup>1</sup> *Department of Mathematics and Computer Science, New Mexico Highlands University, Las Vegas, New Mexico.*

<sup>2</sup> *Department of Natural Resource Management, New Mexico Highlands University, Las Vegas, New Mexico.*

The Valles Caldera National Preserve (VCNP), located in Northern New Mexico is being affected by climate change. The most pronounced effects on the region are the increasing temperatures and decreasing snowpack. Climate change is expected to increase wildfire severity. Following large wildfires, the potential for soil erosion during precipitation events is also increased, therefore potentially degrading the aquatic systems. The purpose of this study was to determine the impact the Las Conchas wildfire had on diversity and abundance in populations of aquatic macroinvertebrates. Samples were collected from the East Fork of the Jemez River pre and post fire and sorted, counted, and identified to family. Pre and post fire diversity and abundance were compared. Results indicate that diversity and abundance changed post fire when compared to pre fire conditions. Future research will be conducted to determine the length of time needed for aquatic macroinvertebrates to recover from the Las Conchas fire disturbance.

## **Deep Seed Planting of Native American Corn**

**Juan Jauregui\*, Reyna Montano, Craig Conley**

**\*Undergraduate Student, Natural Resource Management**

Native American farmers have used a variety of strategies over their long history of agriculture in the Southwest to enhance the ability to produce crops under extreme conditions (Dominguez, 2002; Maxwell, 2000). Deep seed planting is one of these biocultural drought management strategies. During severe drought periods, corn seeds have been planted as deep as 45 cm to take advantage of stored soil moisture. Deep seed planting has been demonstrated in the field but has limited replication or study in controlled conditions. In this experiment, we test the ability to plant a native corn variety (Hopi Greasy Head) at depths of 7.5, 15, 22.5, 30 37.5 and 45 cm in a greenhouse environment. Successful growth was achieved with seeds planted up to a depth of 22.5 cm. Preliminary analysis of roots shows some mycorrhizal infection. Successful planting at greater depths may require placing multiple seeds in the same planting hole. Some of these seeds may serve as a carbon source for early seed development. Deep seed planting in a controlled environment allows us to study mycorrhizal activity at depth, mechanisms for soil to plant carbon transfer (Jones et al, 2009) and possible drought management strategies.

## **Paleomagnetism of Glacigenic Sediments from the Neoproterozoic Age from Svalbard Norway and Their Relationship to “Snowball Earth”**

**Lemen, D.\* and Petronis, M.S.**

**\*Undergraduate Student, Geology**

The Neoproterozoic (1,000 – 542 Ma) is well known for its ice ages, in particular, the Cryogenian Era (850 – 635 Ma). In Svalbard and East Greenland, a Caledonian fold belt has exposed a thick succession of Neoproterozoic through to Ordovician strata including exceptionally well preserved glacigenic sediments of the Polarisbreen Group associated with the Marinoan Glaciation. Much effort has gone into understanding the environmental conditions at this time using geochemistry; however, the glacial dynamics remain vague due to the lack of good paleo-latitude data. Preliminary paleomagnetic and rock magnetic data reveal that several formations of the Polarisbreen Group possess a stable remanence carried by titanomagnetite. This study involved a series of demagnetization experiments to ultimately remove the low coercivity magnetism of the test core samples to reveal the primary magnetic signatures. These data gathered from the paleomagnetic experiments will allow us to calculate the paleolatitude of the glacial sediments at the time of remanence acquisition. Analyses also includes, three post cryogenic measurements, magnetic moment estimates in progressive steps from 5 milli Tesla (mT) to 120mT, and progressive thermal demagnetizing to peak temperatures of 640°C. The results indicate the presence of a high coercivity phase(s), likely hematite or fine grained titanomaghemite. Ongoing paleomagnetic studies will aid in constraining the tectonic and thermal history of the sediments. If the remanence is demonstrated as a primary detrital remanent magnetization, this study will constrain the paleolatitude of the deposits during the Cryogenian Era.

