

Biology Department Undergraduate Research Symposium DECEMBER 4TH 2014

Undergraduate Research: BIOL 5800 (Summer and Fall students)

Laine Anderson Scott Bernhardt

Genetic relationships among populations of the primary flea vector of plague to humans in the United States

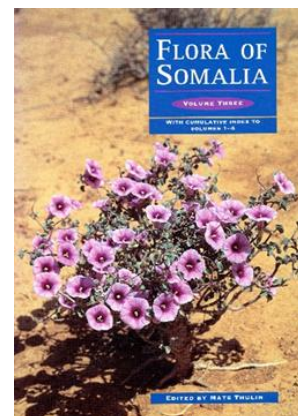
Plague is maintained in complex epizootic and enzootic transmission cycles involving rodents and their fleas. Ground squirrels, prairie dogs, woodrats and their associated fleas have been identified as essential for bacterial maintenance. The flea, *Oropsylla montana*, is of major interest due to the fact that it is distributed throughout the western U.S. where most human plague cases occur. Evidence suggests this species is the primary vector of plague to humans. Data on the genetic variation within and among populations of potential vectors of *Yersinia pestis*, including *O. montana*, are very limited. *O. montana* fleas were previously collected from 35 geographically distinct field sites from Colorado and New Mexico on the east, to California and Oregon on the west. Genomic DNA was extracted and mitochondrial and nuclear genetic data was sequenced to estimate phylogenetic relationships. The data collected from these studies will expand our knowledge of natural *O. montana* populations. We anticipate the genetic data collected from these flea populations will provide information that will assist with understanding human plague risk. Such information will, in turn, provide potentially significant insights into the ecology and epidemiology of plague in this region and is likely to suggest new strategies for monitoring and preventing this disease.



Garrett G. Billings Mary E. Barkworth

Distribution of plant diversity in Somalia: learning from the Flora of Somalia

The Flora of Somalia summarizes the distribution of each taxon found in Somalia in terms of eight regions and states which taxa are endemic to Somalia. We used this information to identify the regions and families with highest diversity and highest endemism. Both diversity and endemism are highest in the three northern regions. The three most diverse families are *Fabaceae*, *Poaceae*, and *Euphorbiaceae*. The family with the highest proportion of endemics, 49%, is *Xanthorrhoeaceae*.



Jennica Blasi Kimberly Sullivan

Bird nesting integration at Utah's Hogle Zoo

Many wildlife parks are contributing to current conservation efforts through reproduction to increase the populations of different animal species with declining wild populations. Utah's Hogle Zoo is working on increasing the populations of Roseate Spoonbill's, Scarlet Ibis', Speckled Mousebird's, and Superb Starlings. The department of the Small Animal Building is working on artificial ways to induce a mating behavior in these four species. To accomplish this task, the zoo concluded three requirements must be obtained. First, the nests must be stable and accessible to the birds. Two, the nests must be high in the trees so the birds can feel comfortable and safe to lay and leave their eggs in the nests. Lastly, the nests must be accessible by the staff so as ensure the safety of the nests. All requirements were met by creating large nests and small nests, placing them in a hammock structure, placed at a height that is accessible by the species is was intended for, and the smaller nests were attached to a pulley system. Due to time constraints and zoo resources diverted to AZA certification process little data were obtained after the placement of the nests.



Rebecca Condie James Pitt, *The Bee Lab. USU*

Systematics & Phylogenetics of *Pseudomethocini* (Hymenoptera: Mutillidae)

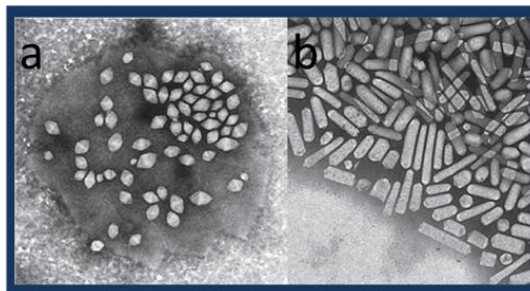


The tribe *Pseudomethocini* has a complex phylogeny. There are several genera in it, but the distribution of species within those genera is heavily lopsided with most species placed in *Pseudomethoca*. This research aims to use molecular data from the ITS1 and ITS2 genes to revise the taxonomy and phylogeny. It is hypothesized that the data collected will show a more even distribution and that several species now thought to be of the genera *Pseudomethoca* will be more closely related to sister genera.

Seth Montgomery Drury Leo Chen (Chemistry)

Effectiveness of *Halobacterium salinarium* gas vesicles as sonographic molecular reporters

Contrast ultrasound has been an active area of research and development for the past 40 years. Research in contrast studies have been dominated by lipid or protein stabilized gas microbubbles. Microbubbles are promising and used mostly in a clinical setting but are difficult to synthesize and lack long-term stability. Gas vesicles are an innovative alternative that represents a possibility to bring molecular ultrasound into a new niche of biomedical diagnostics. Gas vesicles are organelles that can be found in various bacteria and archaea.