## Differential Enolase 1 Protein Expression in *Golga3<sup>repro27</sup>* Mice

Constance Little\* and Carol Linder

\*Undergraduate Student, Biology

Infertility affects about 15 percent of couples, usually in these kinds of cases, male infertility is a factor. In this study *Golga3<sup>repro27</sup>* mice were used as a model to understand spermatogenesis and male infertility. *Golga3<sup>repro27</sup>* have a mutation in the golgin subfamily A member 3 gene that disrupts spermatogenesis during meiosis and leads to germ cell death. Specifically, the sperm defects observed in the *Golga3<sup>repro27</sup>* mutation on the C57BL/6J strain (B6-27) have more severe defects than what is observed in the C3HeB/FeJ strain (C3Fe-27). The genomes and proteins expressed in these two strains are unique and the resulting phenotypes of mutant mice carrying the same mutation are different. 2-D gel electrophoresis identified seven proteins that were differentially expressed in testes between B6-27 and C3Fe-27. The purpose of this study was to validate the protein expression levels of two of these proteins, enolase 1 (47 kD) and beta actin (42 kD), using western blotting. Wildtype B6 and C3Fe inbred strains were used as controls. Enolase-1 protein levels appeared to be the same between B6 (n=3) and C3Fe (n=3) controls but were lower in B6-27 (n=3) compared to C3Fe-27 (n=3) mutants. This result contradicts what was expected from the 2-D analysis performed previously. Beta actin results are pending. Enolase 1 is an isoenzyme important for glycolysis. Future studies are needed to understand why differential expression of enolase 1 may contribute to the differing phenotypes seen in the two strains carrying the same *Golga3<sup>repro27</sup>* mutation.

## The Synthesis of 3,5-bis(arylidene)-4-piperidone Dye for Photodynamic Therapies

Rachael Lucero\* and Rodolfo Martinez

\*Undergraduate Student, Chemistry

Arylidine piperidones are used in photodynamic therapy. They are pharmacologically and biologically valuable compounds for treatment of cancer and other skin conditions. Currently, at New Mexico Highlands University, work is being done on the characterization of these compounds using X-ray crystallography. These dyes are conjugated, heterocyclic systems that are light and oxygen sensitive, making the synthesis of this class of compounds difficult. The synthesis of arylidene piperidones is generally done by condensing N-substituted piperidones with various aldehydes. The aldehydes are relatively inexpensive. However, depending on the N-substituent, the piperidones are, in many cases, expensive. We have developed a method for the production of desired N-substituted piperidones using inexpensive starting materials to generate 4H-pyran-4-one. The pyran-4-one is then treated with primary amines to make the pyridin-4-one. Hydrogenation gives the desired N-substituted piperidone. Changing both the aldehydes and the N-substituents on the piperidone can change the therapeutic properties of the molecule, its solubility, and sensitivity to light and oxygen.

## Fire History of Baker Flats in Gallinas Canyon, New Mexico

Estevan Martinez\* and Tim Cusack\* and Sara Brown

\*Undergraduate Student, Natural Resource Management

Historical wildland fire frequency is important ecological information and can be useful in management and restoration planning. In 1835 the town of Las Vegas, NM was settled by Spanish-Mexican settlers who utilized local natural resources, including the forested area of the Gallinas Canyon where our study site is located. Currently, the Gallinas Canyon is at risk of catastrophic fire due to increased fuel loadings caused in part by suppression of the frequent fire events that once removed understory fuels and seedlings. We sampled 26 partial cross sections ("cookies") from ponderosa pine (*Pinus ponderosa*), Douglas-Fir (*Pseudotsuga menziesii*), white pine (*Pinus stobus*), and limber pine (*Pinus flexilis*) trees west of Las Vegas, NM in the Gallinas canyon near Baker Flats campground. We collected, cured, sanded, aged, and located fire scars on all 26 partial cross sections to estimate a fire return interval for the canyon. Our samples each recorded between 1-5 fire events, with a median of 3. Samples taken from live trees allowed us to identify fire events by year. Samples from dead trees only provided fire frequency data (the number of annual rings between fire scars). Our live samples ranged in age from ~1721-1821. The range in fire frequency from our samples is 36.8-106.6 years, with a mean of ~71.7 years. One dead ponderosa pine sample recorded 5 fire events, with a mean return interval of 36.8 years. Understanding local fire history will help fire managers better understand the historical role of fire in this area, and could assist in future fire management goals.

## Bison Conservation Genetics Study at Wind River Ranch, New Mexico

Lisa McBride\*, Wacey Cochise, Jesus Rivas, and Sarah Corey-Rivas

\*Undergraduate Student, Biology

Bison face a variety of threats to their long-term survival as a species, including the spread of new diseases, low genetic diversity, and the introgression of domestic cattle genes. We are studying the genetic diversity and cattle hybrid status of the resident wild bison herd at Wind River Ranch (WRR), NM to ensure its conservation significance. In the field we sampled hairs from fifty-three bison where we later isolated DNA and performed PCR to amplify the D-loop region of the mitochondrial genome in the lab. The bison gene sequences were then compared to published bison and cattle sequences. Of the thirty-seven D-loop sequences analyzed, three hybrid bison were found with *Bos taurus* sequences. Two lineages of *Bison bison* were identified: lineage WRR\_1 is common (83% sampled) sharing 100% identity with bison from Fort Niobrara NWR, Montana's National Bison Range, Yellowstone NP, and a private herd in Montana. Lineage WRR\_2 is rare (8% sampled), and is not shared with any known lineages published. The presence of a lineage from conservation herds including Yellowstone is significant because WRR bison are brucellosis-free and may therefore be an asset to our national bison genetic 'portfolio'. The unique lineage of bison at WRR discovered in this study is a further indication that the herd is a conservation genetics resource. The study will be expanded to include microsatellite markers, a reliable tool for assessing cattle gene introgression in the nuclear genome and estimating overall levels of genetic diversity in the herd.

## Acute effects of a commercially available energy drink on human arterial endothelial hormonal function

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Commercial energy (stimulant) drinks contain substances (mainly high dose caffeine and additives) that affect the human cardiovascular system. The specific effects of these vasoactive agents on the inside lining (endothelium, a large paracrine organ) of the human major arteries are unknown. Hormones from the arterial endothelium affect arterial diameters and thus systemic blood pressure and blood flow to distal organs. We tested the hypothesis that a popular, commercially available energy drink (Five Hour Energy Drink) decreases human endothelial hormonal function. In 5 healthy young adults (24±3 yrs, 3 female) we noninvasively measured (10 MHz, 2D ultrasound, 0.08 mm axial resolution) mean brachial artery lumen diameters (mm) before (control, LDC) and after (hyperemic, LDH) a 5 minute, proximal, arterial occlusion. This technique, flow mediated dilation (FMD), is a standard, well validated index of shear stress activation of endothelial paracrine release of systemic vasodilators (mainly nitric oxide). FMD (% change) is calculated as: (LDH-LDC) / (LDC) x 100. FMD is linearly related to increased endothelial hormonal function. A low FMD is a significant risk factor for systemic atherosclerosis, and FMD decreases with age. Resting, fasting, supine FMD (pre) was measured and compared to identical FMD measurements 20 minutes after (post) consumption of 57 ml of the stimulant. Noninvasive heart rate (HR) and mean blood pressure (BP) were measured (mean/*SD*; with \* = *p*<0.05 Post versus Pre; # = *p*<0.05 LDH versus LDC).

Stimulant	BP (mmHg)	HR (bpm)	LDC (mm)	LDH (mm)	FMD (%)
Pre	78/13	58/10	4.19/0.29	4.64 /0.31#	10.3/3.3
Post	89/13*	57/11	4.27/0.31	4.50/0.22#	5.5/2.4*

Preliminary results suggest that acute intake of a highly consumed (9 million/week) energy/stimulant drinks (215mg caffeine) significantly decreases endothelial hormonal function and vasodilatation (as indexed by FMD). Thus, it may decrease blood flow. Chronic consumption may have significant physiological and pathophysiologic consequences.