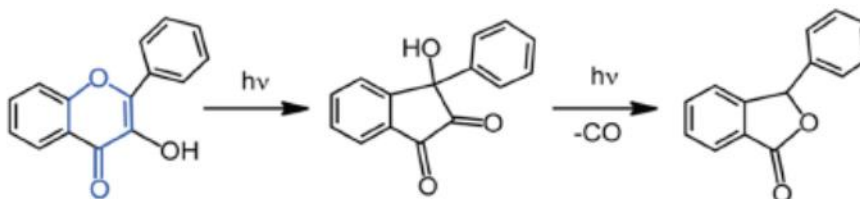
They are gas-filled proteinaceous nanostructures with widths of 45-250 nm and lengths of 100-600 nm. Gas vesicles are innately stable organelles that can withstand conditions that compromise their host cells. We used gas vesicles harvested from *Halobacterium salinarium*. We examined viability in stand-alone gas vesicles and gas vesicles loaded into alginate carriers. Alginated gas vesicles were observed for loading of gas vesicles, resonance, and kinetics. We will observe gas vesicles effectiveness as reporters of ovarian cancer cells *Skov3* and *HeLa*. We hypothesize that gas vesicles will be effective molecular reporters for *Skov3* and *HeLa* by displaying detailed contrast reports

Hector Esquer Abby Benningoff (Animal Dairy and Veterinary Sciences)

Flavonols as photo-induced CO release agents: assessment of toxicity and light sensitivity *in vitro*

Carbon monoxide (CO) is a signaling molecule that has been shown to have anti-inflammatory and anti-apoptotic effects on cells, to promote vasodilation and to protect tissues against reperfusion injury.

Thus, scientists are interested in the design and chemistry of CO-releasing molecules (CORMs). A new



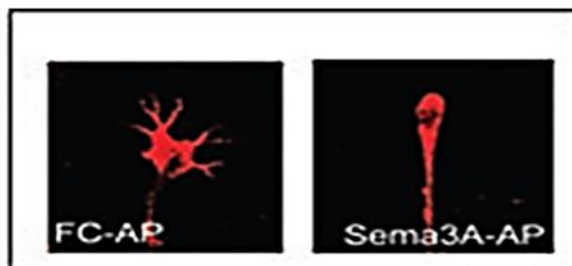
class of photo-reactive CORMs was recently synthesized, using a flavonol base structure and a ruthenium (Ru^{II}) core, as opposed to metal-based cores previously devised. In this study, our objective was to assess the *in vitro* toxicity of this new CORM and its photo-induced product using the MTT cell viability assay with human lung cancer (A549) and leukemia (Jurkat) cell lines. Light activation resulted in a CORM product that had no apparent cellular toxicity. Using fluorescence microscopy of A549 cells, we determined that the CORM localized exclusively to

the cytosolic cell compartment. Photo-activation of the compound via visible light led to complete loss of the fluorescence signal. These observations agree with the chemical characterization of this new CORM, in that upon photo-activation and release of the CO molecule, the complex is no longer fluorescent. These observations provide further evidence that flavonol base structure and Ru^{II} core CORMs are a promising new class of CO-releasing therapeutic compounds.

Brooke Hansen Mona Buhusi (Department of Psychology)

Investigation of the pathogenicity of the CHL1 Leu17Phe polymorphism in schizophrenia

Schizophrenia is a devastating brain disorder that affects a surprising 1% of the world's population. Despite this prevalence, little is known about the molecular aspects of this disorder making it both difficult to diagnose and treat. Several studies have identified the CHL1 gene (Close Homolog of L1), as a risk gene for schizophrenia. CHL1, a neural cell adhesion molecule, has major roles in cell migration, and the development of dendritic and axonal projections. Therefore any deficiency in the CHL1 gene may result in brain defects similar to those identified in schizophrenic populations. Moreover, in genetically engineered mice, studies have shown that deficiency of CHL1 results in altered emotional reactivity and motor coordination, reduced sensorimotor gating and impaired working memory, similar characteristics to those seen in schizophrenia patients.



The purpose of this study is to induce a point mutation (changing leucine to phenylalanine) within the signal peptide region of CHL1 in order to produce a functional deficit of the CHL1 gene. This polymorphism has been identified as a risk factor for schizophrenia in Asian populations. Through this mutagenesis, we aim to study CHL1 protein recruitment to the cell membrane to understand CHL1's role in schizophrenia at a molecular level.

Gavin L. Johnson Wayne Wurtsbaugh (Watershed Science Department)

Culture of *Tubifex tubifex* worms, the host of the whirling disease parasite: Effect of feed type on production and survival

Whirling disease (WD) causes significant declines in some western North American populations of trout with significant economic and ecological impacts. *Myxobolus cerebralis* (Mc), a



myxosporean parasite, is responsible for WD (Oplinger, et al. 2011). The life cycle of Mc requires two hosts: *Tubifex tubifex*, a worm that ingests the myxospores allowing development in its gut, and a salmonid fish. However, some worm strains are resistant and inactivate the myxospores (Beauchamp et al. 2006). Stocking and supplementation of waters with these resistant strains could help prevent or eradicate occurrence of WD (Oplinger, et al. 2011).

Optimum conditions for culture of *T. tubifex* are unresolved. I tested the effects of five feed

types on survival, weight gain and fecundity in a 90-day culture experiment. The feeds were: TetraColor tropical flakes/Tetramin (Tetra Holding Inc, Blacksburg, Virginia), cow manure, wheat bran, soybean meal and an equal mixture of the four. The average number of worms in the Tetramin treatment was significantly greater than with the wheat bran or soybean feeds. No statistically significant differences in average number of worms were found among all other combinations of treatments. In conclusion, Tetramin may be a healthy, but expensive feed in culture of *T. tubifex*, and manure could be an inexpensive alternative.

Austin Klomp Claudia Nischwitz

Identification of *Monilinia* species, causal agent of brown rot on peaches, in Utah and their response to fungicide treatments

Brown rot was first observed in Utah in 2013 but has been reported from the east coast for years. The disease has been known to cause severe economical losses in Europe. The reason for the sudden outbreak was unknown and could have been a result of unusually wet weather or potential fungicide resistance. Using PCR and DNA sequencing, two species *Monilinia fructicola* and *M. laxa* were identified. Both species have probably been present for years. I tested these two species on PDA (Potato Dextrose Agar) amended with fungicides. When applicable, both of the upper and lower recommended limits of the fungicides were tested. The results of our findings indicate that the fungicides with the exception of a copper based product were effective in controlling both *Monilinia* species. An interesting observation was made with one fungal isolate contaminated with a bacterium. The bacterium was able to break down the fungicide and allow the fungus to grow. If this occurs on the plant, breakdown of the fungicides may result in an ineffective fungicide. In conclusion, the outbreak was not due to fungicide resistance but due to unusually wet weather that occurred in July-September in combination with warm weather.