### **The Response of the Native aquatic fauna to the eradication of bullfrog (*Lithobates catesbeiana*) in a section of the Mora River, at Wind River Ranch**

**Justin T. Saiz\* (Biology), Micah A. Daboub (Biology), Robert Ortega (Natural Resource Management), Steven Salinas (Biology), Adrian Carter (Biology), & Dr. Jesús Rivas (Biology)**

\*Undergraduate Student, Biology

This poster summarizes the body of research on the vertebrate community of the Mora River being carried out by faculty and students of New Mexico Highlands University. This anchor poster presents the context in which many of the projects that are taking place, with reference to the general methods used in a common study site and the various techniques that were applied. The core of the project consists on evaluating the impact of Bullfrog (*Lithobates catesbeiana*) eradication in the community of aquatic vertebrates. For this purpose, a section of the Mora River was divided in two regions. The first region was the experimental area where the bullfrogs were eradicated using different methods and another half, a control region, where bullfrog populations were not affected. Most of the project associated in this site look at the impact of the presence or absence of bullfrogs on different aspects of the ecosystem.

### **What is inside an invasive frog?: Bullfrog Diet of the Mora River**

**Steven A. Salinas\*, Micah Daboub, Justin Saiz, Robert E. Ortega, Jesús Rivas**

\*Undergraduate Student, Biology

Invasive species are the single worst conservation problem at the species level worldwide. Invaders can negatively affect the diversity of native species via predation or competition for resources. American Bullfrogs was introduced in Northern New Mexico since the 1940s and because the introduction was so long ago there have been no quantification on the impact bullfrogs cause on the native aquatic fauna. In this study analyzed 286 stomach contents of bullfrogs in the Mora river. Most of the stomachs contained crayfish (likely *Orconectes* sp.) followed by whatever insect was abundant at the time. We found often some unidentified white slime that we believe may be from eggs masses of other amphibians or fishes. Surprisingly, we did not find any leopard frogs in the diet of bullfrogs. The fact that leopard frogs are not present in the diet of bullfrogs, yet they are locally common, suggest that there may have experienced a microevolutionary process that allows them to coexist with the invasive predator. We believe that this population may be used to restock other sites where leopard frogs have been driven extinct by bullfrogs.

### **X-Ray Structural Analysis of Chiral Aspects of Antiepileptic Drugs Containing an $\alpha$ -Substituted Amide Group**

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Enantiomers of a racemic compound may have different biological activities and pharmacokinetics. Most of the current research is focused on synthesizing and marketing racemic drugs for pharmaceutical purposes but we are interested in separating and characterizing the enantiomers of two racemic drugs such as 2-Phenyl butyramide (2PBA) and 3-Me-3-Ph-succinimide (MPS) [Fig.1]. The enantiomers of these antiepileptic drugs were separated using chiral high performance liquid chromatography (HPLC) OD-RH and OJ-H columns. The absolute configuration and difference in conformations of enantiomers and racemic compound of above drugs were determined using single crystal X-ray diffraction technique.

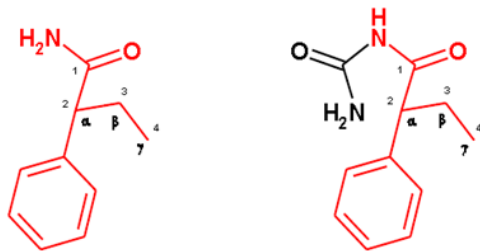


Fig. 1: Structures of representative anticonvulsants containing  $\alpha$ -substituted amide

Table 1: Crystallographic data for racemic mixture and enantiomers of 2PBA and MPS.

enantiomer of MPS forms two polymorphs as shown in Table 1. The crystal packing of both 2PBA and MPS is strengthened by strong N-H...O hydrogen bonding between the adjacent molecules respectively. In the case of 2PBA, both enantiomers and racemic structures exhibit trans orientation with the phenyl groups aligned in opposite direction (up – down) to each other [Fig. 2a]. In case of MPS, the racemic molecule shows a cis orientation of phenyl groups which are aligned in the same direction (up – up) whereas, the phenyl groups of enantiomeric MPS is aligned in opposite direction (up – down) to each other creating a trans orientation [Fig. 2b, 2c].

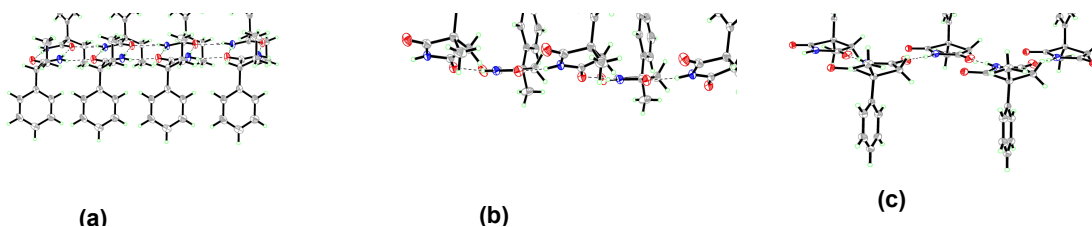


Fig. 2: Hydrogen bonding patterns; (a) Racemic/enantiomeric 2PBA showing trans orientation; (b) Racemic MPS showing cis orientation; (c) Polymorph 1 with (+) enantiomer showing trans orientation.

Currently, research is in progress to cocrystallize antiepileptic drugs with pharmaceutically acceptable ingredients to improve storage characteristics, solubility and bioavailability of these series of pharmaceuticals.

## Seasonal Variations in Nutrient and Dissolved Organic Carbon Concentrations of Two Valles Caldera Head Water Streams

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High elevation areas, such as the Valles Caldera National Preserve (VCNP) located in the Jemez Mountains of Northern New Mexico, have been described as exceptionally vulnerable to changes in climate and thus offer an ideal window to monitor temperature changes and their possible implications. In the present study, we examined the effects diurnal and seasonal water temperature changes and discharge have on water quality. Two water sampling regimes (diurnal and grab samples) were employed from May 2010 to May 2012 at four sites along two potentially vulnerable headwater streams located within the VCNP. Concentrations of primary nutrients (nitrate, nitrite, and phosphate), dissolved organic carbon, and other solutes (bromide, chloride, fluoride, and sulfate), along with discharge and physicochemical parameters (conductivity, dissolved oxygen, pH, and turbidity) served as indices of water quality. The results of this study indicated that primary nutrients and other solutes were sensitive to seasonal temperature changes, but that their sensitivity was modulated by the unique characteristics of sample sites. Effects of seasonal water temperature fluctuations on primary nutrient and other solute concentrations can offer a deeper understanding of challenges headwater streams may face as result of anticipated climate changes.

## **Separation and Purification of Antimicrobial Peptides from Cockroaches and from Amphibians using HPLC and MS**

**Matt Sandoval\* and Richard Plunkett**

\*Undergraduate Student, Biology

Samples taken from American Bullfrogs and a variety of cockroaches containing individual anti-microbial peptides and found to be effective in hindering bacterial growth or all together killing the bacteria will be analyzed using the high performance liquid chromatography (HPLC). A mass spectrum analysis of active fractions to begin characterization of antimicrobial peptides and assist in their identification will also be conducted. The study of antimicrobial peptides is promising because these are innate responses to infection are found in organisms from all domains of life, and include general defenses against infection. Cockroaches have been suggested to have very effective AMP in response to bacterial challenge, as have secretions from the skins of amphibians, especially frogs. We will be working in collaboration with researchers (faculty members and students) from NMHU and from Northern New Mexico College, to collect and prepare protein samples isolated from several species of cockroach (maintained in colonies at NNMC) as well as from American Bullfrogs captured at the Rio Mora National Wildlife Refuge by students from NMHU.