Kjertsi Matheson Anne Anderson

Effects of CuO nanoparticles on the pathogenicity of *Pythium* on wheat

Due to the ever-increasing need food around the world, methods are continuously being developed to increase and ameliorate soil conditions to aid in plant production. Nanoparticles (NPs), that can release metal ions, have been under recent scientific appraisal because of their antimicrobial properties. In this experiment, we investigated the effects CuO NPs on *Pythium*, a ubiquitous plant pathogen found in soils throughout the world. The *Pythium* isolates used caused a die-back of wheat seedlings. CuO NPs were inhibited the growth of these *Pythium* isolates on plate medium. Studies were

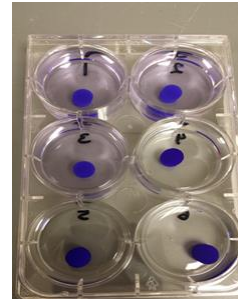


extended to examine the effect of adding CuO NPs into the growth matrix which was planted with wheat seeds.

Nate Needham Randy Lewis

Spider silk - Drug release

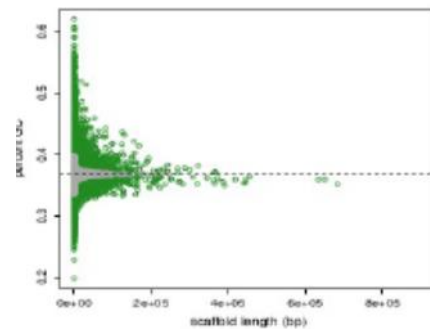
Spider silk is stronger than Kevlar and more elastic than nylon. One quality of spider silk that has scientists in the biomedical field jumping is that it is biocompatible. This opens a broad range of medical uses. This application tests whether spider silk coatings of drugs on implantable devices will allow controlled drug release over time. Possible hardware implanted in the body include catheters, heart stents and IV catheters. The drugs could be prevent infection, promote healing, and thus allow the implants to exist in the body longer. Methyl violet is used to mimic many properties of drugs for research purpose because it is easy to detect from its color. My results show that methyl violet is successfully released over time after coating with spider silk.



Peter Nelson Zach Gompert

How programming can be beneficial for biologists

Over the course of the semester I have been learning certain computer programming skills and using them to study genome content and genome evolution. I learned to work in a UNIX computing environment and write simple programs in Perl. I wrote a program to quantify genome-wide nucleotide composition. This includes the average nucleotide composition and the nucleotide composition for individual regions of the genome. I was given whole genome sequences from six closely related butterfly species, and used my program to calculate the frequency of individual nucleotides and pairs of nucleotides. I then compared nucleotide and di-nucleotide frequencies across different regions of the genome and among the genomes of the six species. I found considerable variation in nucleotide composition suggesting that the relative influence of different evolutionary processes varies across the genome. This project has also taught me how a useful skill such as programming can help solve a wide range of problems.



Robert Olsen Zach Gompert

Factors that affect the evolution of butterfly populations across space and time

The amount of biological diversity on Earth is astonishing. The study of evolution in natural populations has helped our understanding of the origin and maintenance of biological diversity. The study that will be done in the Greater Yellowstone Area (GYA) is to study the rate and cause of evolution in the wild over a long period of time. Population size is a major factor in



evolution. It is predicted that genetic drift and natural selection is a major factor in evolution, which is predicted in this system that I'll be helping do research with. A distance sampling method will be used to collect data which accounts for imperfect detection. I will help in four different ways: 1) quantify population's size, 2) compare last year's population size, 3) analyze degrees in climate variables, and 4) collect butterfly samples from each population. Being able to contribute with this study will give me great knowledge in field work, along with a first-hand experience of how evolution works. With the results I'll be able to share with others how the process works, as well as the next steps that can be taken. It will also allow me to focus on my own research that I will pursue once I graduate.

Allison Pratt Eadric Bressel (Health Phys Ed & Recreation)

Effect of water immersion on dual task cognitive and motor performance

Past research has detailed many implications of water immersion on cardiovascular and



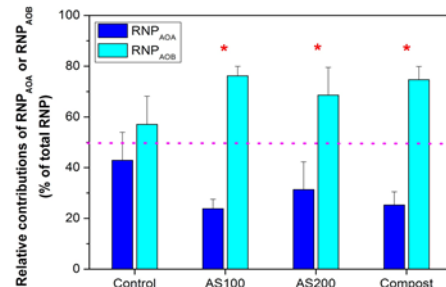
biomechanical responses. But there remains a lack in understanding of how water immersion effects higher order neural responses. The purpose of this study was to explore these effects using a dual task paradigm of cognitive and motor performance to measure cortical processing between land and water environments. A quasi-experimental cross-over research design was used with a group of participants with a mean age of 24.3.

These participants performed cognitive (auditory vigilance) and motor (standing balance) tasks separately and together both on land and in chest deep water. Listening errors and center of pressure (CoP) area were used as measures of each task. Results found that participants tended to make fewer cognitive errors while immersed in water than land and also had less postural sway during dual task conditions, but more sway in water than on land. The implications of this study are important for fully understanding the benefits of aquatic physical therapy especially in elderly and stroke patient populations.

Marlen Rice Jeanette Norton (Plants, Soil and Climate)

Complete Genome of *Nitrosospira briensis* Strain C-128

The nitrogen cycle is crucial to ecological systems as well as to crop cultivation. In order to understand the nitrogen cycle more fully we must be able to describe the key players involved. Nitrification is an important



two-step process in the N cycle and the first step is mediated in part by ammonia-oxidizing bacteria (AOB). In soil systems it is believed that the genus *Nitrosospira* dominates the AOB and are also responsible for the majority of ammonia-oxidation occurring in cultivated fields. We present here the complete genome for the type species of the genus *Nitrosospira*. In the summer of 2012 DNA was isolated from *Nitrosospira briensis* Strain C-128 (NBR) in the lab of Dr. Jeanette Norton. In the summer of 2014 the genome was completed at the Joint-Genome Institute Dept. of Energy and here we offer a comparison with the two other complete genomes of ammonia-oxidizing bacteria. Thus far we have found that NBR contains a plethora of nitrogen-transforming enzymes: 3 ammonia monooxygenase operons, 2 hydroxylamine oxidoreductases, a urease operon, a nitrite reductase, as well as a nitric-oxide reductase.

Daniel Roper Christine Bedore and Becky Williams (USU Uinta Basin)

Tetrodotoxin production newly discovered in three species of cuttlefish

Tetrodotoxin (TTX) causes asphyxiation and death through nervous and muscular tissue function disruption. The deadly blue-ringed octopus is the only cephalopod known to possess TTX. Here we investigated the presence of TTX in another brightly-colored and conspicuous cephalopod. We examined both captive-born and wild-caught Flamboyant Cuttlefish (*Metasepia pfeifferi*; n = 25), as well as Stumpy Cuttlefish (*Sepia bandensis*; n = 4) and a Common Cuttlefish (*Sepia officinalis*; n = 1). Twenty-one tissue-types were extracted based on standard methods, and TTX was quantified via an improved competitive inhibition enzymatic immunoassay. Our results revealed TTX in several tissues of all three species of cuttlefish, and in both captive-bred and wild-caught specimens. Tetrodotoxin was found in the hearts and gills (suggesting distribution via the blood), the reproductive organs (gonads, eggs, and associated glands), ink, and the skin. Tetrodotoxin was also found in the anterior and posterior salivary glands (the venom gland of cephalopods). However, based on the literature and our own unpublished data, these amounts of TTX are unlikely to subdue prey or deter common predators of the cuttlefish (maximum 54 ng TTX in a systemic heart of *M. pfeifferi*). The ecological function of TTX, if any, in these organisms requires further study.

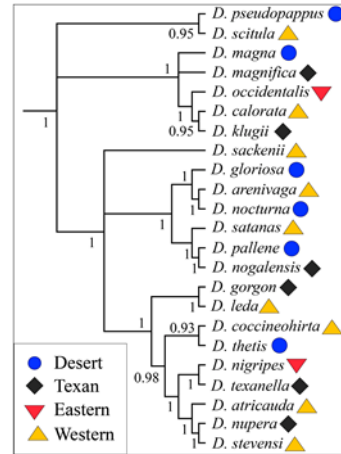


Erica S. Sheehan Joseph S. Wilson Toole Campus USU

Exploring the thermal dynamics of velvet ants (Hymenoptera: Mutillidae) in the Desert and Western mimicry rings

Of the six known velvet ant mimicry rings in North America (Wilson et al. 2012), species in the Desert ring (which are white) are often close relatives of species in the Western ring (which are orange). The Desert mimicry ring is mainly found in the regional hot deserts, while the Western ring is more widespread across the West. Here, we investigate how thermal dynamics might contribute to the evolution of the distinct color forms found in these mimicry rings. We hypothesize that the white coloration of the Desert ring enables them to remain cooler in hot

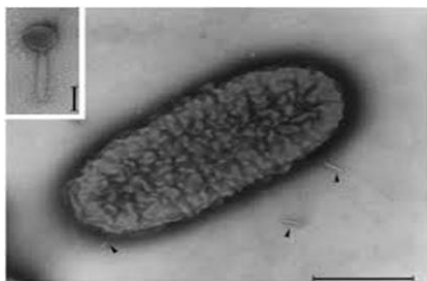
desert environments compared to their orange relatives. We used thermal imaging to measure the temperature of closely related species in the Desert and Western mimicry rings. We found that the species in the Western ring heated up significantly more than the species in the Desert ring. These data support our hypothesis and suggest that the white coloration of the Desert ring may be beneficial for individuals living in hotter areas because they do not heat up as fast, therefore enabling them to remain active in hotter areas compared to their relatives in the Western ring.



Jason Stewart Bart Tarbet (Animal Dairy and Veterinary Sciences)

Comparison of *Bordetella avium* isolates from different time periods and different locations by pulsed-field gel electrophoresis to identify genetic relationships

Bordetella avium has been isolated from turkeys showing clinical signs of respiratory disease and increased mortality over the last two years in Sanpete County Utah, despite receiving the *B. avium* vaccine. To determine whether recent *B. avium* isolates are related, or unrelated to the vaccine strain, thirty-two isolates from different time periods and different locations in the United



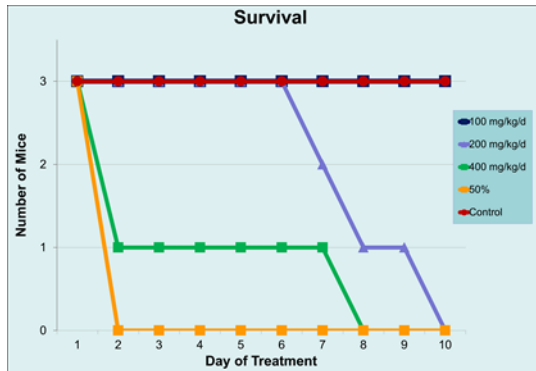
States have been collected for comparison by Pulsed-Field Gel Electrophoresis (PFGE). PFGE is a technique used for the separation of large DNA molecules through an agarose gel in an electric field. This technique may be used for genotyping or genetic fingerprinting of different bacterial strains by evaluating the migration patterns of DNA. If differences are observed in DNA migration patterns between recent and older *B. avium* isolates, DNA sequence

analyses will be completed to identify the genetic regions associated with changes and identify potential genetic relationships to the vaccine strain.

Kelsey Tolbert Justin Julander (Animal, Dairy and Veterinary Sciences)

Efficacy of Eugenol in reducing severity of Chikungunya disease: A Preliminary Toxicity Study

Chikungunya virus (CHIKV) is a mosquito-vector pathogen that has infected millions of people since a widespread outbreak that began in 2004. In May 2014 there were 55,992 reported cases in the Americas. CHIKV is characterized with a low mortality rate; however, the



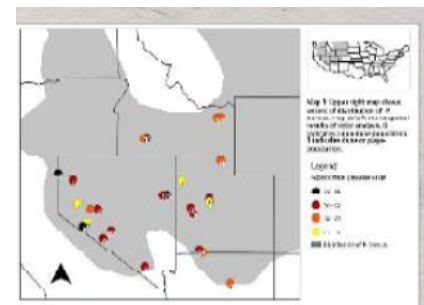
majority of infected individuals display symptoms which often include debilitating arthritis that can last for weeks to years. Studies testing compounds that ameliorate the immune activation of CHIKV reduce disease in a mouse model. Eugenol, an active compound found in clove buds (*Syzygium aromaticum*) exhibits immunomodulatory and anti-inflammatory properties. It inhibits production of IL-6, a pro-inflammatory cytokine, which may help suppress or relieve symptoms associated with joint inflammation. We hypothesize that eugenol will

reduce the severity of CHIKV disease in mice. To prepare for an infection study, we determined the maximum tolerated dose of eugenol in mice. We tested eugenol in DBA/1J mice via intraperitoneal injection at doses of 100, 200, or 400 mg/kg/day or by using 0.1ml at a 50% dilution. We found that a dose of 100 mg/kg/d eugenol is well tolerated and can be tested in mice infected with CHIKV.

Zach Valois Zach Gompert

Parallel Evolution in the northern scorpion, *Paruroctonus boreus*

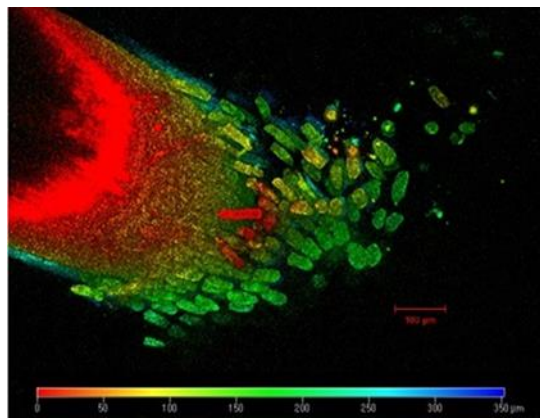
Parallel evolution occurs when the same traits evolve independently in multiple, closely related populations. Instances of parallel evolution inform us about the nature of natural selection and the repeatability of evolution. Here we investigate a putative case of parallel evolution in the Northern scorpion, *Paruroctonus boreus*. Northern scorpions are mottled in color and found in consolidated sage steppe and rocky habitat throughout the great basin, but pale forms exhibiting reduced pigment occur in multiple geographically isolated dune systems. The overall goal of this study is to test the hypothesis that natural selection drove the parallel evolution of pale color across isolated dune systems. As a first step to test this hypothesis, we have analyzed morphological variation, including color variation, across the range of *P. boreus*. We found substantial morphological variation and differences between dune and non-dune scorpions. Next, we will quantify genetic variation in this species to determine whether the pale form evolved once, or independently on different dune systems. Repeated evolution by natural selection could explain the persistence of cryptic lineages in *P. boreus* and would highlight selection's contribution to biological diversification.



Hannah Wagner Anne Anderson

Do CuO nanoparticles affect release of protective border cells from roots?

CuO nanoparticles (NPs) may be formulated into fertilizers to aid in the supply of Cu, an



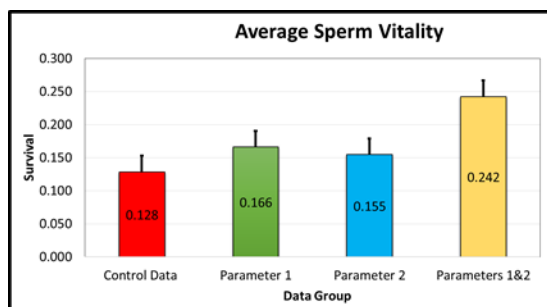
essential element for cells, to boost plant performance. However, CuO NPs at high doses limit root extension by as yet undetermined mechanisms. This work focuses on the impact of NPs on border cells, which are differentiated cells surrounding the root tip providing a protective function. These cells uniquely become released when protection of the tip is needed. Suspension in water is one such stress. This research examined whether CuO NPs promoted release of border cells from the globally important crop, wheat. Wheat plants were grown in sand amended with defined doses of CuO NPs.

Root tips from 6 day- old seedlings were dyed, and examined microscopically for border cell release. Border cell release was not increased by exposure to CuO NPs but it did occur. Further studies will determine whether the released cells remain viable or whether cell death, due to accumulation of toxic reactive oxygen species is involved. Although NPs alter some aspects of a root's growth and function, when crops are overexposed to NPs, this work suggests that some part of their defensive line against infection will remain intact in the form of released border cells.

Hayley Williams Ralph Meyer (Animal,Dairy and Veterinary Science)

Optimizing cryopreservation of murine sperm to enhance post-thaw survival

Freezing sperm from genetically modified mice allows for cryopreservation of valuable



transgenic mouse lines because they can be regenerated through in-vitro fertilization or similar methods. This may benefit facilities and investigators by reducing operation costs, providing protection against disease outbreaks or disasters, and increase the ability to distribute mouse models. However, sperm cell survival rates after the freeze-thaw cycle are low using currently available protocols for preserving the sperm of the species

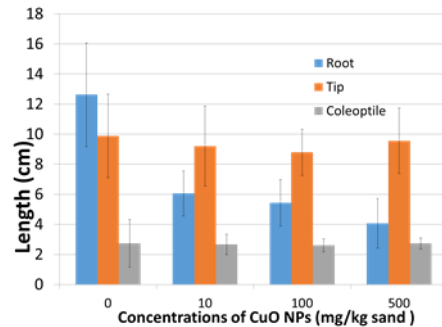
Mus musculus. This project sets out to test and optimize parameters on the post-thaw survival rate of cryopreserved sperm using a fluorescence-based live/dead assay. A pre-incubation step at 37°C step in combination with a precooling phase at -20°C prior to freezing in liquid nitrogen provided a synergistic benefit, resulting in sperm survival rates of up to 30%. We are currently

testing the extent to which the protocol can be optimized by adding antioxidants to the sperm freezing medium.

Melanie Wright Anne Anderson

Do copper oxide nanoparticles (CuO NPs) affect plant growth?

Copper is an essential element for cell function. CuO NPs are sources of Cu ions and although there is dose-dependent phytotoxicity, observed as inhibited root elongation, the NPs have the possibility of being formulated into fertilizers. Work by other researchers showed that growth of wheat roots is inhibited by Cu ions. They also demonstrated that the coleoptile, a protective sheath enfolding the developing leaf tissue lengthened less as Cu ion-dose increased. This study examined whether CuO NPs would, like the Cu ions, inhibit coleoptile growth. However, no change in coleoptile elongation occurred, although Cu loading was higher in the



coleoptile than in the leaf tissue after growth of seedlings with CuO NPs. Washing the coleoptiles reduced this Cu loading. SEM analysis of the coleoptiles showed CuO particles to be present on the outer but not the inner surface. Thus, it appears that there was surface association by contamination of the coleoptile with NPs during growth. Only about 10 % of the Cu loading for coleoptiles was within the tissues. The results of this study are a little piece in the puzzle of understanding the environmental impact and value of nanoparticles.

Internship-Co-op BIOL 4250

Section I Mentor Dennis Welker

Terek Behunin

Veterinary internship

Veterinarians carry the qualifications for a variety of jobs including careers in food safety, animal health, and public health. All these professions are influential on the success of society in providing food and quality healthcare to animals and the public alike. There are many who



desire to become veterinarians but do not possess the skills and knowledge required. This lack of required skill and knowledge, however, can be improved by experience in one's desired field. By participating in an internship at Cache Meadow Veterinary Clinic I have enhanced my abilities to better work with people and animals. I have also gained knowledge preparing me for professional education and

future success as a veterinarian. I did this by making learning goals and working with an advisor to achieve them.

Leticia L. Hoffmann Michael C. Amacher, US Forest Service

Co-op Internship: Mesocosms for Environmental Soil Science Research

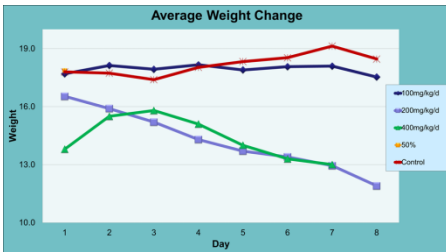


As an intern, I developed new skills through observation and hands on training by working under the direct supervision of Soil Scientist, Dr. Michael C. Amacher associated with the US Forest Service. His research deals with monitoring and assessing climate change effects on soils, forest health, soil and water quality, and remediation of contaminated mines and wetlands.

Kelsey Tolbert Justin Julander (Animal, Dairy and Veterinary Sciences)

Internship at USU's Institute of Antiviral Research

Utah State University's Institute of Antiviral Research (IAR) conducts testing for antiviral compounds and vaccinations both in vivo and in vitro for a wide range of pathogenic viruses. I spent my internship with IAR in the Laboratory Animal Research Center (LARC) working with



hamsters and mice. I assisted in conducting research on viruses causing diseases such as *influenza*, *dengue*, *chikungunya*, *hepatitis B*, and *West Nile*. My duties included infecting animals, administering treatment, measuring weights, performing necropsies, and collecting samples. Necropsying requires harvesting individual organs which were then weighed, assigned a score based on appearance, and homogenized in a minimum essential

media (MEM) and gentamicin solution. The mixture was titered for viral load. Assigning lung scores was a task I spent a particular amount of time perfecting. The lung score is a subjective number given to a set of lungs to describe the amount of damage present. The score ranged from 0-4 with 4 being the most affected. A healthy lung will appear bright pink and spongy whereas a damaged lung is dense and has a dark red or brown coloration.

Abshiro Dirie

Atlantis Project Pre-health Internship

Pre-health and pre-med students aspire to one day work in a health profession; however, it's difficult to fully grasp what those professionals do on a day to day basis. With the Atlantis Project, students are able to take part in a unique hospital internship, learning from doctors first hand while being completely immersed in a new culture. During the internship, students work in a public hospital shadowing doctors in a different specialty weekly. Students have an

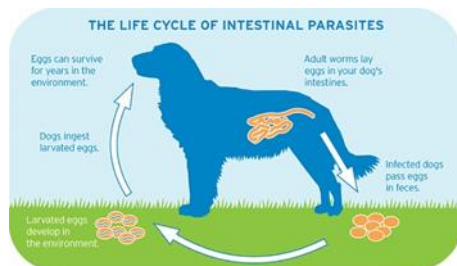
opportunity to sit down in consultations and observe surgeries. To give back to the community, students hold English classes for local physicians. Spanish classes are also held for the students. They attend bioethics seminars and learn about the European healthcare system in comparison to the United States. Finally, students tour the island they're on and learn about the culture and history of the people there. My reason for doing in this internship was to solidify my decision in working towards becoming a doctor and to gain hospital experience. During this internship, I learned what was required to diagnose and treat a patient, watched incredible surgeries, and learned about doctor's personal experiences in the medical field.



Section II Mentor Kim Sullivan

Kailey Allen

Heartguard and Deworming Schedule for Captive Animals



Providing regular administration of Heartguard and deworming medications is very important; not only in the household but also in zoo and sanctuary settings. Most people are familiar with deworming our domestic animals such as dogs and cats, but do not think about animals at the zoo. Many animals at zoos and in the wild are also susceptible to worms. Raccoons generally being the most likely to contract and transmit disease, including worms, to

other mammalian species. Deworming medicine and Heartguard should be given to captive animals orally every three to four weeks. Having a schedule and record keeping make treating the animals and worm prevention more efficient. Worms can cause severe damage to animals. In fact heartworms are known to cause permanent damage to the host and complications continue to arise even after the heartworms have been removed from the host. For this reason it is important to eliminate cross-contamination between species as well as practice regular preventative treatments for worms in confined animals.

Lindsay Hansen

Developing a care plan for geriatric zoo animals

There are five common health concerns that zookeepers need to be aware of in geriatric animals; arthritis, neoplasia, age-related organ failure, dental disease, and the loss of special

senses. I focused my attention at the Willow Park Zoo on a 14 year- old lynx named Bonnee who has advanced arthritis in her carpals. When I started, Bonnee was already on a glucosamine chondroitin supplement but I helped develop an extensive care plan for her. I also created a general geriatric animal checklist that covered all five health concerns so staff can consult it so they can know the symptoms and treatment options for geriatric animals facing these concerns. When an animal is facing arthritis you want to make sure they are not walking on surfaces that are too hard, and you want to place them on a glucosamine chondroitin supplement; this will help control the inflammation and cartilage damage. In Bonnee's enclosure we placed leaves on top of the dirt and cement to add a soft layer for her to walk on. Future plans for Bonnee include adding a new diet with more glucosamine, and possibly transferring her to a better home.



Mikkell Minnoch

Enrichment at the Willow Park Zoo



The behavioral wellness of zoo animals has become a common focus throughout zoos nationwide. To improve behavioral wellness, a tactic known as behavioral enrichment is used. Enrichment is defined as the process of providing stimulating environments for animals in order for them to demonstrate their species-typical behavior, to allow them to exercise control or choice over their environment, and to enhance their well-being. When performing enrichment exercises it is important to understand and document the range of behavioral acts displayed. At the Willow Park Zoo located in Logan, Utah, I provided enrichment activities for a variety of animals. These activities were performed on raccoons, kinkajou, capuchins, birds, tortoises, elk, fallow deer, and reindeer. I was able to experience first-hand the positive effects of enrichment and how it benefits the animals

Exploring Animal Behavior BIOL 4060 *Kim Sullivan*

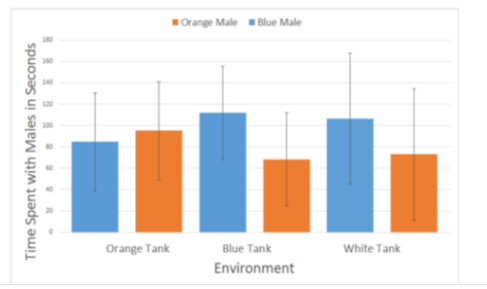
Makayla Ballard, Victoria Holman, and Lacy Susman

“What a girl guppy wants...”

Male coloration and environment in female guppy mate choice

Mate choice is essential to reproduction in the natural world. Females and males determine their mates based on a variety of factors. In the three-spine stickleback, females choose their mates by color and how it contrasts to the environment. Sexual selection shows that male coloration in aquatic animals can increase reproductive fitness at the cost of making males more prominent. Female guppies are similar to the stickleback in that they tend to prefer bright colors, such as orange. Orange spots on the tail can indicate better fitness, because orange-spotted males tend to swim longer in a strong current.

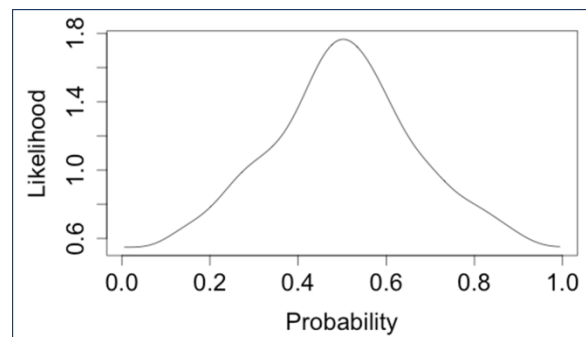
Our research was based on male coloration affecting female guppy mate choice. It was unclear whether habitat affects female mate choice in guppies. The experiment examined female mate choice in environments that contrasted or matched with male coloration. Females were placed into three separate habitats constructed to match one male's color while contrasting with the other, in a three-section tank. The time she spent on either side of the tank determined preference. Our results suggest female mate choice is not dependent on the combination of male color and environment. Future studies on female mate choice may entail a larger sample size.



Terek Behunin, Jonathan Gonzalez, Austin Spence

The effects of mood lighting on female guppy mate choice

Guppy females (*Poecilia reticulata*) choose mates based off of visual cues, such as color, size, and movement. Light and its ability to alter color perception therefore may have a strong impact on guppy mate choice. This experiment investigated if female choice was affected by different colors of light. Females were given a choice of two proxy male guppies. Her choice was recorded first under white light and then under red light. Females mate choice changed significantly when exposed to red light. These results support previous data that color and contrast are important aspects in female mate choice.

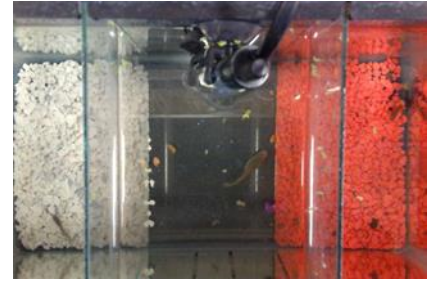


Trevor Tolman, Griffin Meador, James Utley

Female guppy preference with color

Mating is a vital function to continued genetic diversity and the spread of many forms of life on earth. But why do animals choose the mates that they do? Our research takes a look at the female preference in guppies when color is introduced to better understand why they would

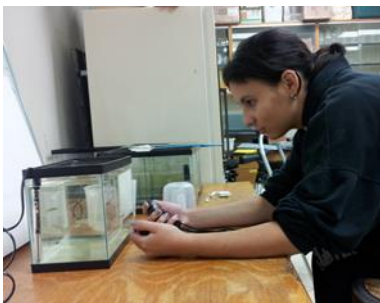
choose a specific mate in a wild setting. Over a series of 40 trials, testing plain and orange guppies against orange and white gravel, we found no significant difference. We did not show a significant preference for color among female guppies.



Caitlin Allyse, Liesl Cannon, Leah Fillmore, Marlayna Postan

Size-based mate choice in wild-type and pet store male guppies

Female mate choice is a well-known complex phenomenon throughout the animal kingdom. Male mate choice is less often examined, although it does play a role in some species. We analyzed the importance of size in male guppy mate choice. Our primary hypothesis was when choosing mates, male guppies prefer large females. Secondary to that, we hypothesized that wild type males will prefer large females more strongly than pet store males. To determine



preference we set up a divided tank and we placed a male in between a small female and a large female. We performed three different types of trials, one with pet store males, one with wild type males, and a set of control trials. For the control trial a male was placed between two females of the same size (either small or large). This was performed with both types of males and both types of females. Our results were not statistically significant, but suggest a slight preference towards larger

females. Other factors that we did not study may have been more important than size in mate choice. Future work can determine the relative importance of each factor.

Marcus Singleton, Jordan Frank, David Johnson, Hayley Sanzotti

Light, does it matter?

Color variation of male guppies is thought to influence female mate choice. We asked whether the color of the light illuminating the tank influenced mate choice. We tested female choice



under four different lighting conditions, white, blue, red, and black lights were used in a dark room. Under each lighting condition we recorded which male the female preferred. We found that there was a slight preference for the red male guppy under the different lighting conditions. This preference did not

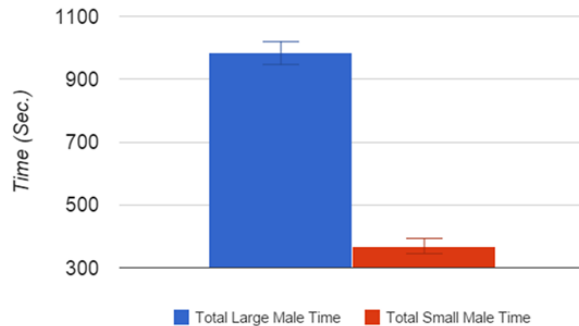
change under the different lighting conditions showing that there was no significant effect of light on female mate choice.

Alek Montgomery, Drake Fonua, Michel Farrow, Shane Bullock

Bigger is better

Although females prefer to mate with brightly colored males in numerous species, it is unknown if size may also play a factor in female mate choice. Here, we measure female mate preference in like-colored males, *Poecilia reticulata*, that are variable in size (measured by weight in grams). In this study, we show that female guppies are choosy

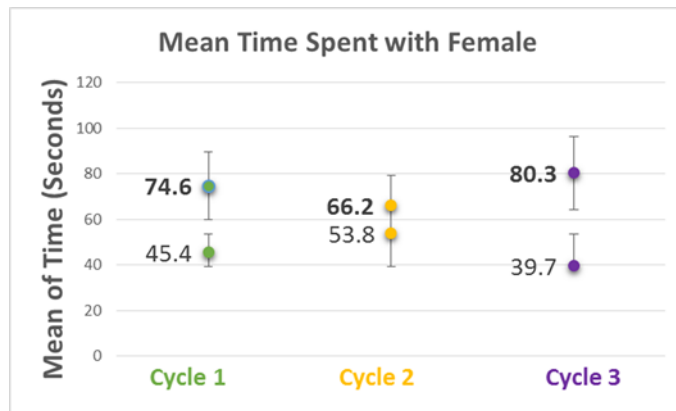
when selecting a male to associate with, significantly preferring the larger male when presented with two males that differed by at least 0.1 g in weight. An apparent but not-significant anomaly, whereby females appear to prefer the smaller of the two males when the difference between the males was less than 0.1 g in weight, deserves further investigation.



David Anderson, Melissa Harvey, Tien Lindsay

“How a Mr. chooses his Mrs.”

Although females are the choosier sex in most species, male mate choice is expected to occur when the female population is higher than the male population. In nature, males would



encounter multiple females and choose which he would want to mate with. Females vary in body size, length, and fecundity. We predicted males would prefer larger females as mates because larger females exhibit a higher fitness. In a laboratory setting, we tested our hypothesis by using wild type male guppies and observing mate choice in a divided tank. The male selected between a smaller or larger female. We conducted three cycles of testing (30 trials). Our figures and analyses provide support for

our hypothesis, that males preferred larger females.