## **Modified Starch in Aspirin to Slow Down the Rate of Dissolution**

**Travis Saxon\*, Kaiguo Chang**

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The goal of this experiment was to find out if esterification of starch would slow down the dissolution of aspirin. The ester was proven by taking the FTIR. The ester was substituted for a hydroxyl group. There are several reasons why the modified aspirin was able to keep in the water solution longer than aspirin. The main reason was because the organic, hydrophobic modified starch that was in equal amounts with the aspirin slowed down the water from washing out the aspirin. The concentration of aspirin in the modified aspirin pill was lower than the normal aspirin pill but it still stayed longer in the water because of the protection from the modified starch. This experiment was done with five different pathways to making the ester. This could be advancement in medicine allowing people to take fewer medication and lower concentrations of medication and still maintaining the full effects for longer periods of time. This project can be extended further and make an ester modified starch that is even less soluble than the one made in this experiment. If every hydroxyl group on the starch was turned into an ester it would last longer. There are a total of four hydroxyl groups on each glucose molecule in the starch compound. From the results obtained in this experiment it is reasonable to believe that esterification on every hydroxyl group could slow down the dissolution rate enough to allow for only one or two pills to be taken every day.

## **Acute effects of ipsilateral arm resistance exercise on human arterial endothelial hormonal function in the contralateral resting arm: Is there a systemic signal?**

**Tapia JL\*, Nalamlieng SM, Valenza T, Bentley A, Greene ER**

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The signaling of cardiovascular control mechanisms bilaterally during unilateral exercise is complex. Specifically, the effect of acute, single arm resistance exercise (ARE) on the inside lining (endothelium, a large paracrine organ) of the resting arm is unknown. We assume that ARE will increase conduit artery blood flow, wall shear forces, and thus arterial endothelial hormonal function (AEF). This would further enhance mass transport to distal working tissues for optimal performance. By circulating hormones and the sympathetic nervous system ARE also may have a similar, systemic effect on the resting arm. Accordingly, we tested the hypothesis that ARE would significantly increase AEF in the working arm and systemically in the resting arm where blood flow and shear forces remain unchanged. In 5 healthy young adults ( $24 \pm 3$  yrs, 3 female) we noninvasively measured (10 MHz, 2D ultrasound, 0.08 mm axial resolution) mean left brachial artery lumen diameters (mm) before (control, LDC) and after (hyperemic, LDH) a 5 minute, proximal, arterial occlusion. This technique, flow mediated dilation (FMD), is a standard, well validated index of shear stress activation of endothelial paracrine release of systemic vasodilators (mainly nitric oxide). FMD (% change) is calculated as:  $(LDH-LDC) / (LDC) \times 100$ . FMD is linearly related to endothelial hormonal function. A low FMD is a significant risk factor for systemic atherosclerosis, and FMD decreases with age. Resting, fasting, supine FMD (pre) was measured in the resting arm and compared to identical FMD measurements immediately after (post) contralateral (right) arm resistive exercise of 50% of

maximal effort to exhaustion. Noninvasive heart rate (HR) and mean blood pressure (BP) also were measured (mean/*SD*; with # =  $p < 0.05$  LDH versus LDC).

Exercise	BP (mmHg)	HR (bpm)	LDC (mm)	LDH (mm)	FMD (%)
Pre	93/6	66/9	4.32/0.31	4.61/0.23#	7.1/2.4
Post	86/8	66/9	4.45/0.29	4.70/0.28#	6.3/2.2

Preliminary results suggest that acute ipsilateral ARE does not significantly increase contralateral, resting arm arterial endothelial hormonal function or arterial diameters (as indexed by FMD). Thus, any effects of circulating hormones or direct sympathetic nervous activity on the contralateral, resting arm are minimal. The effect of single arm resistance exercise is unilateral.

### ***Clip1* as a Candidate Gene for *repro29* Male Infertility: A Test Using Sperm Morphology**

**Alfonso Trujillo\*, Lisa Bentson, and Carol Linder**

\*Undergraduate Student, Biology

Finding genes important for sperm development and understanding their function will help us understand the underlining causes of human infertility. C3Fe.B6-*repro29* mice have a recessive mutation that causes complete male infertility due to defects in late sperm development. The main goal of this project was to determine the gene that causes infertility in the *repro29* mutant mouse strain. Gene mapping has narrowed the known candidate gene region on Chromosome 5 to ~0.29 Mb; this region includes the *Clip1*, gene. CLIP1, a CAP-GLY domain containing linker protein that is a microtubule associated protein, was the best candidate gene because a knockout mouse strain carrying the *Clip1<sup>tm1Gal</sup>* shows defective spermatogenesis and reduced fertility. We obtained the *Clip1<sup>tm1Gal</sup>* mice and performed a morphological comparison of epididymal sperm with *repro29* and performed a genetic complementation test with *repro29* mice. Caudal epididymal sperm in *Clip1<sup>tm1Gal</sup>* had different head defects than *repro29*. *Clip1<sup>tm1Gal</sup>* mutants have a more circular shaped head and *repro29* have a more oval shaped head but both have absent of hooked heads. Male mice carrying both the *Clip1<sup>tm1Gal</sup>* and *repro29* mutations were characterized to determine if they had defective spermatogenesis by analyzing epididymal sperm for motility and morphology. Analysis of 26 *repro29/Clip1<sup>tm1Gal</sup>* mice indicates that the sperm was normal and that *repro29* and *Clip1<sup>tm1Gal</sup>* are not allelic. We reject our hypothesis that *Clip1* is the gene responsible for the *repro29* male infertility phenotype.

### **Acute effects of oral chewing tobacco on human arterial endothelial hormonal function**

**Valenza T\*, Nalamlieng SM, Tapia JL, Bentley A, Greene ER**

\*Undergraduate Student, Biology

Oral chewing tobacco contains substances (mainly nicotine and other additives) that affect the human cardiovascular system. The specific effects of these vasoactive agents on the inside lining (endothelium, a large paracrine organ) of the human major arteries are unknown. Hormones from the arterial endothelium affect arterial diameters and thus systemic blood pressure and blood flow to distal organs. We tested the hypothesis that oral chewing tobacco (Grizzly Pouch) decreases human endothelial hormonal function. In 5 healthy young male adults (24±6 years, moderate oral tobacco users) we noninvasively measured (10 MHz, 2D ultrasound, 0.08 mm axial resolution) mean brachial artery lumen diameters (mm) before (control, LDC) and after (hyperemic, LDH) a 5 minute, proximal, arterial occlusion. This technique, flow mediated dilation (FMD), is a standard, well validated index of shear stress activation of endothelial paracrine release of systemic vasodilators (mainly nitric oxide). FMD (% change) is calculated as: (LDH-LDC)/(LDC) x 100. FMD is linearly related to increased endothelial function. A low FMD is a significant risk factor for systemic atherosclerosis, and FMD decreases with age. Resting, fasting, supine FMD (pre) was measured and compared to identical FMD measurements 10 minutes after (post) administration of 1 Grizzly tobacco pouch ( 2.31-2.67mg of nicotine per gram). Noninvasive heart rate (HR) and mean blood pressure (BP) were measured (mean/*SD*; with \* =  $p < 0.05$  Post versus Pre; # =  $p < 0.05$  LDH versus LDC).

Stimulant	BP (mmHg)	HR (bpm)	LDC (mm)	LDH (mm)	FMD (%)
Pre	93/5	67/13	4.72/0.60	5.11/0.73#	8.3/3.1
Post	101/6*	74/13*	4.62/0.81	4.87/0.59#	5.1/2.0*



Preliminary results suggest that acute intake of oral tobacco (nicotine) significantly decreases endothelial hormonal function and vasodilatation (as indexed by FMD) and thus may decrease blood flow. Chronic consumption may have physiological and pathophysiologic consequences.

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NOTES: